

Welcome

Thank you for choosing Freenove products!

About Battery

First, read the document [About_Battery.pdf](#) in the unzipped folder.

If you did not download the zip file, please download it and unzip it via link below.

https://github.com/Freenove/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/archive/master.zip

Get Support and Offer Input

Freenove provides free and responsive product and technical support, including but not limited to:

- Product quality issues
- Product use and build issues
- Questions regarding the technology employed in our products for learning and education
- Your input and opinions are always welcome
- We also encourage your ideas and suggestions for new products and product improvements

For any of the above, you may send us an email to:

support@freenove.com

Safety and Precautions

Please follow the following safety precautions when using or storing this product:

- Keep this product out of the reach of children under 6 years old.
- This product should be used only when there is adult supervision present as young children lack necessary judgment regarding safety and the consequences of product misuse.
- This product contains small parts and parts, which are sharp. This product contains electrically conductive parts. Use caution with electrically conductive parts near or around power supplies, batteries and powered (live) circuits.
- When the product is turned ON, activated or tested, some parts will move or rotate. To avoid injuries to hands and fingers, keep them away from any moving parts!
- It is possible that an improperly connected or shorted circuit may cause overheating. Should this happen, immediately disconnect the power supply or remove the batteries and do not touch anything until it cools down! When everything is safe and cool, review the product tutorial to identify the cause.
- Only operate the product in accordance with the instructions and guidelines of this tutorial, otherwise parts may be damaged or you could be injured.
- Store the product in a cool dry place and avoid exposing the product to direct sunlight.
- After use, always turn the power OFF and remove or unplug the batteries before storing.

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About Freenove

Freenove provides open source electronic products and services worldwide.

Freenove is committed to assist customers in their education of robotics, programming and electronic circuits so that they may transform their creative ideas into prototypes and new and innovative products. To this end, our services include but are not limited to:

- Educational and Entertaining Project Kits for Robots, Smart Cars and Drones
- Educational Kits to Learn Robotic Software Systems for Arduino, Raspberry Pi and micro:bit
- Electronic Component Assortments, Electronic Modules and Specialized Tools
- **Product Development and Customization Services**

You can find more about Freenove and get our latest news and updates through our website:

<http://www.freenove.com>

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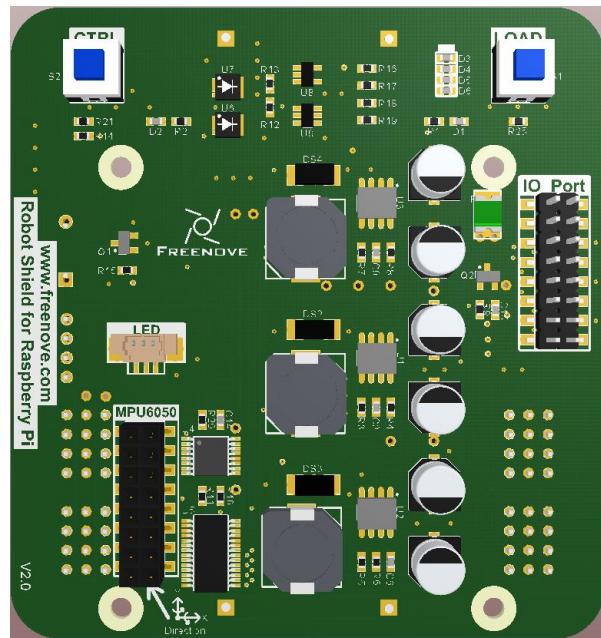
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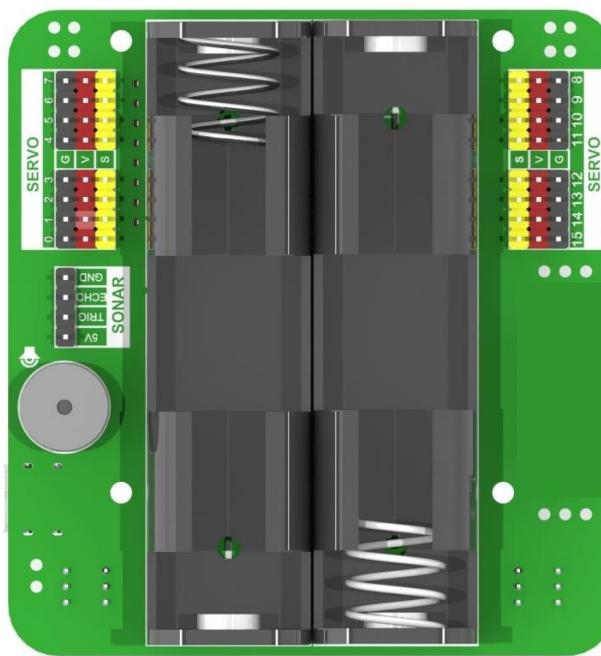
If you have any concerns, please feel free to contact us at support@freenove.com

Robot Shield for Raspberry Pi

Top



Bottom



Machinery Parts

M2.5*14+6 Copper Standoff  x5 Freenove	M2.5*14 Copper Standoff  x5 Freenove	M2.5*8 Screw  x10 Freenove
M2*14 Screw  x32 Freenove	M3*12 Screw  x22 Freenove	M1.2*7 Self-tapping Screw  x60 Freenove
M2 Nut  x32 Freenove	M3 Nut  x22 Freenove	M1.4*4 Self-tapping Screw  x12 Freenove

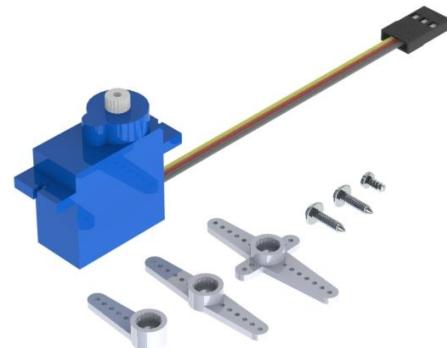
Note: You may receive M1.4*4 or M1.4*5. Both are suitable. If a package of M1.2*7 self-tapping screws cannot be found, it may be packed in the servo package.

Transmission Parts

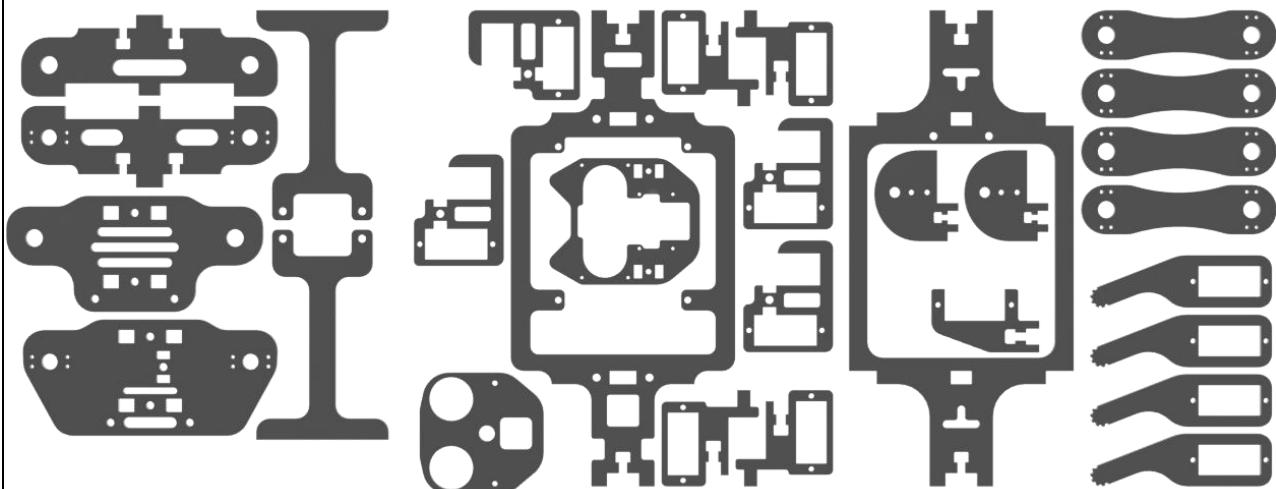
ES08MA II servo package x12



S90 servo package x1



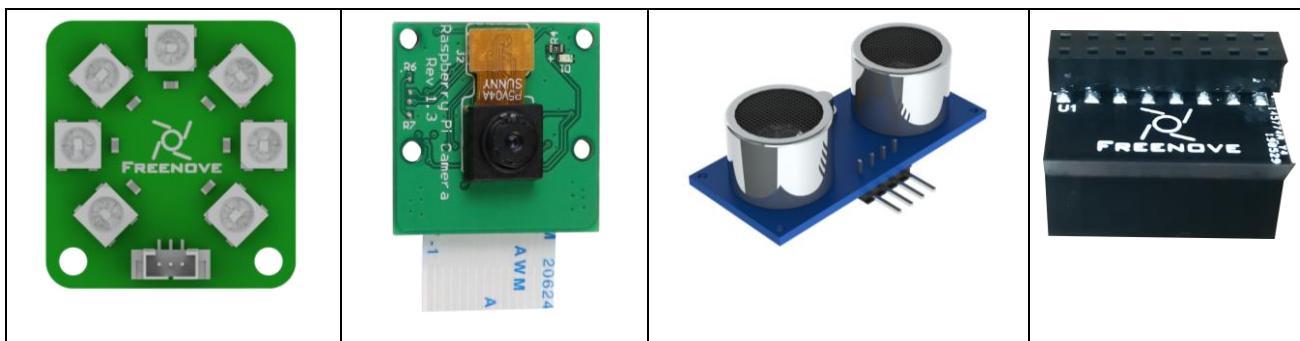
Acrylic Parts



Electronic Parts and Tools

LED module	Camera	HC-SR04 ultrasonic module	Connector
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Jumper wire F/F(4) for ultrasonic module



10cm 3Pin LED cable (same direction)



25cm 15Pin camera cable (reversed direction)



FPC soft line x1



Please note that this cable only come with the purchase of the Raspberry Pi 5 version.

Cross screwdriver (3mm) x1 Cross screwdriver (2mm) x1	Cable tidy x80cm	Red ball

Required but NOT Contained Parts

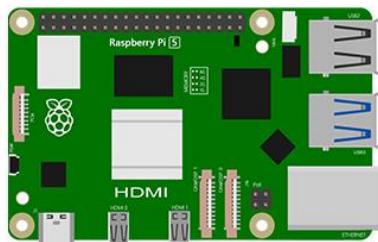
Two 18650 lithium batteries without protected board.

The continuous discharge current >10A

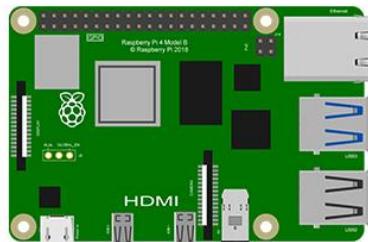
It is not easy to find proper batteries on Amazon. **Search 18650 3.7V high drain on eBay** or other websites.



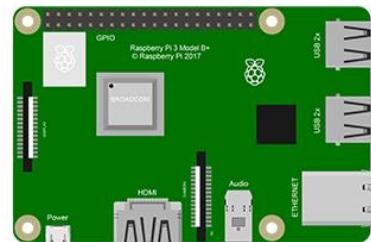
Raspberry Pi (Recommended model: Raspberry 5 / 4B / 3B+) x1



Raspberry Pi 5



Raspberry Pi 4 Model B



Raspberry Pi 3 Model B+

Preface

Welcome to use Freenove Robot Dog Kit for Raspberry Pi. Following this tutorial, you can make a very cool robot dog with many functions.

This kit is based on Raspberry Pi, a popular control panel, so you can share and exchange your experience and design ideas with many enthusiasts all over the world. This kit contains all electronic components, modules, and mechanical components required for making the robot dog. And all of them are packaged individually. There are detailed instructions for assembly and configuration in this book.

If you encounter any problems, please feel free to contact us for quick and free technical support.

support@freenove.com

This book can help enthusiasts with little technical knowledge to make a robot dog. If you are very interested in Raspberry Pi, and want to learn how to program and build the circuit, please visit our website www.freenove.com or contact us to buy the kits designed for beginners:

Freenove Basic\LCD1602\Super\Ultrasonic\RFID\Ultimate Starter Kit for Raspberry Pi

Introduction to Raspberry Pi

Raspberry Pi (or RPi, RPI, RasPi, which will be also referenced in this tutorial), a micro-computer with size of a card, quickly swept the world since it was launched. It is widely used in desktop workstation, media center, smart household, robots, and even the servers, etc. It can do almost everything, which continues to attract fans to explore it. Raspberry Pi is used to be running with Linux system and along with the release of windows 10 IoT, we can also run it with Windows. Raspberry Pi (with interfaces USB, network, HDMI, camera, audio, display and GPIO), as a microcomputer, can be run in command line mode and desktop system mode. Additionally, it is easy to operate just like Arduino, and you can even directly operate the GPIO of CPU.

So far, at this writing, Raspberry Pi has advanced to its fourth generation product offering. Version changes are accompanied by increases in upgrades in hardware and capabilities.

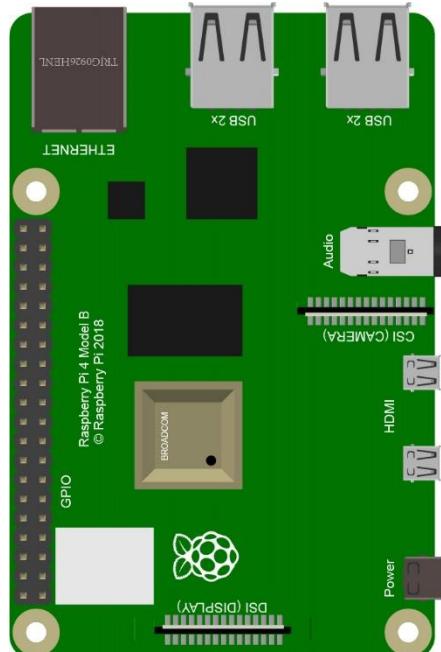
The A type and B type versions of the first generation products have been discontinued due to various reasons. What is most important is that other popular and currently available versions are consistent in the order and number of pins and their assigned designation of function, making compatibility of peripheral devices greatly enhanced between versions.

Below are the Raspberry Pi pictures and model pictures supported by this product.

Practicality picture of Raspberry Pi 4 Model B:



Model diagram of Raspberry Pi 4 Model B:



Practicality picture of Raspberry Pi 3 Model B+ :



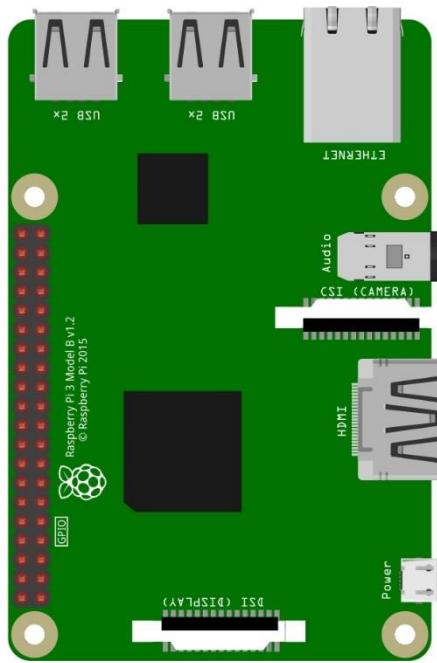
Model diagram of Raspberry Pi 3 Model B+ :



Practicality picture of Raspberry Pi 3 Model B:



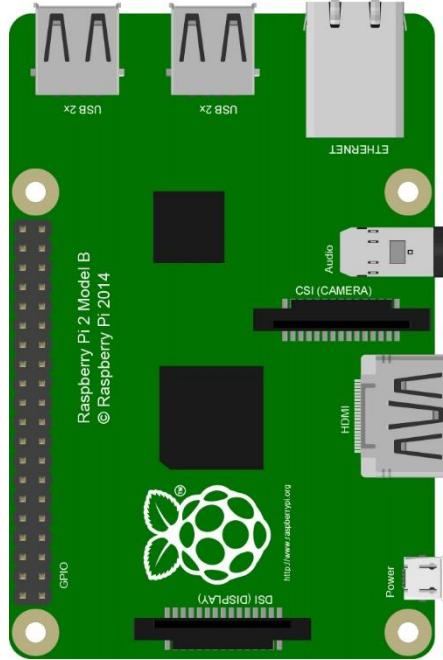
Model diagram of Raspberry Pi 3 Model B:



Practicality picture of Raspberry Pi 2 Model B:



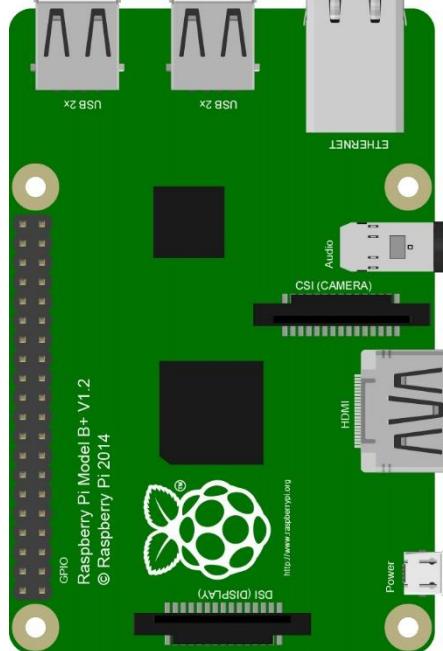
Model diagram of Raspberry Pi 2 Model B:



Practicality picture of Raspberry Pi 1 Model B+:



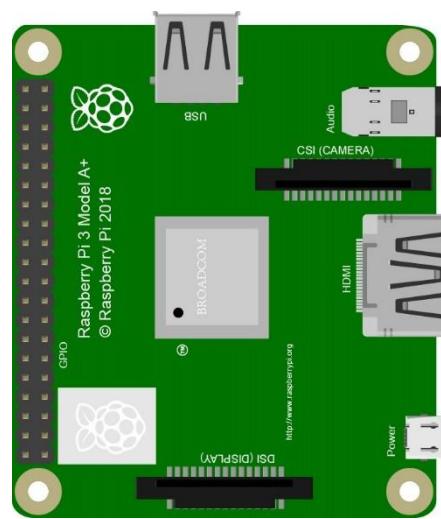
Model diagram of Raspberry Pi 1 Model B+:



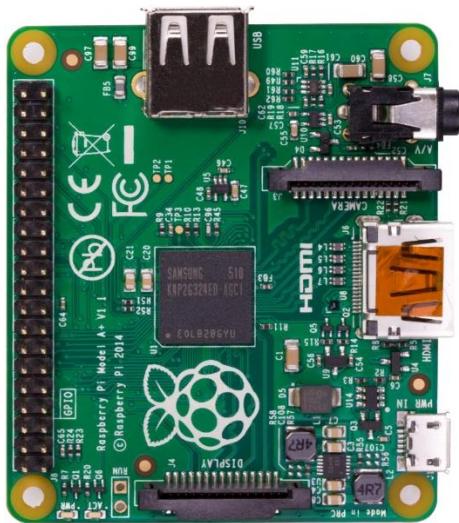
Practicality picture of Raspberry Pi 3 Model A+:



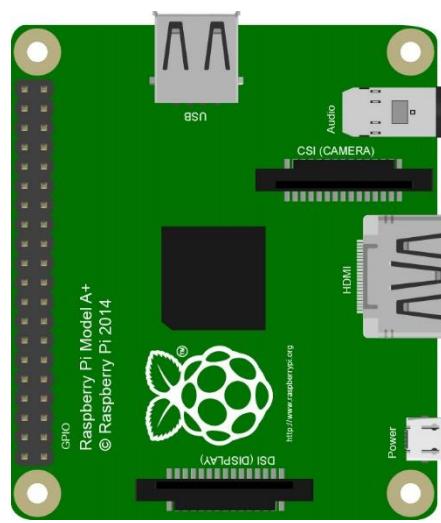
Model diagram of Raspberry Pi 3 Model A+:



Practicality picture of Raspberry Pi 1 Model A+:



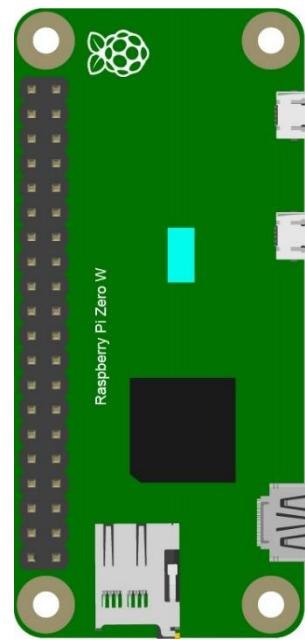
Model diagram of Raspberry Pi 1 Model A+:



Practicality picture of Raspberry Pi Zero W:



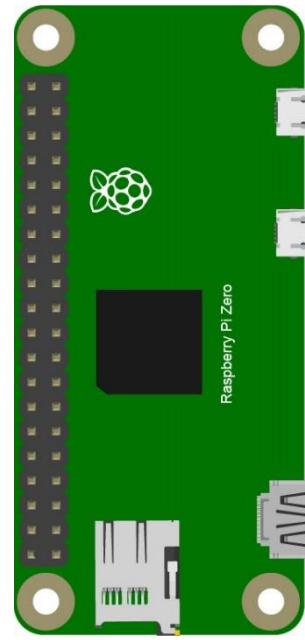
Model diagram of Raspberry Pi Zero W:



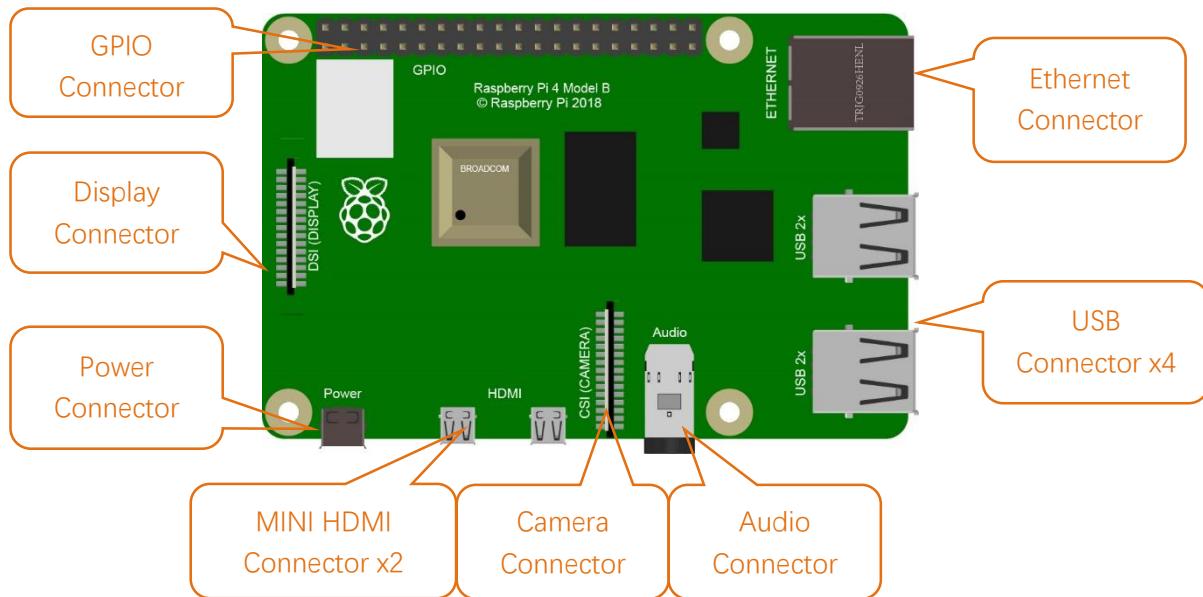
Practicality picture of Raspberry Pi Zero:



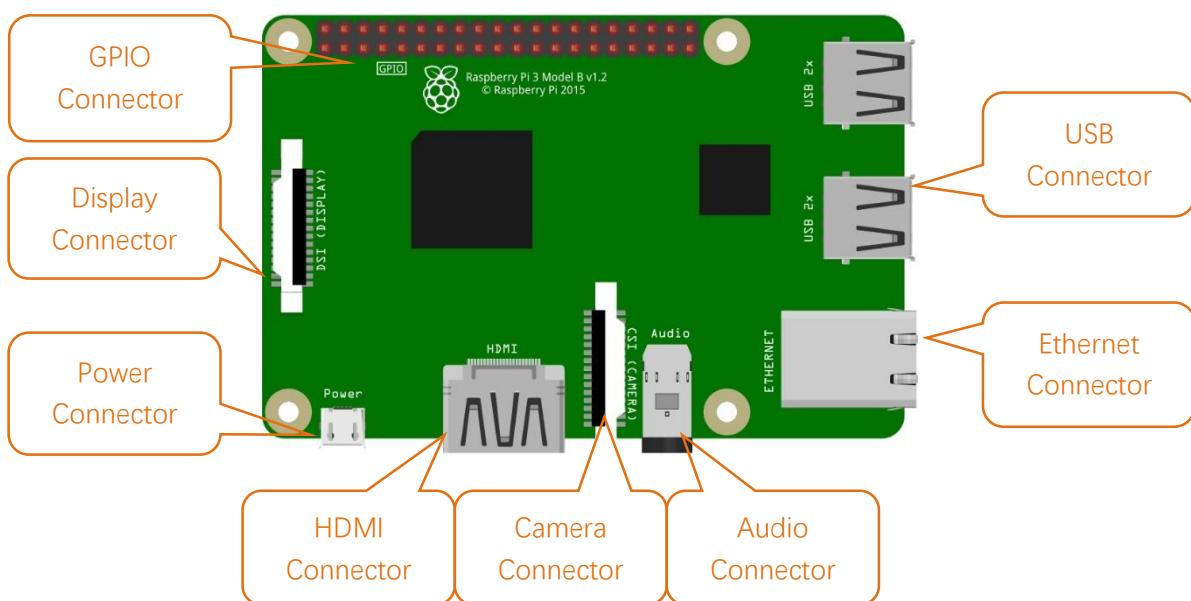
Model diagram of Raspberry Pi Zero:



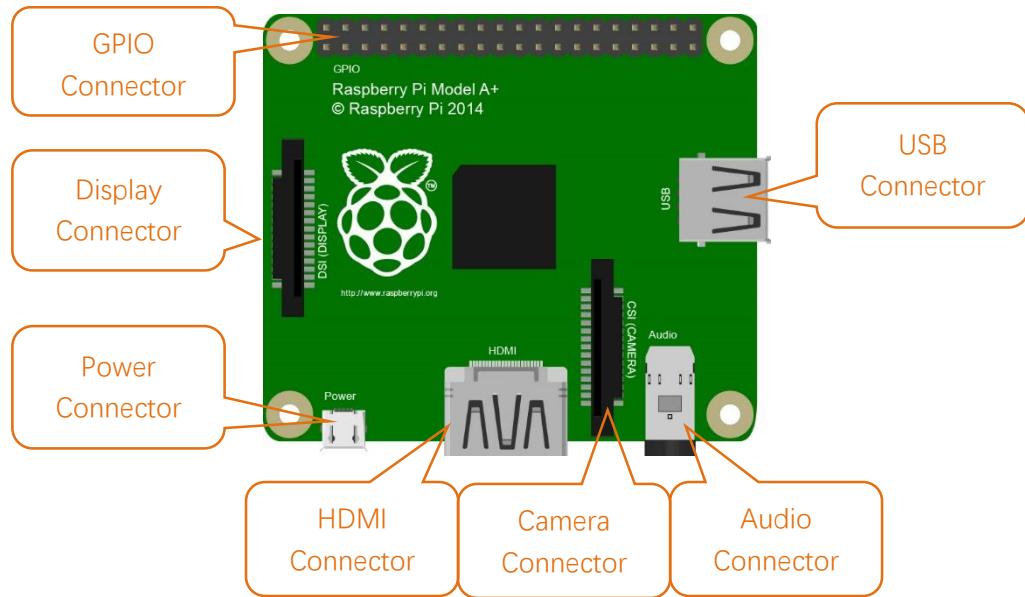
Hardware interface diagram of RPi 4B is shown below:



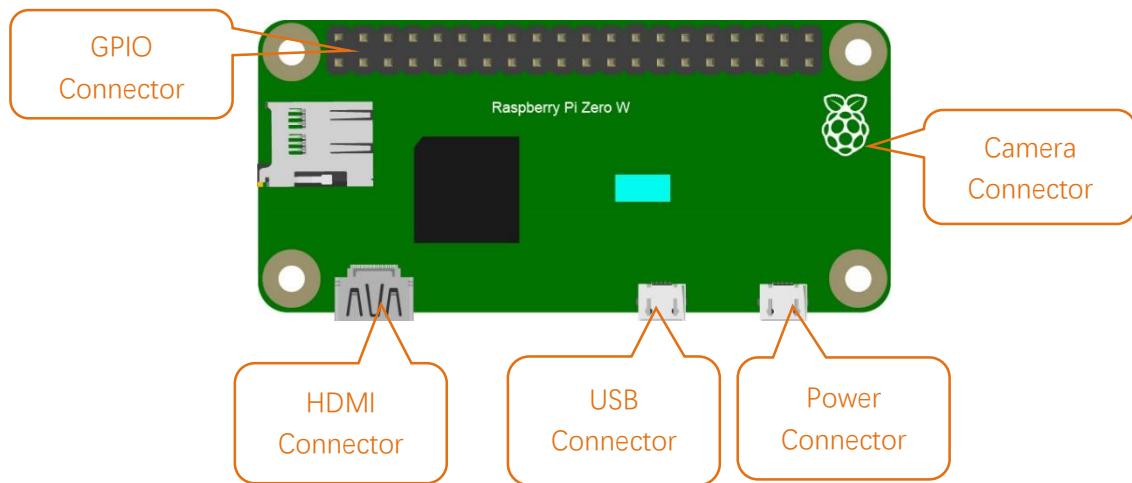
Hardware interface diagram of RPi 3B+/3B/2B/1B+ are shown below:



Hardware interface diagram of RPi 3A+/A+ is shown below:



Hardware interface diagram of RPi Zero/Zero W is shown below:



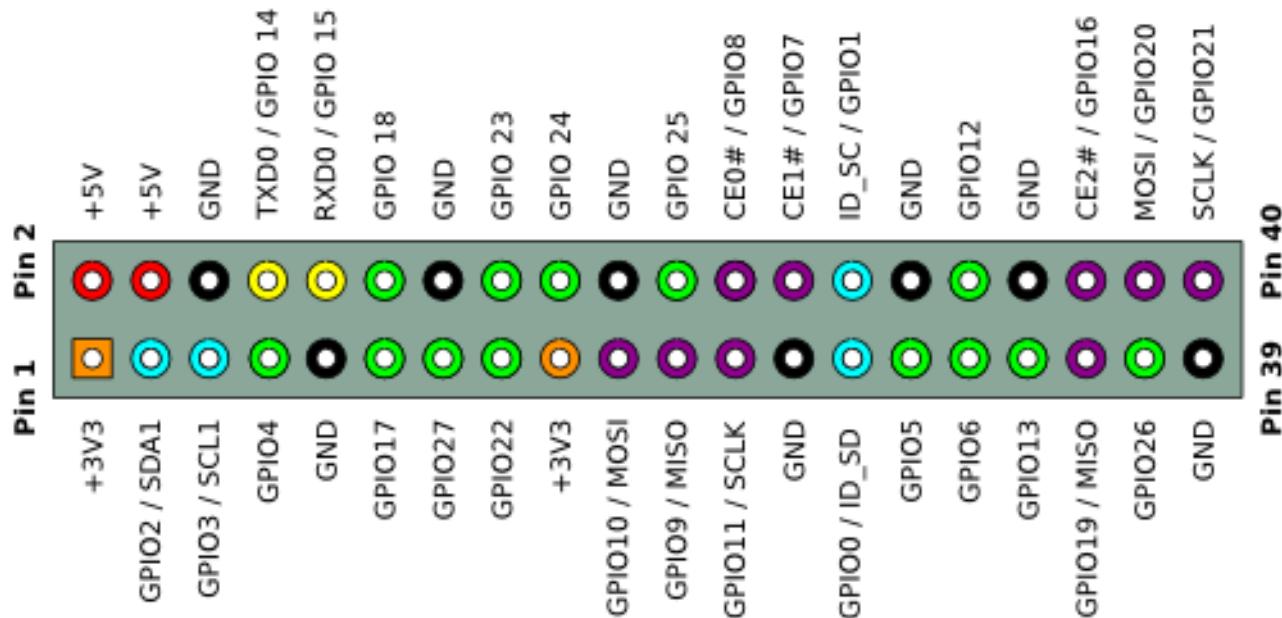
GPIO

GPIO: General purpose input/output. We will introduce the specific feature of the pins on the Raspberry Pi and how you can utilize them in all sorts of ways in your projects. Most RPi Module pins can be used as either an input or output, depending on your program and its functions. When programming the GPIO pins, there are 3 different ways to reference them: GPIO numbering, physical numbering, WiringPi GPIO Numbering.

BCM GPIO Numbering

The Raspberry Pi CPU uses Broadcom (BCM) processing chips BCM2835, BCM2836 or BCM2837. GPIO pin numbers are assigned by the processing chip manufacturer and are how the computer recognizes each pin. The pin numbers themselves do not make sense or have meaning as they are only a form of identification. Since their numeric values and physical locations have no specific order, there is no way to remember them, so you will need to have a printed reference or a reference board that fits over the pins.

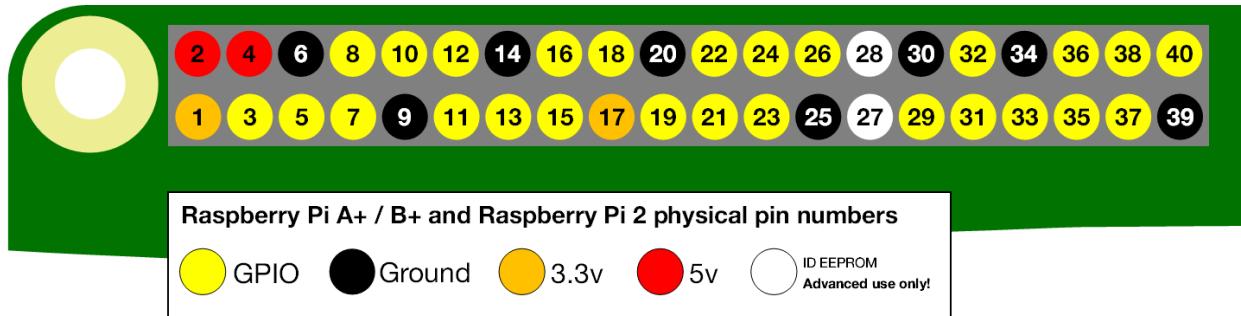
Each pin is defined as below:



For more details about pin definition of GPIO, please refer to <http://pinout.xyz/>

PHYSICAL Numbering

Another way to refer to the pins is by simply counting across and down from pin 1 at the top left (nearest to the SD card). This is 'physical numbering', as shown below:



WiringPi GPIO Numbering

Different from the previous two types of GPIO serial numbers, RPi GPIO serial number of the WiringPi are numbered according to the BCM chip use in RPi.

wiringPi Pin	BCM GPIO	Name	Header	Name	BCM GPIO	wiringPi Pin	
—	—	3.3v	1 2	5v	—	—	For A+, B+, 2B, 3B, 3B+, 4B, Zero
8	R1:0/R2:2	SDA	3 4	5v	—	—	For Pi B
9	R1:1/R2:3	SCL	5 6	0v	—	—	
7	4	GPIO7	7 8	TxD	14	15	
—	—	0v	9 10	RxD	15	16	
0	17	GPIO0	11 12	GPIO1	18	1	
2	R1:21/R2:27	GPIO2	13 14	0v	—	—	
3	22	GPIO3	15 16	GPIO4	23	4	
—	—	3.3v	17 18	GPIO5	24	5	
12	10	MOSI	19 20	0v	—	—	
13	9	MISO	21 22	GPIO6	25	6	
14	11	SCLK	23 24	CE0	8	10	
—	—	0v	25 26	CE1	7	11	
30	0	SDA.0	27 28	SCL.0	1	31	
21	5	GPIO.21	29 30	0V			
22	6	GPIO.22	31 32	GPIO.26	12	26	
23	13	GPIO.23	33 34	0V			
24	19	GPIO.24	35 36	GPIO.27	16	27	
25	26	GPIO.25	37 38	GPIO.28	20	28	
		0V	39 40	GPIO.29	21	29	

(For more details, please refer to <https://projects.drogon.net/raspberry-pi/wiringpi/pins/>)

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You can also use the following command to view their correlation.

```
gpio readall
```

Pi 3 Model B GPIO Pinout												
BCM	wPi	Name	Mode	V	Physical	V	Mode	Name	wPi	BCM		
		3.3v			1	2		5v				
2	8	SDA.1	ALT0	1	3	4		5V				
3	9	SCL.1	ALT0	1	5	6		0v				
4	7	GPIO. 7	IN	1	7	8	1	ALT5	TxD	15	14	
		0v			9	10	1	ALT5	RxD	16	15	
17	0	GPIO. 0	IN	0	11	12	0	IN	GPIO. 1	1	18	
27	2	GPIO. 2	IN	0	13	14		0v				
22	3	GPIO. 3	IN	0	15	16	0	IN	GPIO. 4	4	23	
		3.3v			17	18	0	IN	GPIO. 5	5	24	
10	12	MOSI	ALT0	0	19	20		0v				
9	13	MISO	ALT0	0	21	22	0	IN	GPIO. 6	6	25	
11	14	SCLK	ALT0	0	23	24	1	OUT	CE0	10	8	
		0v			25	26	1	OUT	CE1	11	7	
0	30	SDA.0	IN	1	27	28	1	IN	SCL.0	31	1	
5	21	GPIO.21	IN	1	29	30		0v				
6	22	GPIO.22	IN	1	31	32	0	IN	GPIO.26	26	12	
13	23	GPIO.23	IN	0	33	34		0v				
19	24	GPIO.24	IN	0	35	36	0	IN	GPIO.27	27	16	
26	25	GPIO.25	IN	0	37	38	0	IN	GPIO.28	28	20	
		0v			39	40	0	IN	GPIO.29	29	21	

For more details about wiringPi, please refer to <http://wiringpi.com/>.

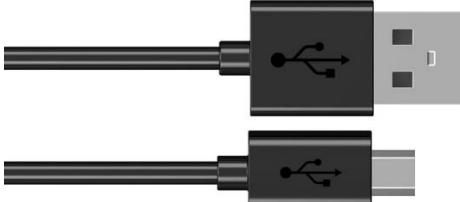
Chapter 0 Raspberry Pi Preparation

Install a System

Firstly, install a system for your RPi.

Component List

Required Components

Raspberry Pi 4B / 3B+/ 3B /3A+ (Recommended)	5V/3A Power Adapter. Different versions of Raspberry Pi have different power requirements. 
Micro USB Cable x1 	Micro SD Card (TF Card) x1, Card Reader x1 

This robot also supports the following versions of the Raspberry Pi, but **additional accessories** need to be prepared by yourself.

Raspberry	Additional accessories
Raspberry Pi Zero W	Camera cable(>25cm) for zero w, 15 Pin 1.0mm Pitch to 22 Pin 0.5mm https://www.amazon.com/dp/B076Q595HJ/
Raspberry Pi Zero 1.3	wireless network adapter, Camera cable(>25cm) for zero w, 15 Pin 1.0mm Pitch to 22 Pin 0.5mm, OTG cable (USB Type micro B to USB Type A)
Raspberry Pi 2 Model B	wireless network adapter
Raspberry Pi 1 Model A+	wireless network adapter
Raspberry Pi 1 Model B+	wireless network adapter

Power requirements of various versions of Raspberry Pi are shown in following table:

Product	Recommended PSU current capacity	Maximum total USB peripheral current draw	Typical bare-board active current consumption
Raspberry Pi Model A	700mA	500mA	200mA
Raspberry Pi Model B	1.2A	500mA	500mA
Raspberry Pi Model A+	700mA	500mA	180mA
Raspberry Pi Model B+	1.8A	600mA/1.2A (switchable)	330mA
Raspberry Pi 2 Model B	1.8A	600mA/1.2A (switchable)	350mA
Raspberry Pi 3 Model B	2.5A	1.2A	400mA
Raspberry Pi 3 Model A+	2.5A	Limited by PSU, board, and connector ratings only.	350mA
Raspberry Pi 3 Model B+	2.5A	1.2A	500mA
Raspberry Pi 4 Model B	3.0A	1.2A	600mA
Raspberry Pi Zero W	1.2A	Limited by PSU, board, and connector ratings only.	150mA
Raspberry Pi Zero	1.2A	Limited by PSU, board, and connector ratings only	100mA

For more details, please refer to <https://www.raspberrypi.org/help/faqs/#powerReqs>

In addition, RPi also needs an Ethernet network cable used to connect it to a WAN (Wide Area Network). All these components are necessary for any of your projects to work. Among them, the power supply of at least 5V/2.5A, because a lack of a sufficient power supply may lead to many functional issues and even damage your RPi, we STRONGLY RECOMMEND a 5V/2.5A power supply. We also recommend using a SD Micro Card with a capacity 16GB or more (which, functions as the RPi's "hard drive") and is used to store the operating system and necessary operational files.

In future projects, the components list with a RPi will contain these required components, using only RPi as a representative rather than presenting details.

Optional Components

Under normal circumstances, there are two ways to login to Raspberry Pi: 1) Using a stand-alone monitor. 2) Using a remote desktop computer monitor “sharing” the PC monitor with your RPi.

Required Accessories for Monitor

If you want to use an independent monitor, mouse and keyboard, you also need the following accessories.

1. A Display with HDMI interface
2. A Mouse and a Keyboard with an USB interface

As to Pi Zero and Pi Zero W, you also need the following accessories:

1. A Mini-HDMI to HDMI Adapter and Cable.
2. A Micro-USB to USB-A Adapter and Cable (Micro USB OTG Cable).
3. A USB HUB.
4. USB to Ethernet Interface or USB Wi-Fi receiver.

For different Raspberry Pi, the optional items are slightly different. But they all aim to convert the interfaces to Raspberry Pi standards.

Item	Pi Zero	Pi Zero W	Pi A+	Pi 3A+	Pi B+/2B	Pi 3B/3B+/4B
Monitor	Yes	Yes	Yes	Yes	Yes	Yes
Mouse	Yes	Yes	Yes	Yes	Yes	Yes
Keyboard	Yes	Yes	Yes	Yes	Yes	Yes
Micro-HDMI to HDMI cable	Yes	Yes	No	No	No	No
Micro-USB to USB-A OTG cable	Yes	Yes	No	No	No	No
USB HUB	Yes	Yes	Yes	Yes	No	No
USB transferring to Ethernet interface	select one from two or select two from two	optional	select one from two or select two from two	optional	Internal Integration	Internal Integration
USB Wi-Fi receiver		Internal Integration		Internal Integration	optional	

Required Accessories for Remote Desktop

If you do not have an independent monitor, or if you want to use a remote desktop, first you need to login to Raspberry Pi through SSH, then open the VNC or RDP service. This requires the following accessories.

Item	Pi Zero	Pi Zero W	Pi A+	Pi 3A+	Pi B+/2B	Pi 3B/3B+/4B
Micro-USB to USB-A OTG cable	Yes	Yes	No			
USB transferring to Ethernet interface	Yes	Yes	Yes			NO

Raspberry Pi OS

Install imager tool

Visit this website to install imager tool.

<https://www.raspberrypi.com/software/>

Install Raspberry Pi OS using Raspberry Pi Imager

Raspberry Pi Imager is the quick and easy way to install Raspberry Pi OS and other operating systems to a microSD card, ready to use with your Raspberry Pi. [Watch our 45-second video](#) to learn how to install an operating system using Raspberry Pi Imager.

Download and install Raspberry Pi Imager to a computer with an SD card reader. Put the SD card you'll use with your Raspberry Pi into the reader and run Raspberry Pi Imager.

[Download for Windows](#)

[Download for macOS](#)

[Download for Ubuntu for x86](#)

To install on **Raspberry Pi OS**, type

`sudo apt install rpi-imager`

in a Terminal window.



Download OS file

Visit following website to download the OS file.

<https://www.raspberrypi.com/software/operating-systems/>

Raspberry Pi OS

Our recommended operating system for most users.

Compatible with:

[All Raspberry Pi models](#)

Raspberry Pi OS with desktop

Release date: April 4th 2022

System: 32-bit

Kernel version: 5.15

Debian version: 11 (bullseye)

Size: 837MB

[Show SHA256 file integrity hash](#)

[Release notes](#)

[Download](#)

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[Archive](#)

Raspberry Pi OS with desktop and recommended software

Release date: April 4th 2022

System: 32-bit

Kernel version: 5.15

Debian version: 11 (bullseye)

Size: 2,277MB

[Show SHA256 file integrity hash](#)

[Release notes](#)

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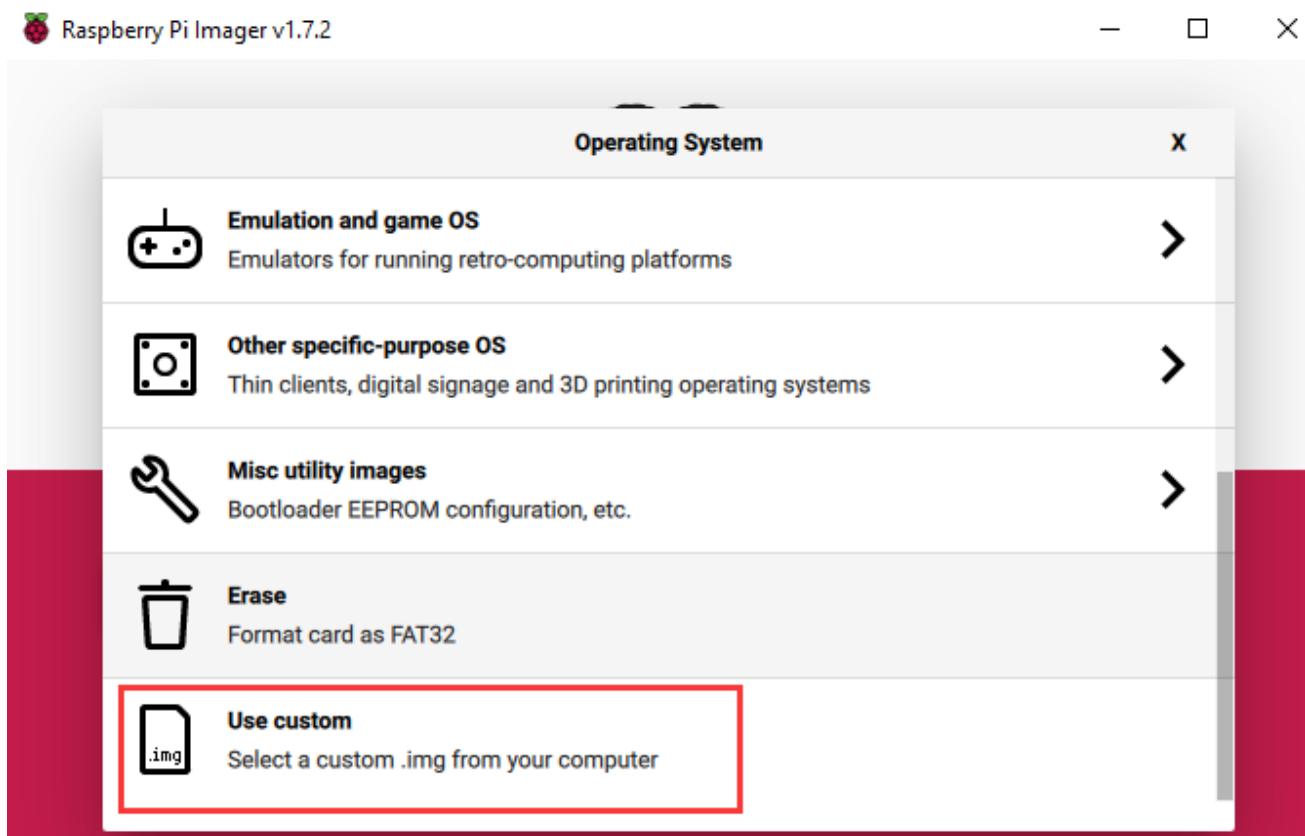
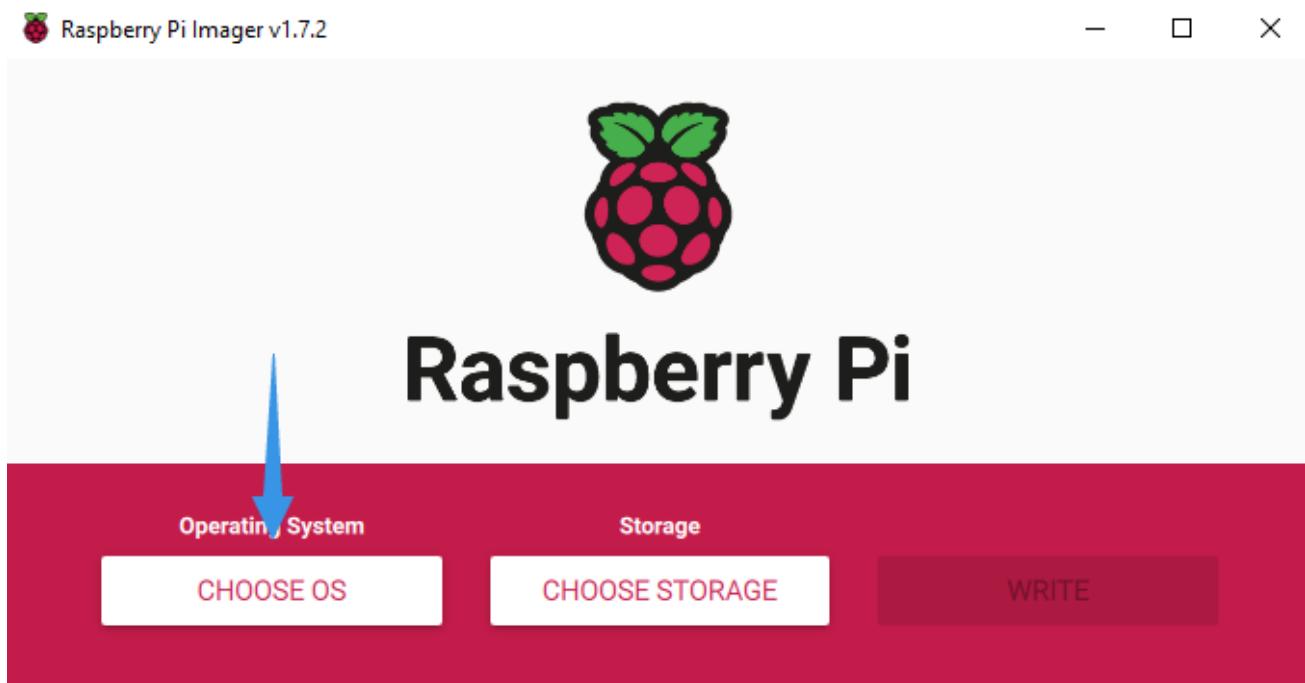
[Archive](#)

Write System to Micro SD Card

First, insert your Micro **SD card** into **card reader** and connect it to USB port of **PC**. Then open imager tool.

Need support? ✉ support@freenove.com

Choose system that you just downloaded in Use custom.



Choose the SD card.

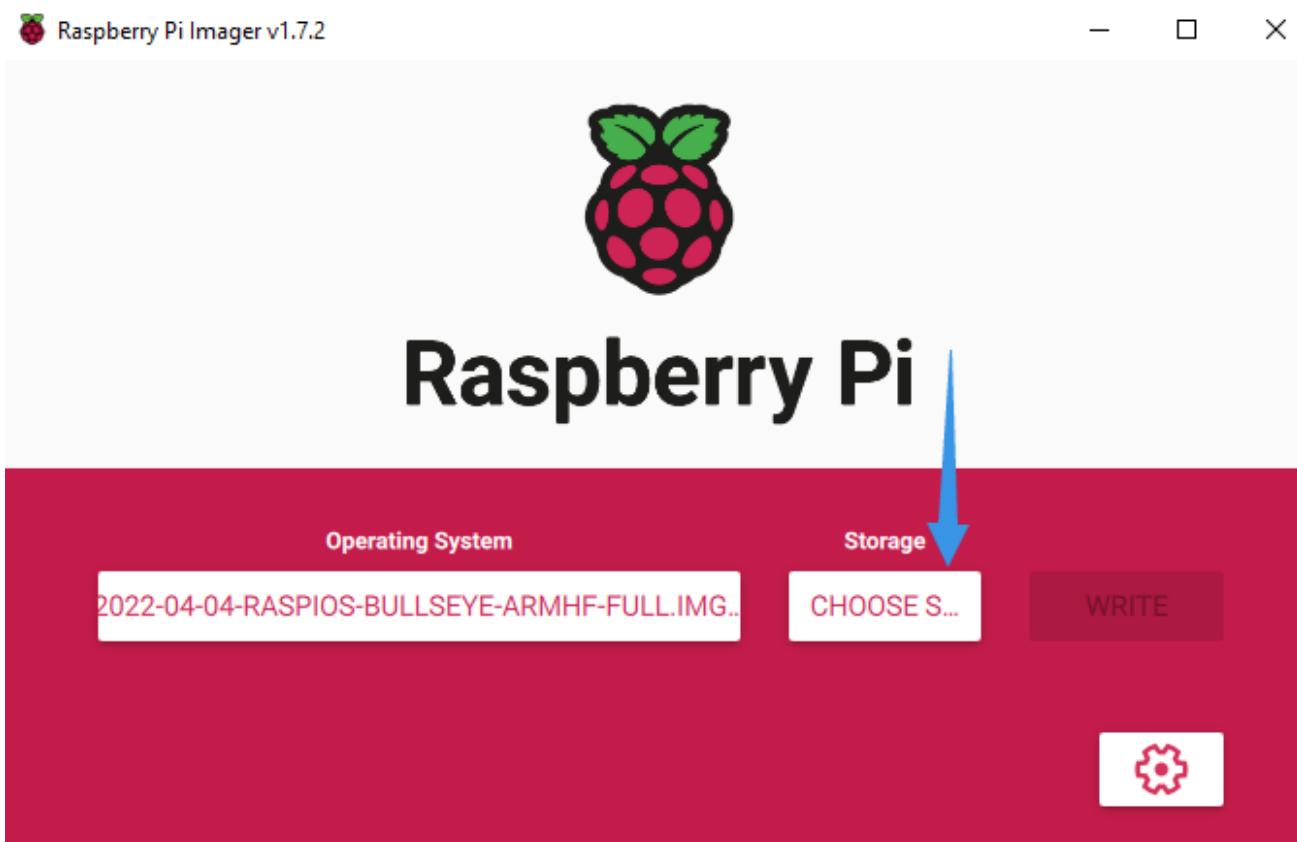
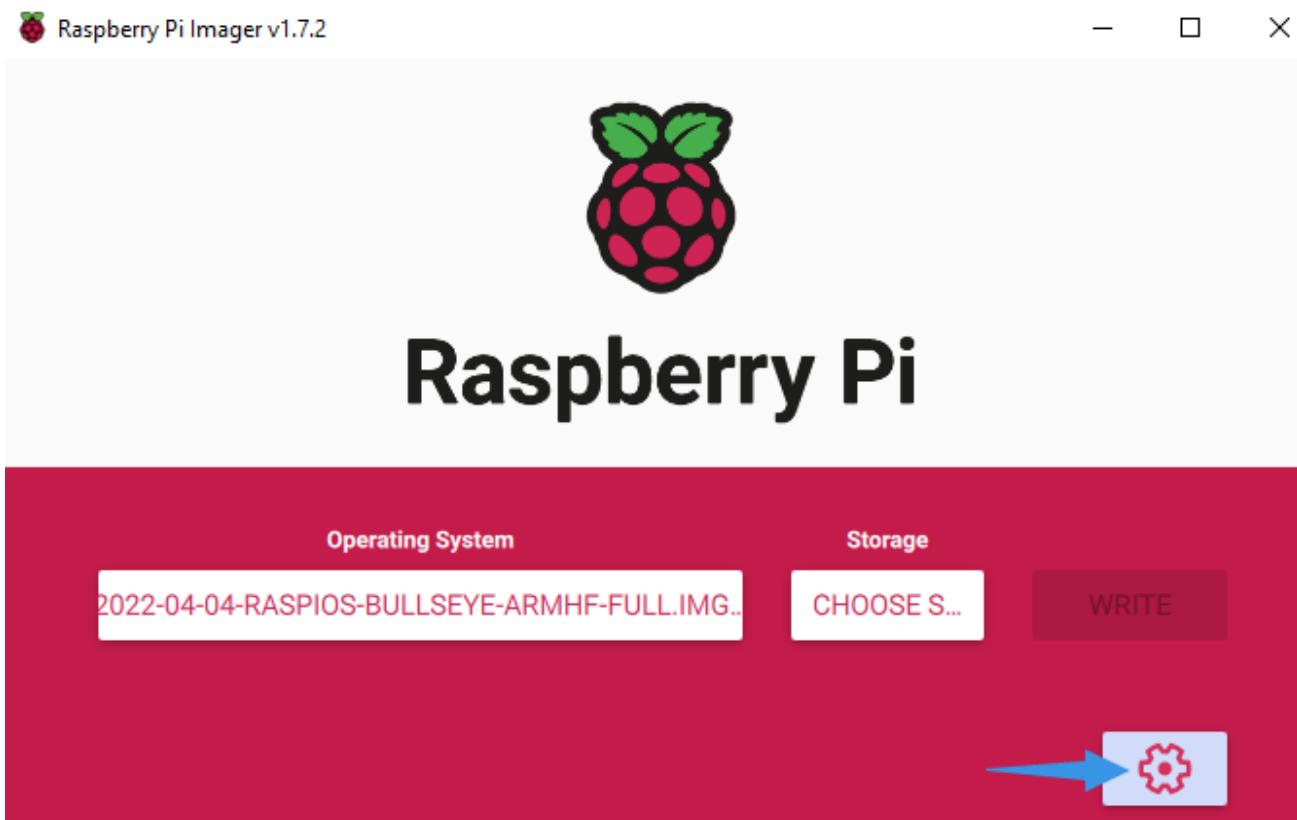
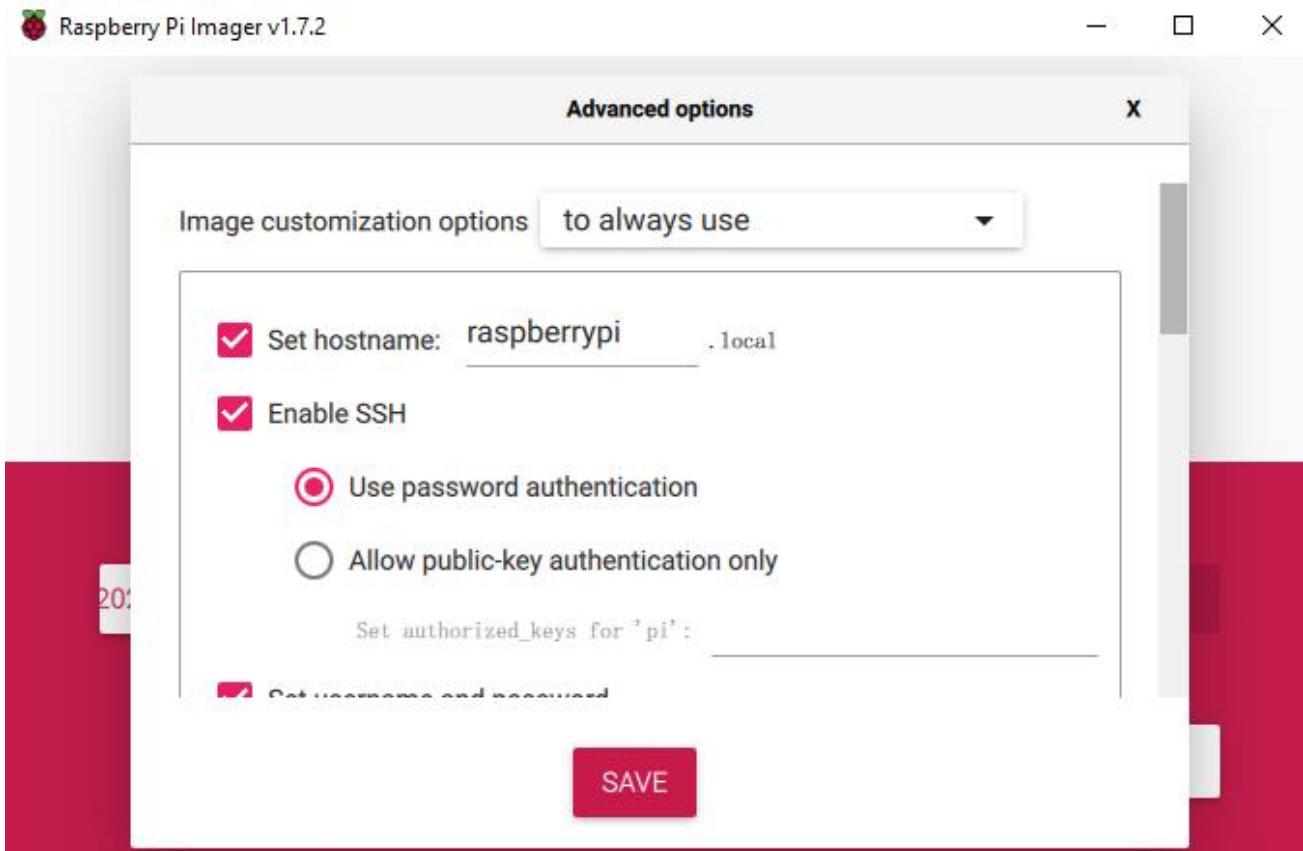


Image option.

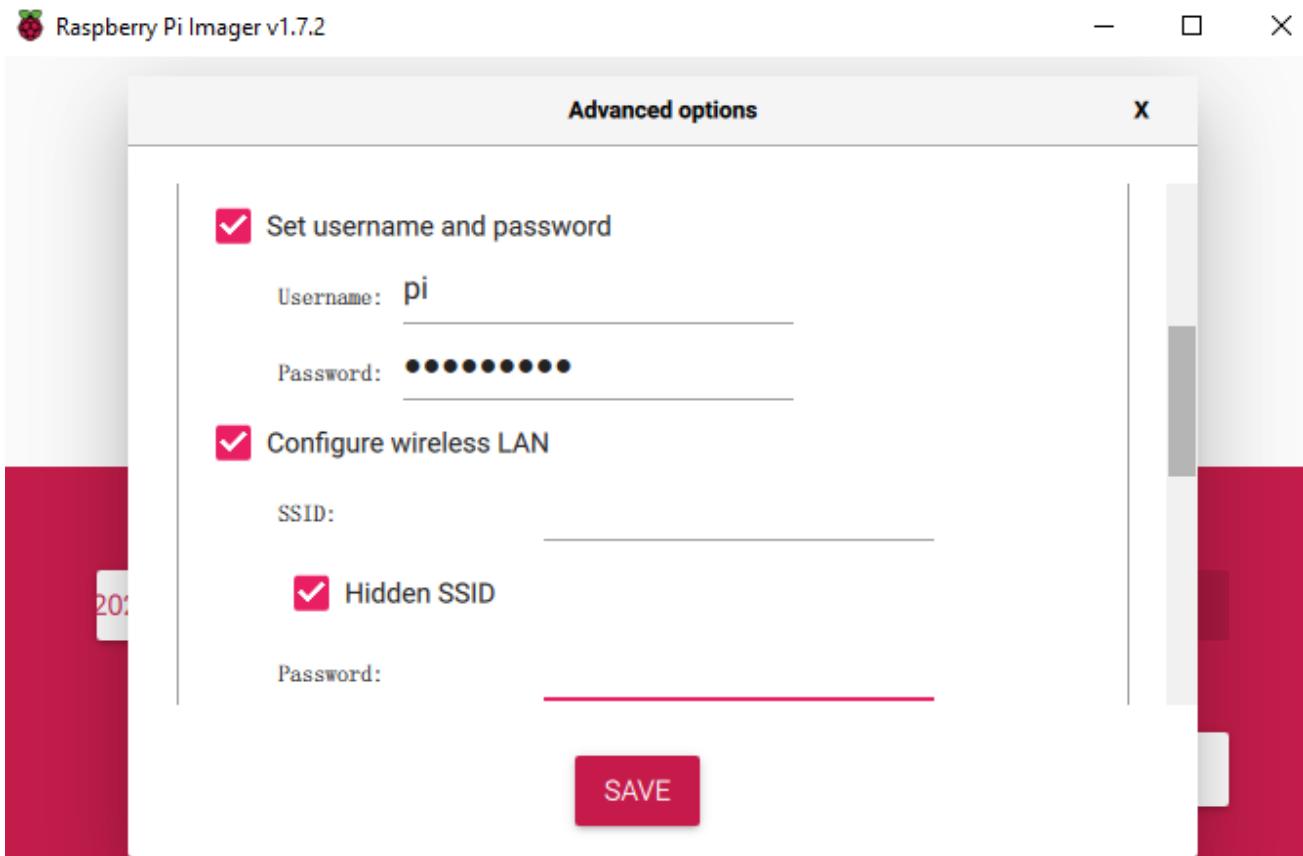


Enable SSH.

Need support? ✉ support@freenove.com



Configure WiFi and location. Here we set username as **pi**, password as **raspberry**



Finally WRITE.

Need support? [✉ support@freenove.com](mailto:support@freenove.com)

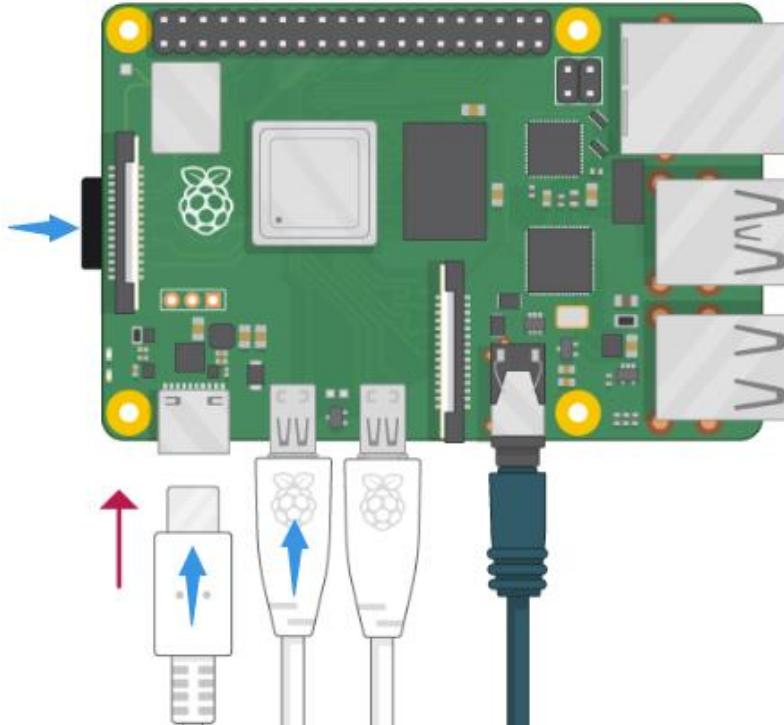


Start Raspberry Pi

If you don't have a spare monitor, please skip to next section.

If you have a spare monitor, please follow the steps in this section.

After the system is written successfully, put SD card into the SD card slot of RPi. Then connect your RPi to monitor through HDMI cable, attach your mouse and keyboard through the USB ports,



Later, after setup, you will need to enter your user name and password to login. The default user name: pi; password: raspberry. After login, you should see the following screen.



You can connect WiFi on the right corner if WiFi is connected successfully.

Now you can skip to [VNC Viewer](#).

Remote desktop & VNC

After you log in Raspberry Pi, please use VNC Viewer to connect Raspberry Pi for this robot. Other remote ways may not support GUI. If you have logged in Raspberry Pi please skip to [VNC Viewer](#).

If you don't have a spare monitor, mouse and keyboard for your RPi, you can use a remote desktop to share a display, keyboard, and mouse with your PC. Below is how to use:

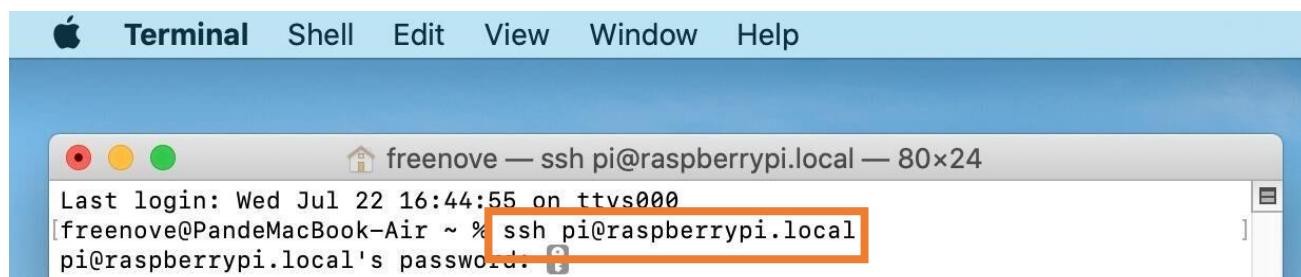
[MAC OS remote desktop](#) and [Windows OS remote desktop](#).

MAC OS Remote Desktop

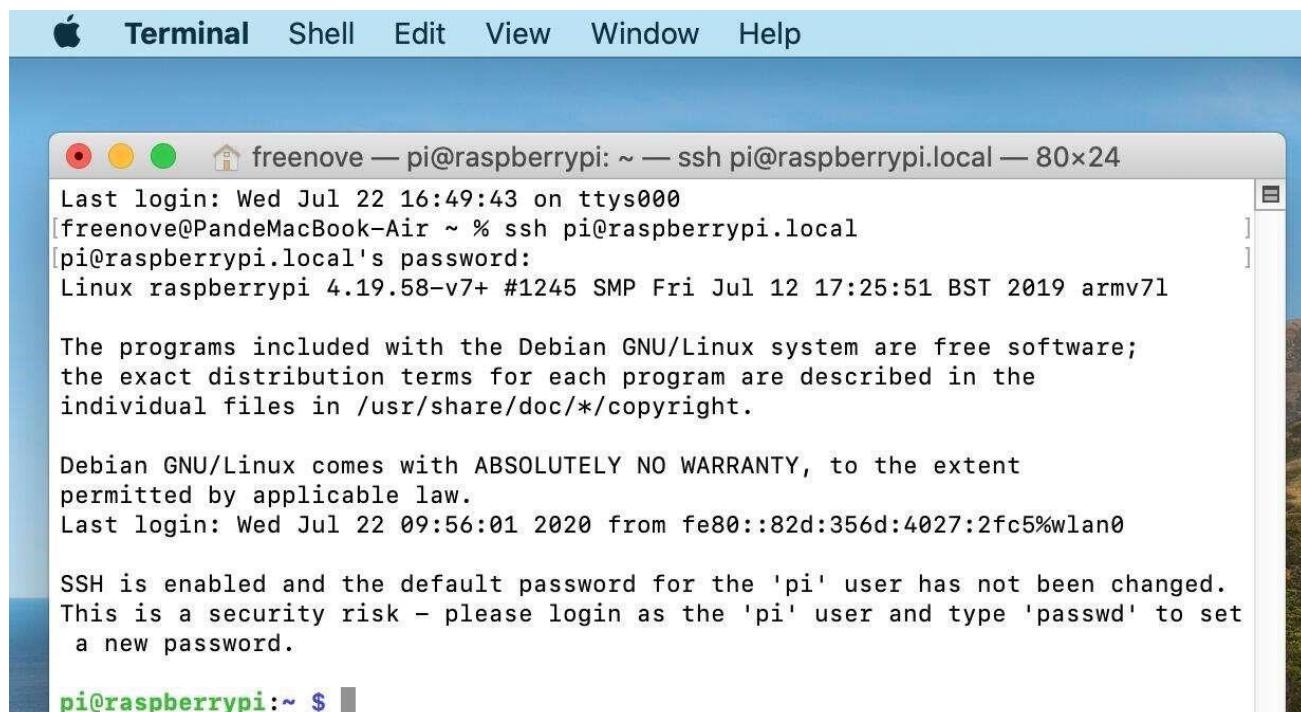
Open the terminal and type following command. **If this command doesn't work, please move to next page.**

```
ssh pi@raspberrypi.local
```

The password is **raspberry** by default, case sensitive.



You may need to type **yes** during the process.



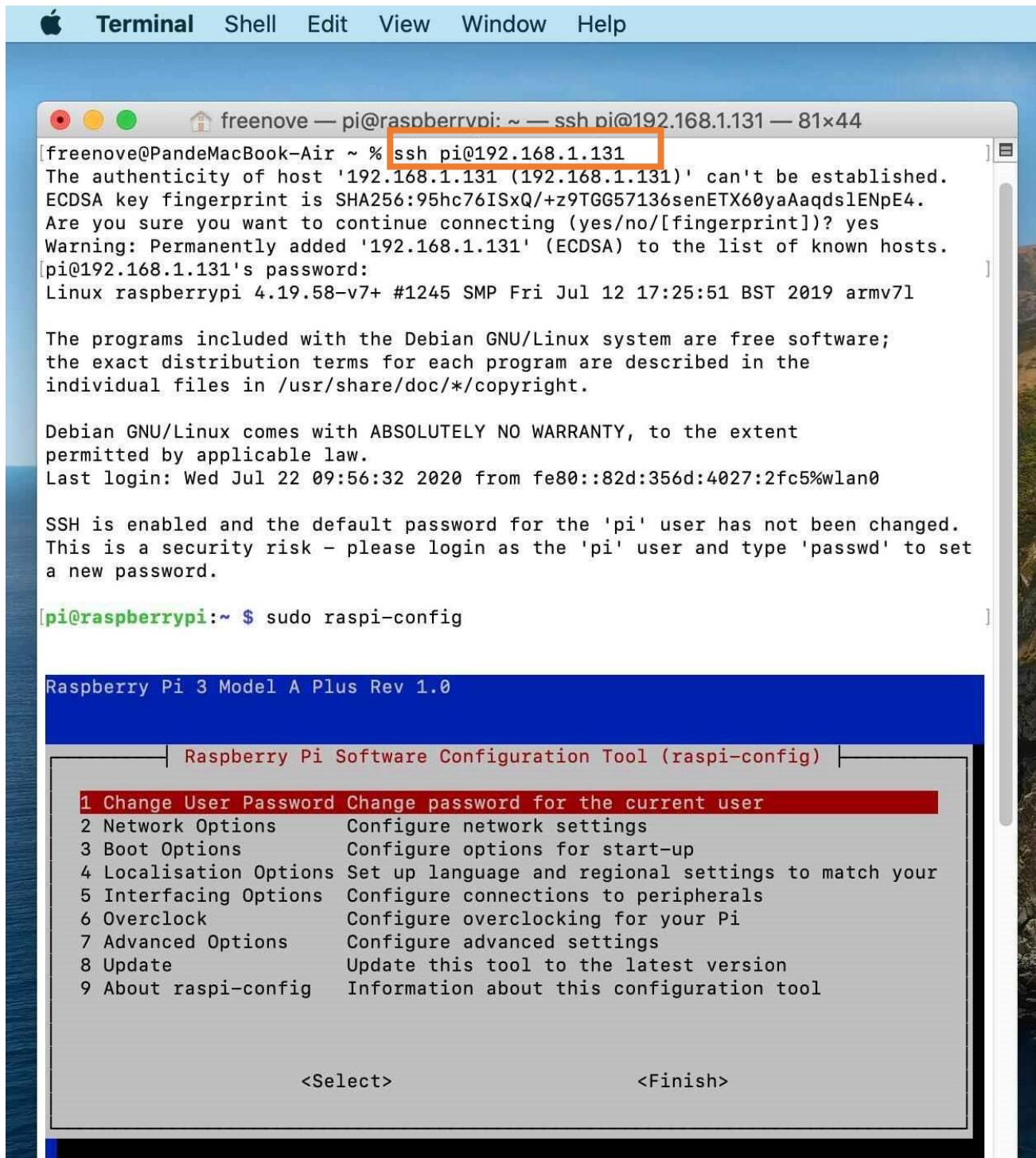
You can also use the IP address to log in Pi.

Enter **router** client to **inquiry IP address** named "raspberry pi". For example, I have inquired to **my RPi IP address, and it is "192.168.1.131"**.

Open the terminal and type following command.

```
ssh pi@192.168.1.131
```

When you see **pi@raspberrypi:~ \$**, you have logged in Pi successfully. Then you can skip to next section.



Then you can skip to [VNC Viewer](#).

Need support? [✉ support@freenove.com](mailto:support@freenove.com)

Windows OS Remote Desktop

If you are using win10, you can use follow way to login Raspberry Pi without desktop.

Press Win+R. Enter cmd. Then use this command to check IP:

```
ping -4 raspberrypi.local
```

```
Windows [Version 10.0.19044.2130]
(c) Microsoft Corporation. All rights reserved.

C:\Users\Administrator>ping -4 raspberrypi.local

Pinging raspberrypi.local [192.168.1.147] with 32 bytes of data:
Reply from 192.168.1.147: bytes=32 time=10ms TTL=64
Reply from 192.168.1.147: bytes=32 time=4ms TTL=64
Reply from 192.168.1.147: bytes=32 time=124ms TTL=64
Reply from 192.168.1.147 [192.168.1.147]: bytes=32 time=7ms TTL=64

Ping statistics for 192.168.1.147:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 4ms, Maximum = 124ms, Average = 36ms
```

Then 192.168.1.147 is my Raspberry Pi IP.

Or enter **router** client to inquiry IP address named "raspberrypi". For example, I have inquired to **my RPi IP address, and it is "192.168.1.147"**.

```
ssh pi@192.168.1.147
```

```
C:\Users\Administrator>ssh pi@192.168.1.147
pi@192.168.1.147's password:
Linux raspberrypi 5.15.74-v7+ #1595 SMP Wed Oct 26 11:03:05 BST 2022 armv7l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Mon Nov  7 10:19:19 2022 from 192.168.1.127

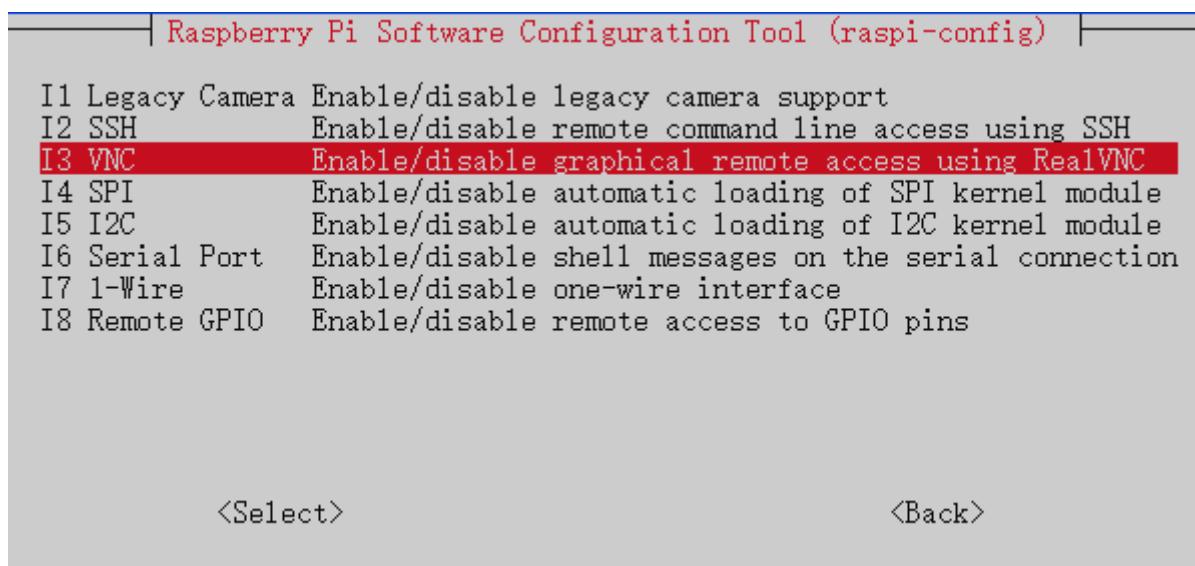
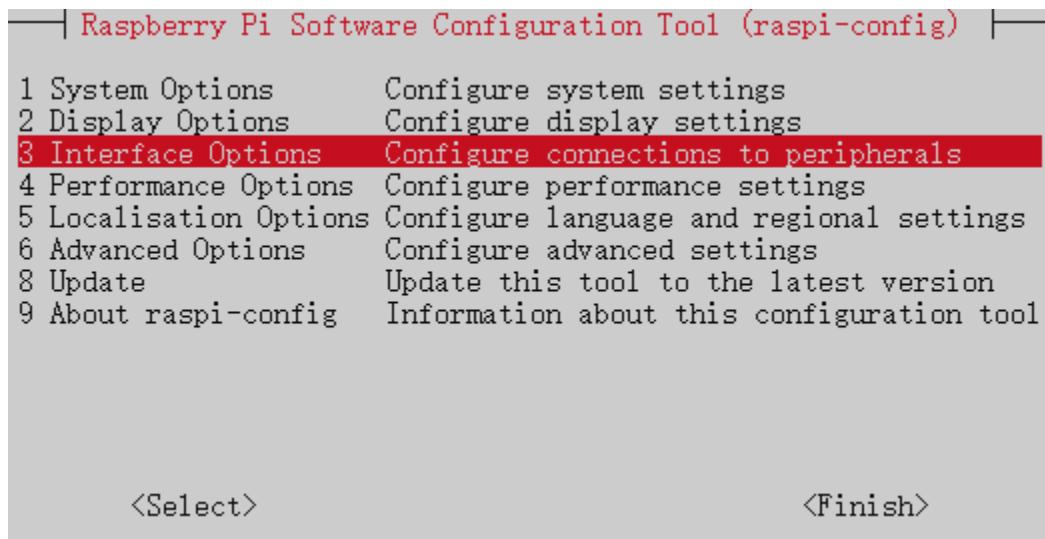
SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set a new password.

pi@raspberrypi: ~ $
```

VNC Viewer & VNC

Type the following command. And select Interfacing **Options** → **VNC** → **Yes** → **OK** → **Finish**. Here Raspberry Pi may need to be restarted, and choose ok. Then open VNC interface.

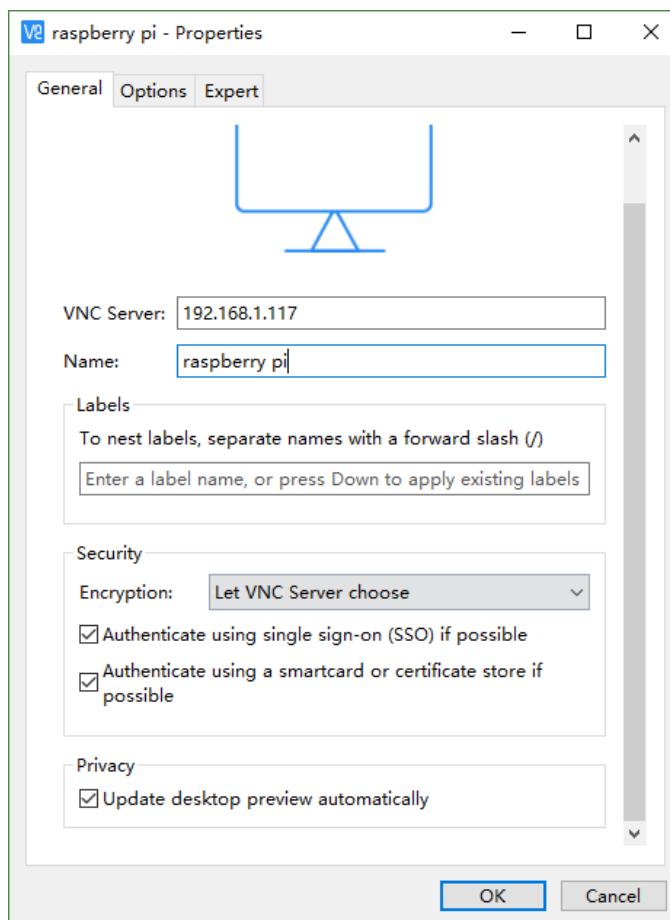
```
sudo raspi-config
```



Then download and install VNC Viewer according to your computer system by clicking following link:

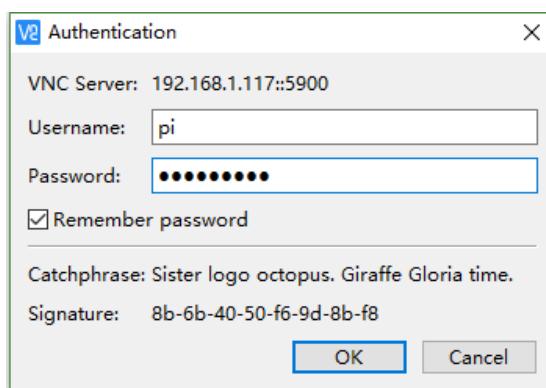
<https://www.realvnc.com/en/connect/download/viewer/>

After installation is completed, open VNC Viewer. And click File → New Connection. Then the interface is shown below.

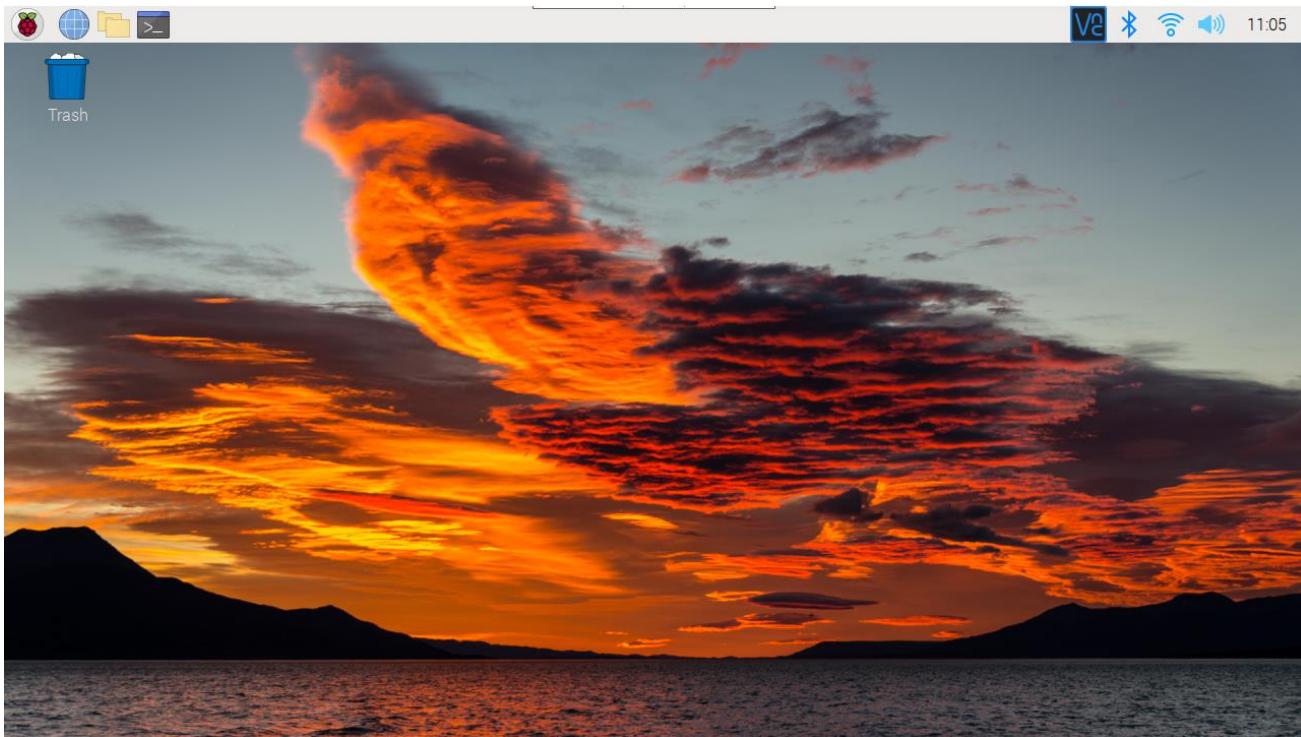


Enter IP address of your Raspberry Pi and fill in a Name. And click OK.

Then on the VNC Viewer panel, double-click new connection you just created, and the following dialog box pops up.



Enter username: **pi** and Password: **raspberry**. And click OK.



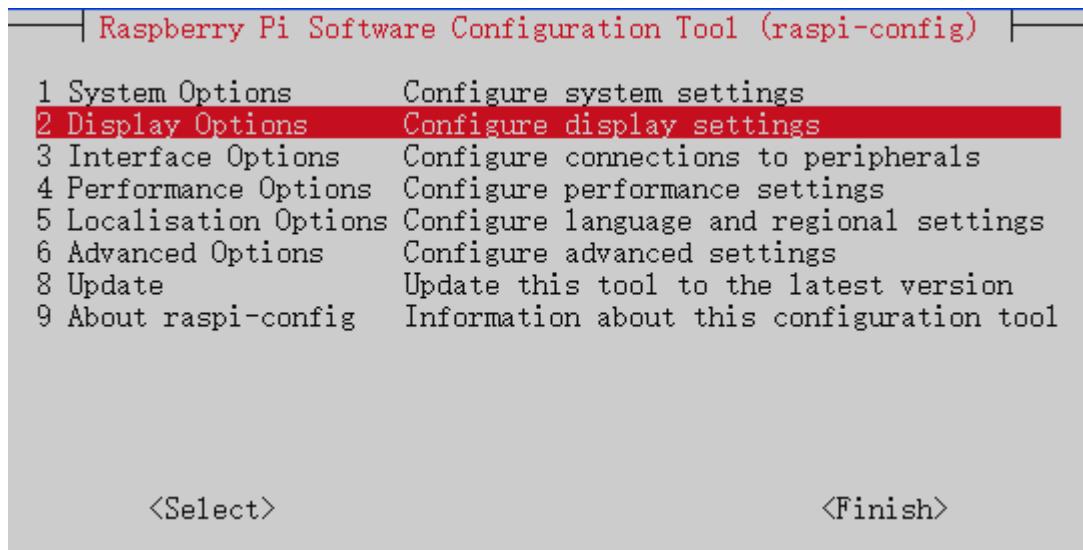
Here, you have logged in to Raspberry Pi successfully by using VNC Viewer

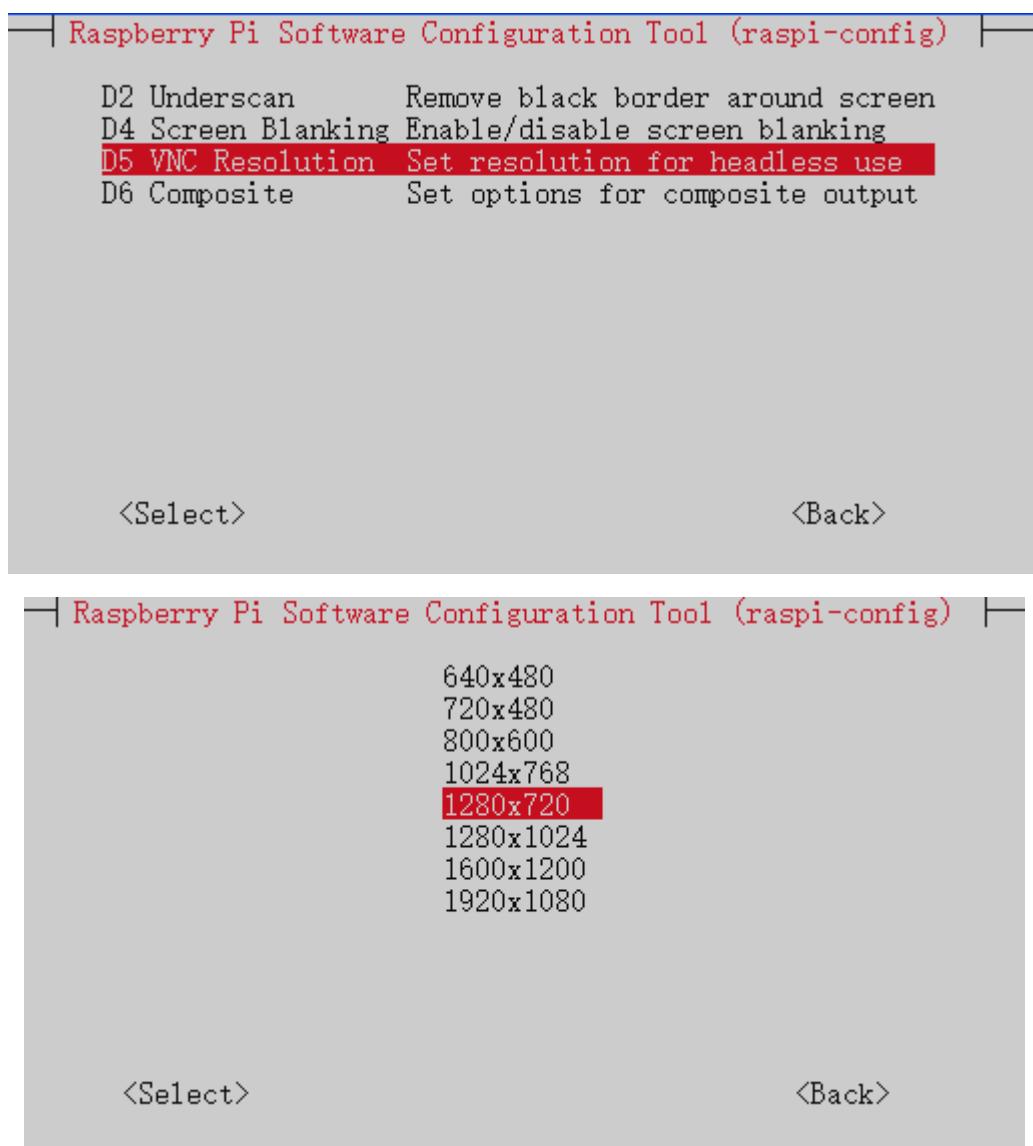
If the resolution ratio is not great or there is just a **little window**, you can set a proper resolution ratio via steps below.

```
sudo raspi-config
```

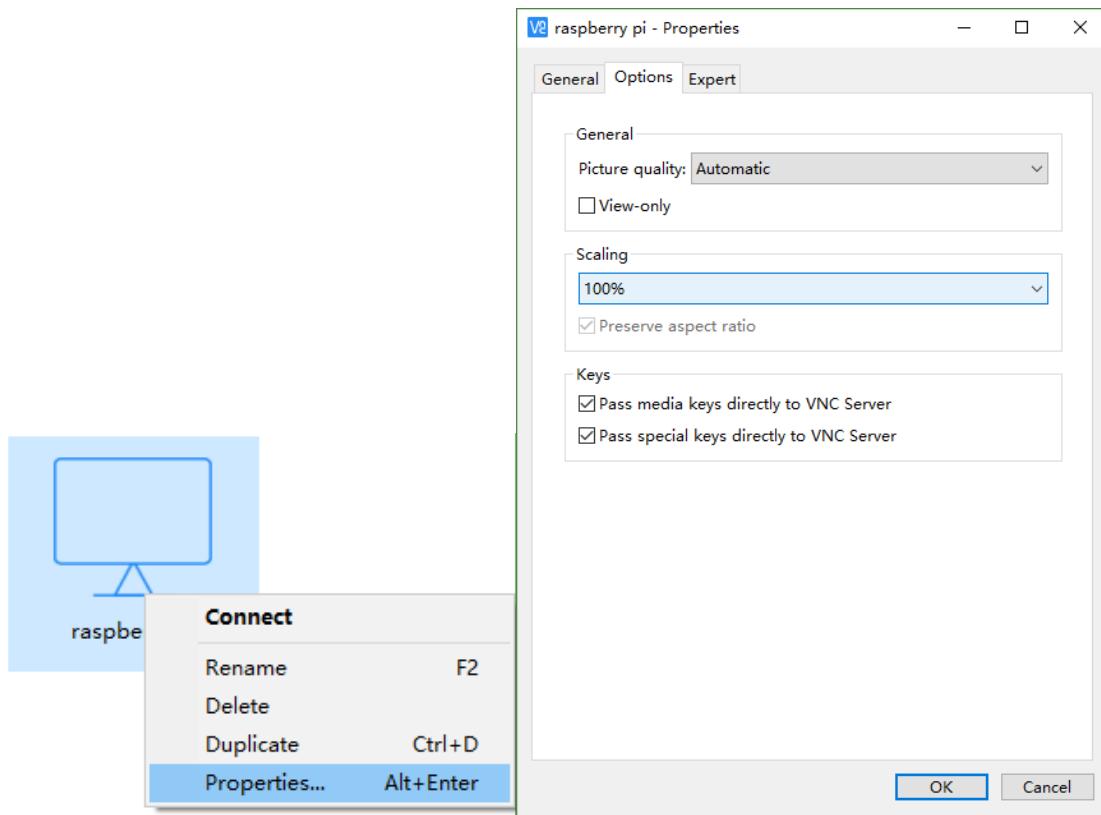
Select **Display Options**→**VNV Resolution**→**Proper resolution ratio (set by yourself)**→**OK**→**Finish**→**Yes**.

And then reboot Raspberry Pi.





In addition, your VNC Viewer window may zoom your Raspberry Pi desktop. You can change it. On your VNC View control panel, click right key. And select Properties->Options label->Scaling. Then set proper scaling.



Here, you have logged in to Raspberry Pi successfully by using VNC Viewer and operated proper setting.

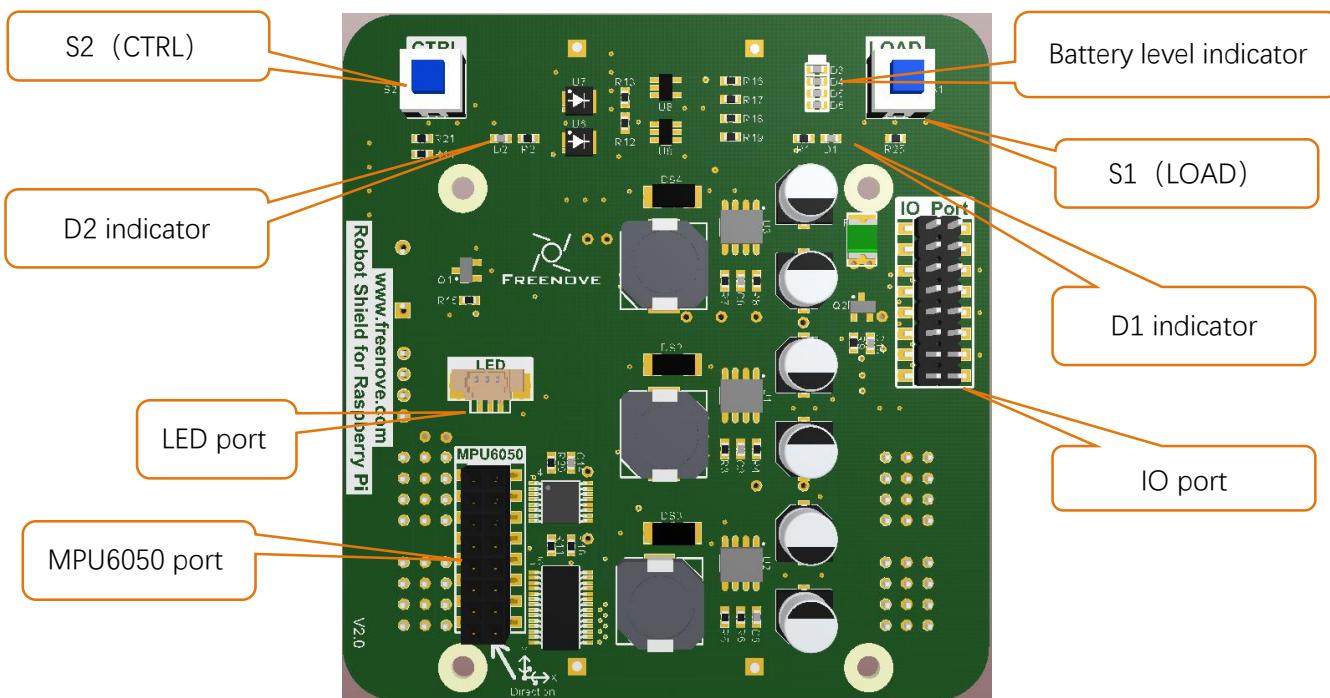
Raspberry Pi 4B/3B+/3B integrates a Wi-Fi adaptor. If you did not connect Pi to WiFi. You can connect it to wirelessly control the robot.

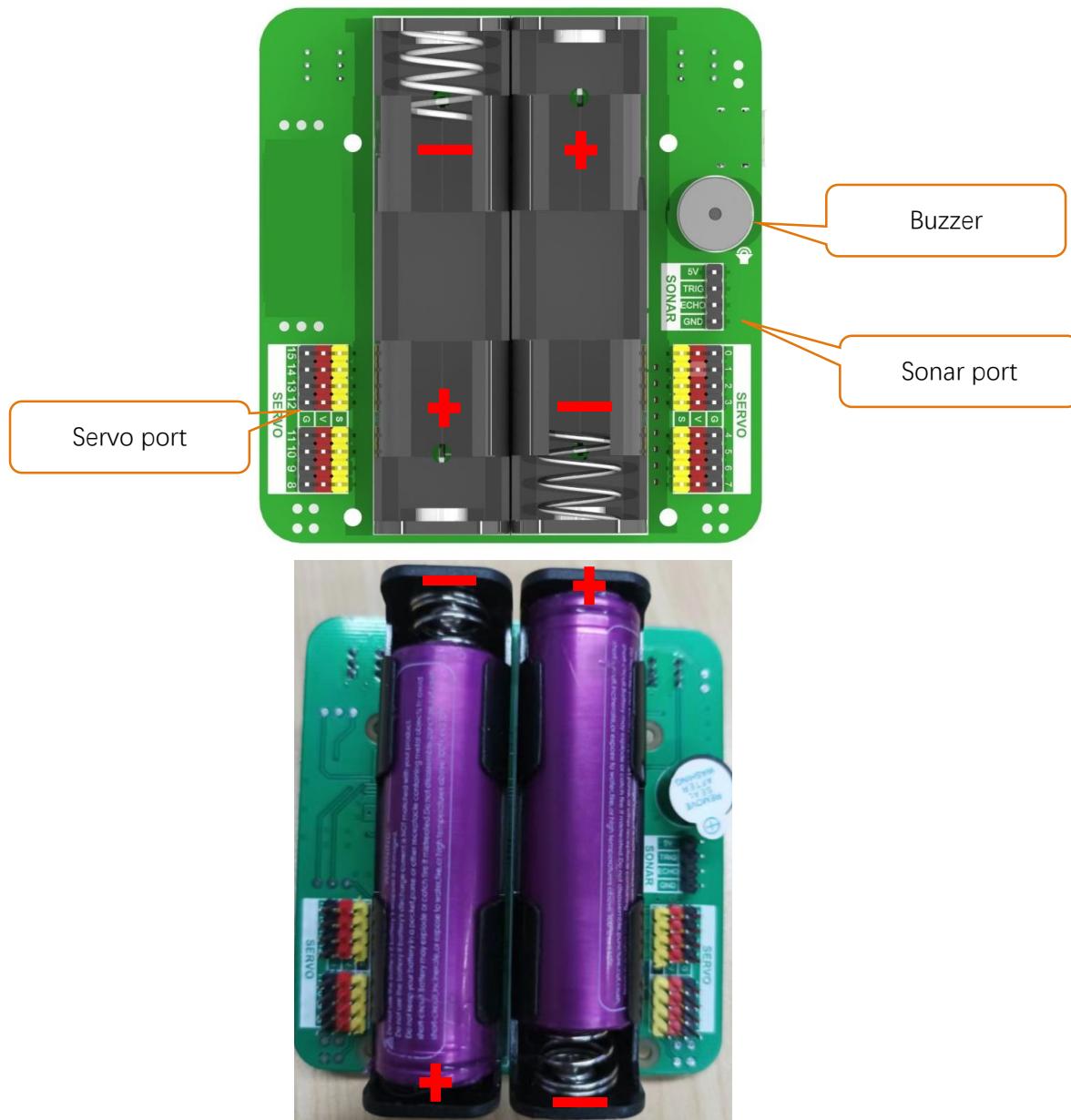


Robot Shield for Raspberry Pi

Shield Introduction

The shield is connected to the Raspberry Pi through the IO Port on the board. The positioning holes on the board are suitable for the Raspberry Pi. The features and functions are as follows.





- **Robot Shield board:** It requires two 18650 3.7v batteries.
- **S1(LOAD) Switch:** It mainly controls the power supply of servos, buzzer, ultrasonic module and LED module. The D1 indicator will light up when S1 is pressed.
- **S2(CTRL) Switch:** It mainly controls the power of chips such as PCF9685, ADS7830 and Raspberry Pi. The D2 indicator will light up when S2 is pressed.
- **LED port:** It is used to connect LED module which is controlled by Raspberry Pi.
- **MPU6050 port:** It is used to connect MPU6050 which is controlled by Raspberry Pi.
- **Battery level indicator:** It consists of four LEDs. When the battery power decreases gradually, the LEDs will get dimmer gradually until it's turned off.
- **IO port:** It is used to connect shield with Raspberry Pi conveniently.
- **Servo port:** There are 16 servo ports with control accuracy of 0.09 degrees.
- **Sonic module port:** The interface of HC-SR04 Ultrasound Module is provided.
- **Buzzer:** It is directly controlled by raspberry pi, which is turned on at high level and off at low level.

Chapter 1 Install Python Libraries (Required)

If you have any concerns, please feel free to contact us at support@freenove.com

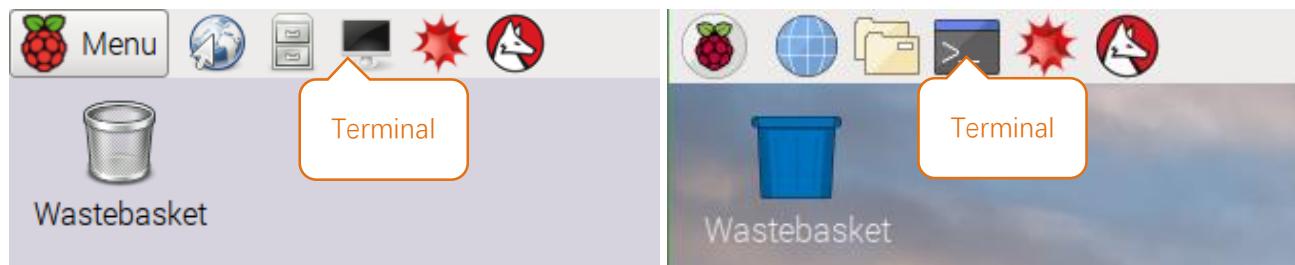
In this chapter, we will do some necessary foundational preparation work: Start your Raspberry Pi and install some necessary libraries. And in next chapter, we will assemble the robot dog.

Note:

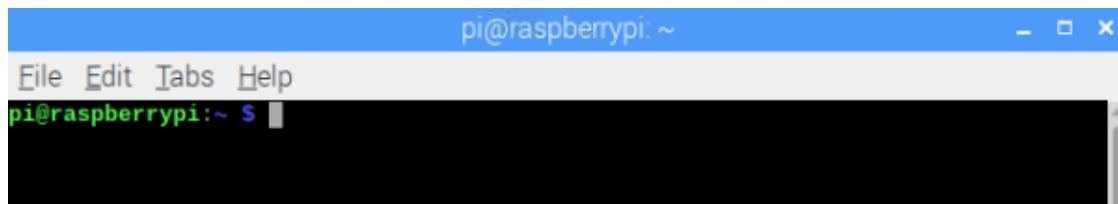
- 1, Please use Raspberry Pi OS with Desktop
- 2, The installation of libraries takes much time. You can power Raspberry Pi with a power supply Cable.
- 3, If you are using remote desktop to login Raspberry Pi, you need to use [VNC viewer](#).

Step 1 Obtain the Code and Set python3 as default

Start the Raspberry Pi and open the terminal. You can click the terminal as shown below, or press "CTRL+ALT+T" on the desktop.



The terminal is shown below:



You can view YouTube video as a reference.

<https://www.youtube.com/watch?v=Lq-OERj2WZM>

Type following command to get robot dog code and place it in user directory "Pi".

Please execute commands below one by one in turn.

```
cd ~  
git clone https://github.com/Freenove/Freenove_Robot_Dog_Kit_for_Raspberry_Pi
```

```
pi@raspberrypi: ~ $ cd ~  
pi@raspberrypi: ~ $ git clone https://github.com/Freenove/Freenove_Robot_Dog_Kit_for_Raspberry_Pi
```

Downloading takes much time. Please wait with patience.

You can also find and download the code by visiting our official website (<http://www.freenove.com>) or our GitHub repository (<https://github.com/freenove>).

Please note that all codes for this robot dog is written with **Python3**. If executed under python 2, there will be error messages.

Need support? ✉ support@freenove.com

Set Python3 as default python

First, execute python to check the default python on your raspberry Pi. Press Ctrl-Z to exit.

```
pi@raspberrypi:~ $ python --version
```

If it is python3, you can skip this section.

If it is python2, you need to execute the following commands to set default python to python3.

1. Enter directory /usr/bin

```
cd /usr/bin
```

2. Delete the old python link.

```
sudo rm python
```

3. Create new python links to python.

```
sudo ln -s python3 python
```

4. Check python. Press Ctrl-Z to exit.

```
python --version
```

```
pi@raspberrypi:~ $ cd /usr/bin
```

```
pi@raspberrypi:/usr/bin $ sudo rm python
```

```
pi@raspberrypi:/usr/bin $ sudo ln -s python3 python
```

If you want to set python2 as default python in **other projects**, just repeat the above command and change python3 to python2.

```
pi@raspberrypi:~ $ cd /usr/bin
```

```
pi@raspberrypi:/usr/bin $ sudo rm python
```

```
pi@raspberrypi:/usr/bin $ sudo ln -s python2 python
```

Shortcut Key

Now, we will introduce several shortcuts that are very **useful** and **commonly used** in terminal.

1. **up and down arrow keys**. History commands can be quickly brought back by using up and down arrow keys, which are very useful when you need to reuse certain commands.

When you need to type command, pressing “↑” (the Up key) will go backwards through the command history and pressing “↓” (the Down Key) will go forwards through the command history.

2. **Tab key**. The Tab key can automatically complete the command/path you want to type. When there are multiple commands/paths conforming to the already typed letters, pressing Tab key once won't have any result. And pressing Tab key again will list all the eligible options. However, when there is only one eligible option, the command/path will be completely typed as soon as you press the Tab key..

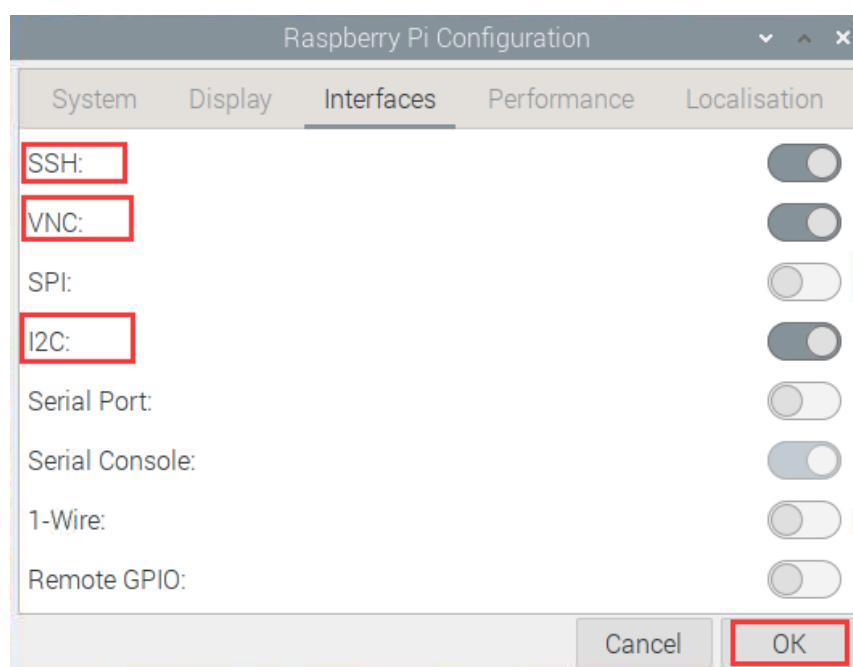
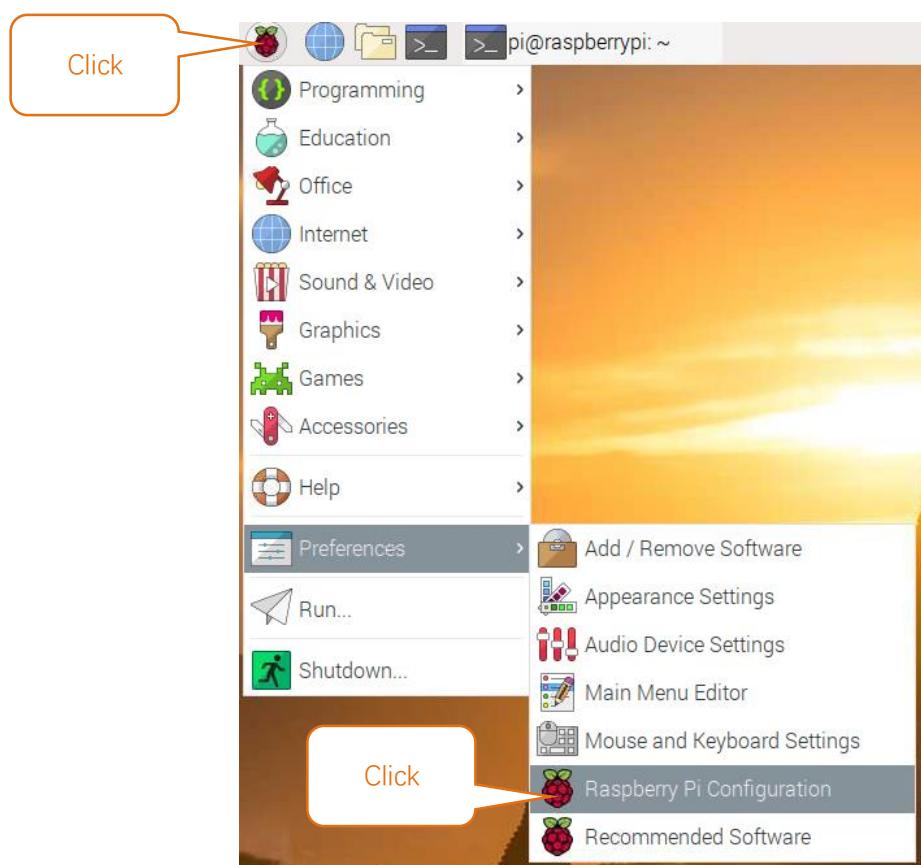
As shown below, under the ‘~’directory, enter the Documents directory with the “cd” command. After typing “cd D”, press Tab key, there is no response. Press Tab key again, all the files/folders that begin with “D” is listed. Continue to type the character “oc”, then press the Tab key, and then “Documents” is typed automatically.

```
pi@raspberrypi:~ $ cd D
Desktop/  Documents/ Downloads/
pi@raspberrypi:~ $ cd Doc
```

```
pi@raspberrypi:~ $ cd D
Desktop/  Documents/ Downloads/
pi@raspberrypi:~ $ cd Documents/
```

Step 2 Configuration

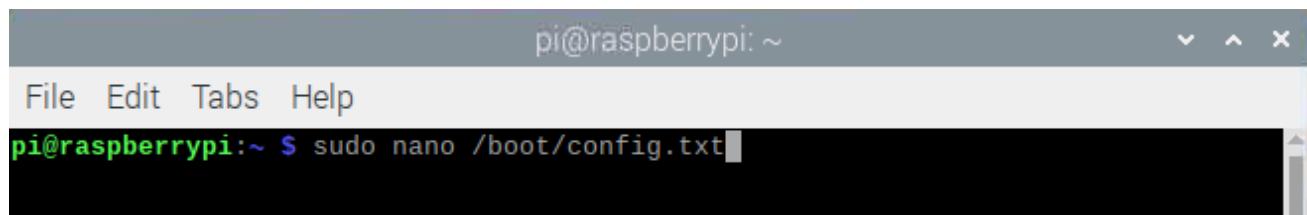
Enable i2c



Set I2C Baud Rate

Open the terminal and enter the following command.

```
sudo nano /boot/config.txt
```



The default I2C Baud Rate is 100000. Now we change it to 400000, because this can speed up the response speed of the servos to make robot dog walk faster. If the baud rate is 100,000, the robot walks slowly.

Scrolling the middle of the mouse to find **dtparam=i2c_arm=on**, and add "**i2c_arm_baudrate=400000**".

```
pi@raspberrypi: ~
File Edit Tabs Help
GNU nano 3.2          /boot/config.txt

# uncomment to force a HDMI mode rather than DVI. This can make audio work in
# DMT (computer monitor) modes
#hdmi_drive=2

# uncomment to increase signal to HDMI, if you have interference, blanking, or
# no display
#config_hdmi_boost=4

# uncomment for composite PAL
#sdtv_mode=2

#uncomment to overclock the arm. 700 MHz is the default.
#arm_freq=800

# Uncomment some or all of these to enable the optional hardware interfaces
dtparam=i2c_arm=on,i2c_arm_baudrate=400000
#dtparam=i2s=on
#dtparam=spi=on
[ Wrote 67 lines ]
^G Get Help ^O Write Out ^W Where Is ^K Cut Text ^J Justify ^C Cur Pos
^X Exit      ^R Read File ^\ Replace   ^U Uncut Text ^T To Spell ^_ Go To Line
```

A screenshot of the nano text editor showing the "/boot/config.txt" file. The file contains several commented-out lines related to HDMI and composite output. In the middle of the file, there is an uncommented line: "#dtparam=i2c_arm=on,i2c_arm_baudrate=400000". A red arrow points from the text above this line to this specific configuration line, highlighting it with a red box. At the bottom of the editor window, there is a status bar with the message "[Wrote 67 lines]" and a menu bar with various keyboard shortcut keys.

Press "CTRL"+"O" and then "Enter" to save the modified content. Then press "CTRL"+"X" to exit editing.

After the modification is completed, reboot Raspberry Pi to make the change work. You can also reboot the Raspberry Pi after completing the step 3 below.

Additional supplement

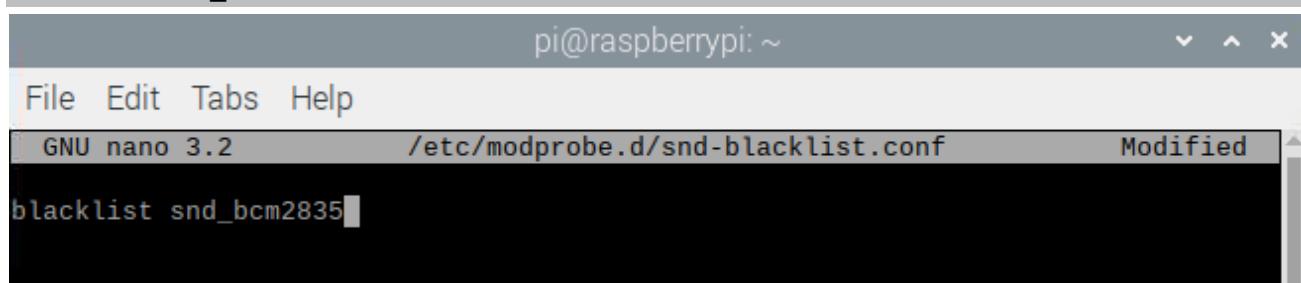
Raspberry Pi, other than 4B and 400, needs to disable the audio module, otherwise the LED will not work properly.

1. Create a new snd-blacklist.conf and open it for editing

```
sudo nano /etc/modprobe.d/snd-blacklist.conf
```

Add following content: After adding the contents, you need to press Ctrl+O, Enter, Ctrl+Z.

```
blacklist snd_bcm2835
```



```
pi@raspberrypi: ~
File Edit Tabs Help
GNU nano 3.2          /etc/modprobe.d/snd-blacklist.conf      Modified
blacklist snd_bcm2835
```

2. We also need to edit config file.

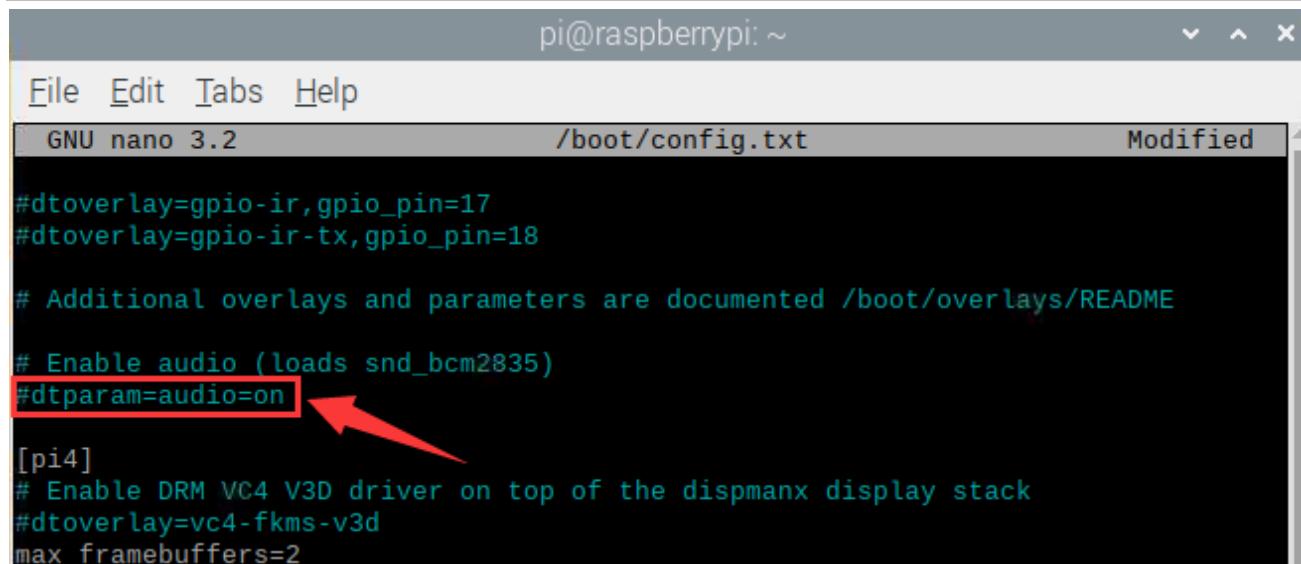
```
sudo nano /boot/config.txt
```

Find the contents of the following two lines (with Ctrl + W you can search):

```
# Enable audio (loads snd_bcm2835)
dtparam=audio=on
```

Add # to comment out the second line. Press Ctrl+O, Enter, Ctrl+Z.

```
# Enable audio (loads snd_bcm2835)
# dtparam=audio=on
```



```
pi@raspberrypi: ~
File Edit Tabs Help
GNU nano 3.2          /boot/config.txt      Modified
#dtoverlay= gpio-ir, gpio_pin=17
#dtoverlay= gpio-ir-tx, gpio_pin=18

# Additional overlays and parameters are documented /boot/overlays/README

# Enable audio (loads snd_bcm2835)
#dtparam=audio=on
[pi4]
# Enable DRM VC4 V3D driver on top of the dispmanx display stack
#dtoverlay=vc4-fkms-v3d
max_framebuffers=2
```

It will take effect after restarting, and you can restart after executing the next section.

If you want to restart the audio module, just restore the content modified in the above two steps.

Step 3 Run the Installation Program

1. Execute following commands to enter directory of "setup.py".

```
cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code
```

2. Run setup.py

```
sudo python setup.py
```

This program will automatically install the pca9685, rpi_ws281x, PyQt5 library, etc. Please **reboot** the Raspberry Pi after the installation is completed, as shown below.

```
Now the installation is successful.
```

```
Please restart raspberry pi
```

If the installation fails, please rerun setup.py. After the installation is completed, restart the Raspberry Pi. Most installation failures are caused by network reasons.

```
sudo python setup.py
```

Chapter 2 Assemble Robot

If you have any concerns, please feel free to contact us at support@freenove.com

It is recommended to assemble and use the robot dog according to the tutorial. Otherwise, there may be installation errors, device damage, etc.

Don't reverse batteries. Or the board will be damaged.



Step 1 Install Disk Servo Arms

Take out 12 disk servo arms from the servo packages.



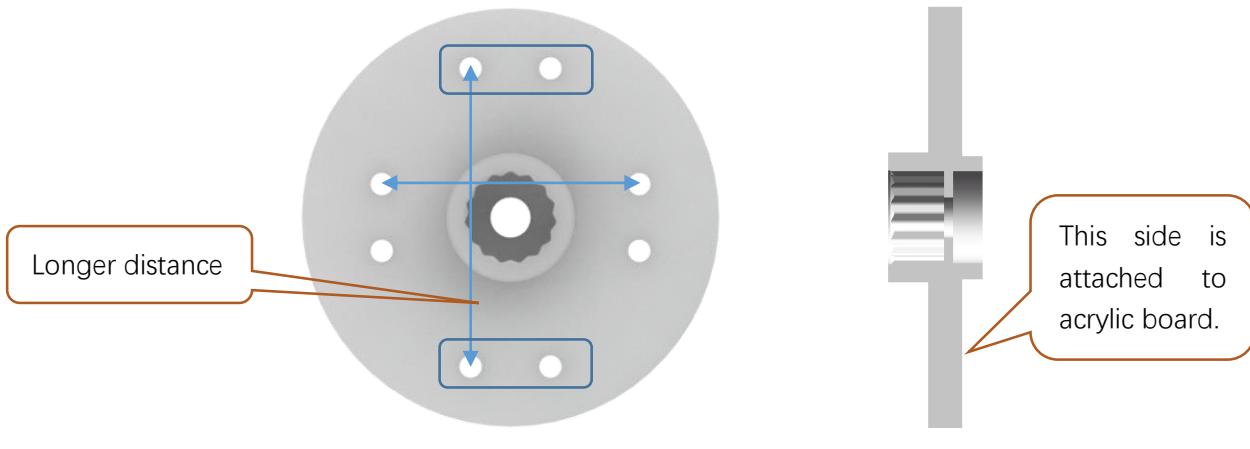
There are 4 pairs of opposite holes on the disk servo arm, and the distance between each pair is different.

Need support? ✉ support@freenove.com

Please use the 2 pairs of holes with **longer distance**.



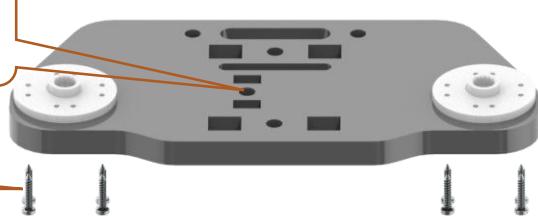
M1.2*7 screws are contained in following plastic bag. **If a package of M1.2*7 self-tapping screws cannot be found, it may be packed in the servo package.**



Get following 4 parts.



This side should be on the left. Don't reverse it.



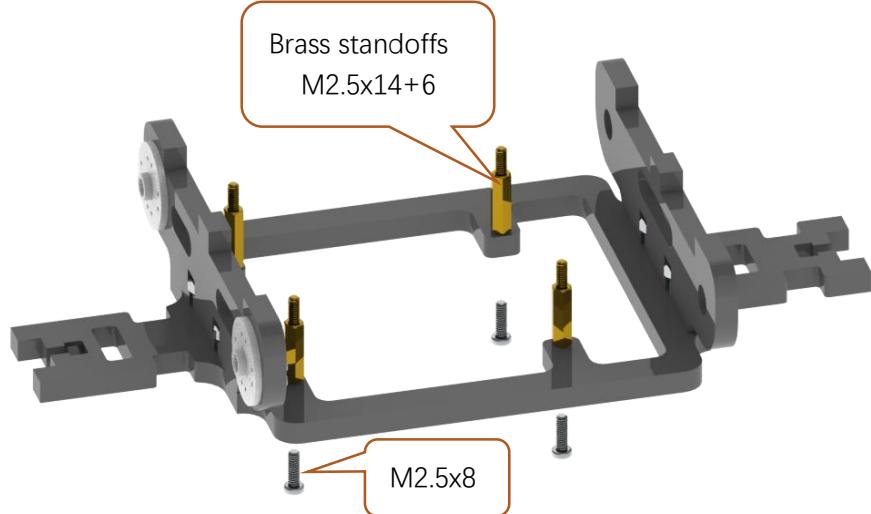
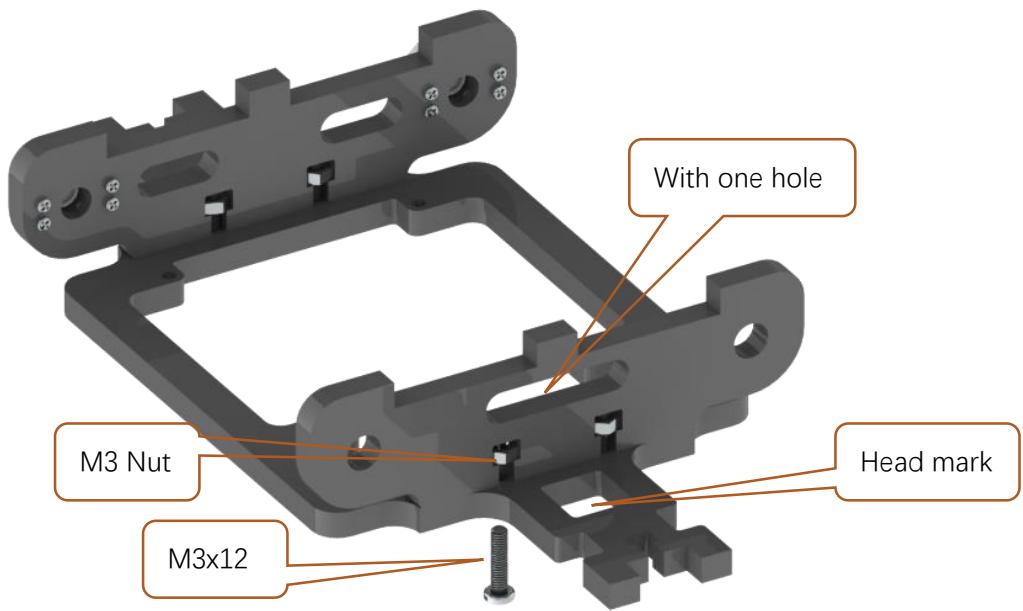
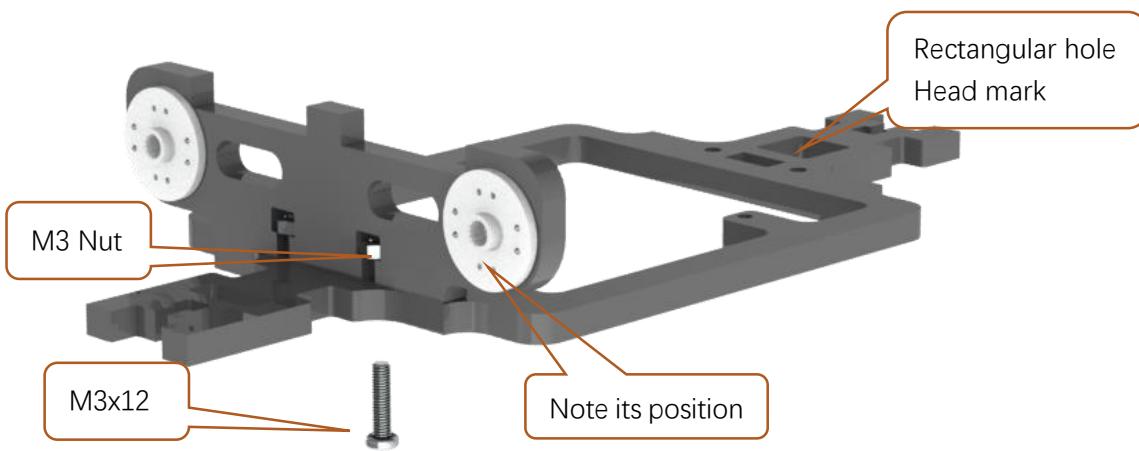
M1.2x7

M1.2x7

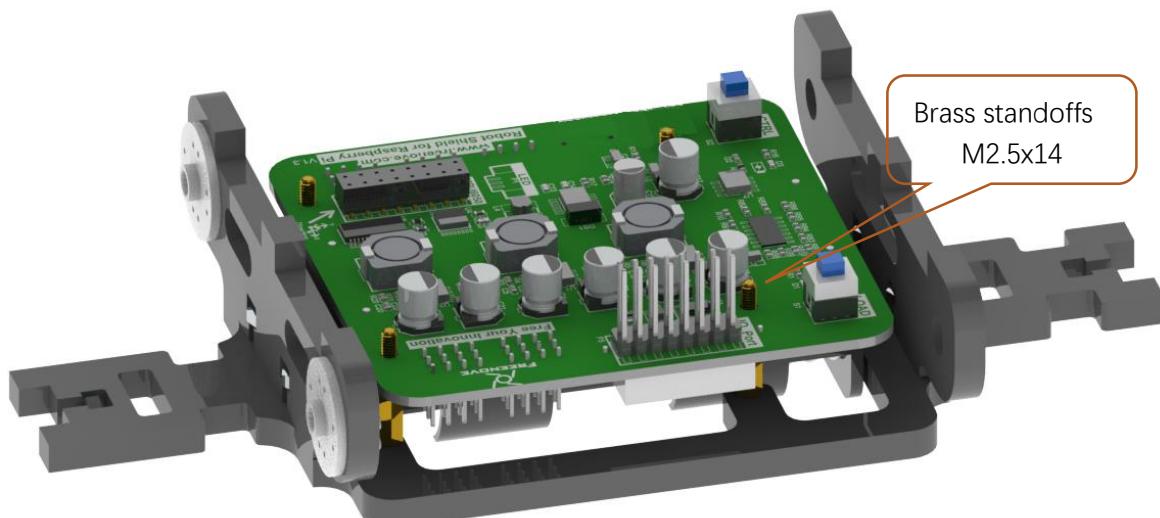
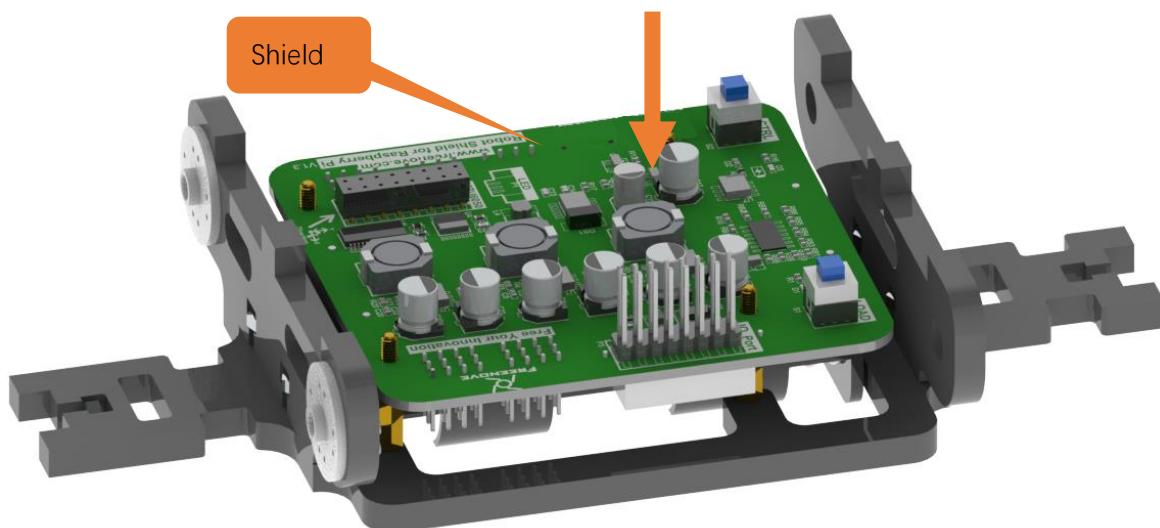
With two holes



Step 2 Install Body Bracket

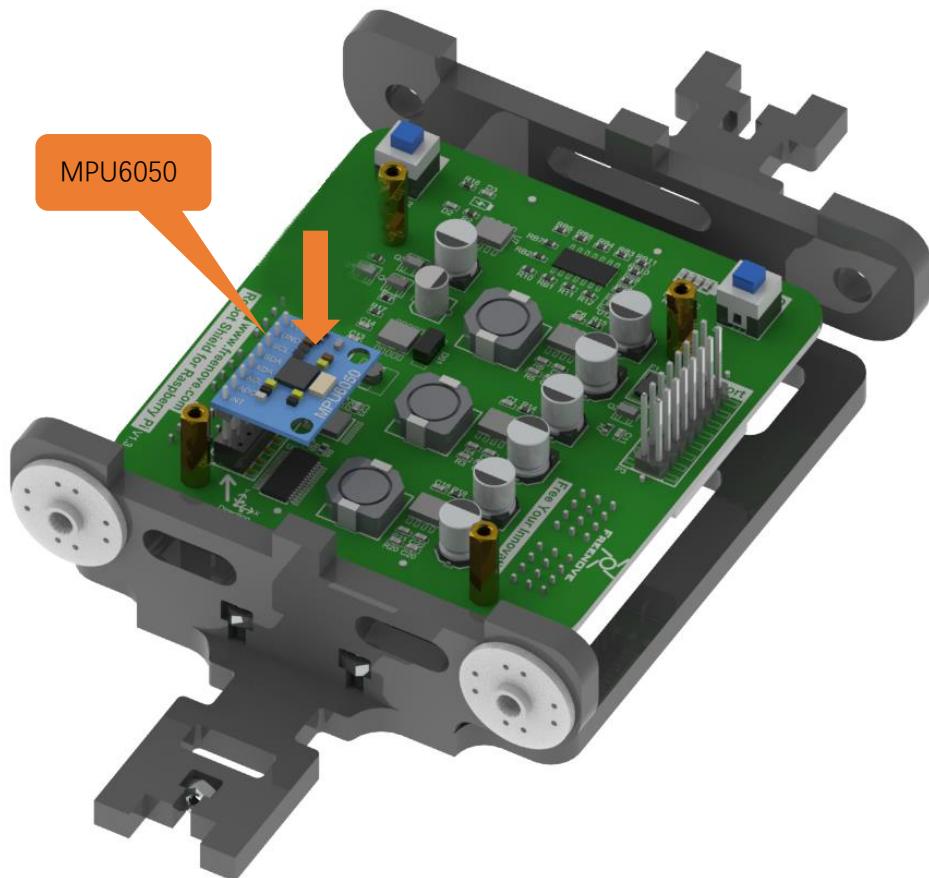


Step 3 Install Shield

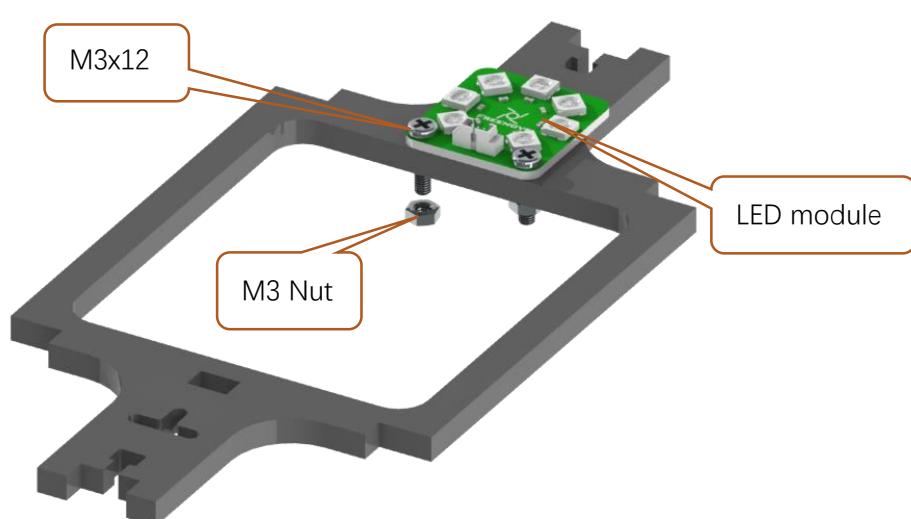


Step 4 Install MPU6050

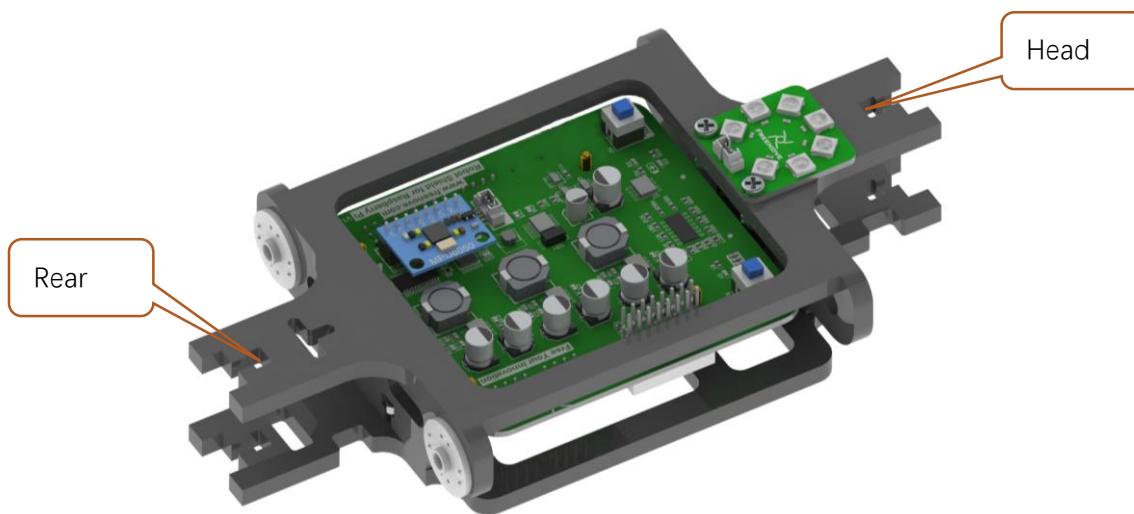
Note: There are two rows of headers. Plug the MPU6050 into the outer Row.



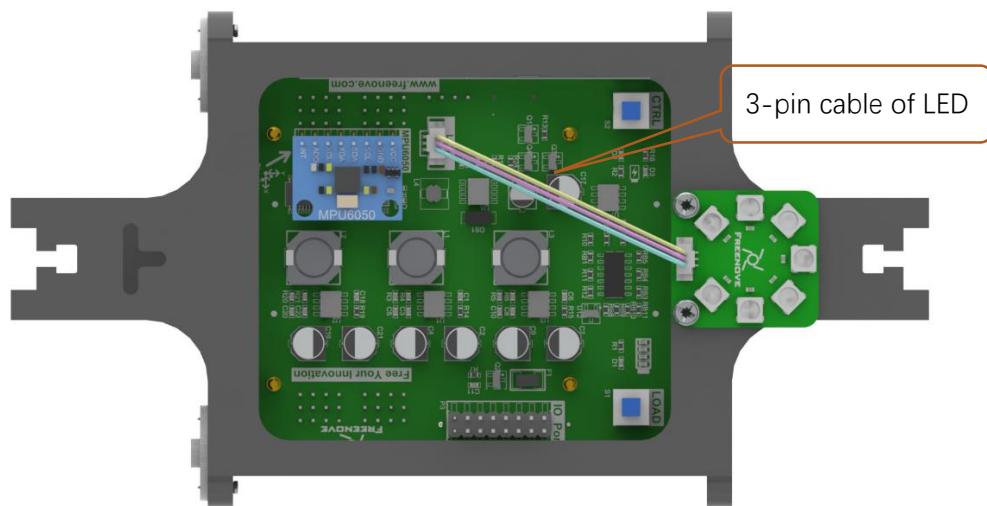
Step 5 Install LED module



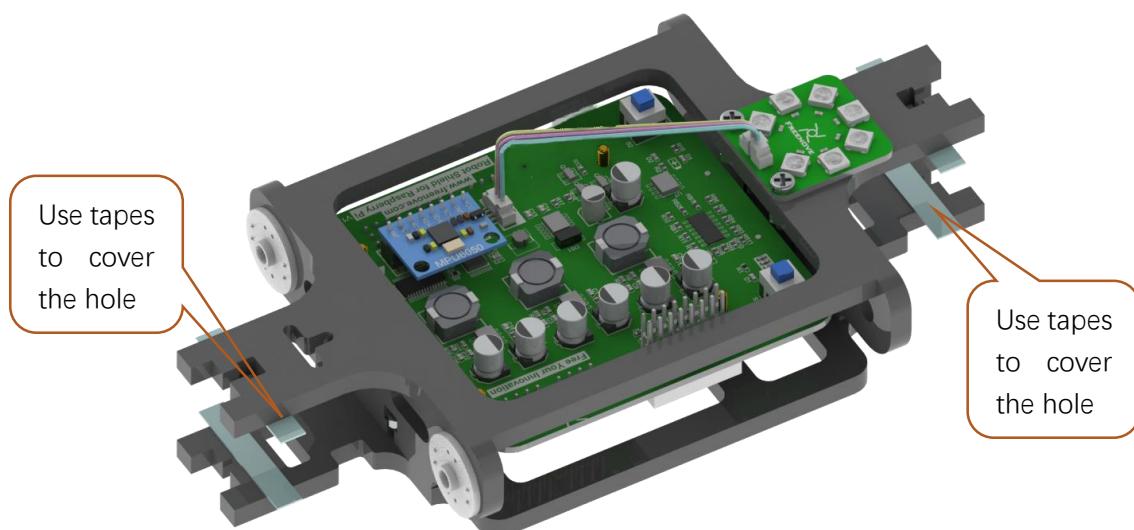
Install the top bracket.



Connect shield with LED module.

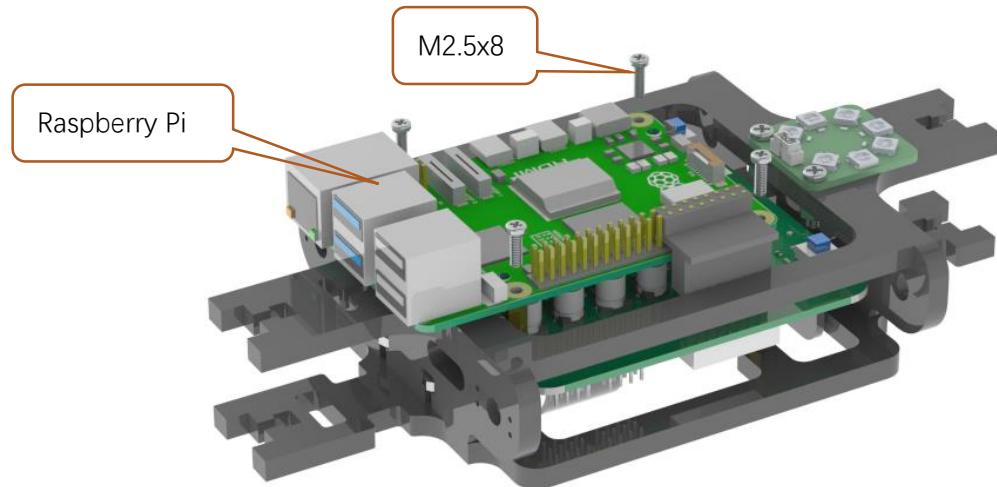


This step will be very helpful for later assembly.



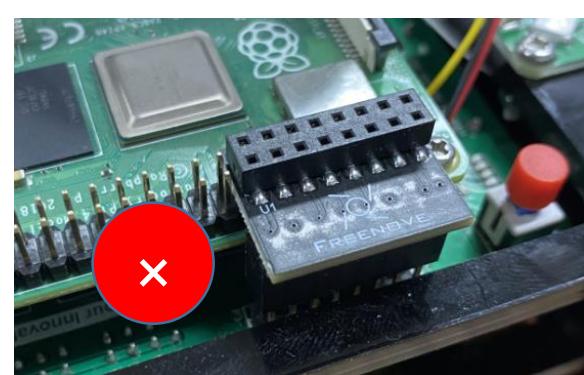
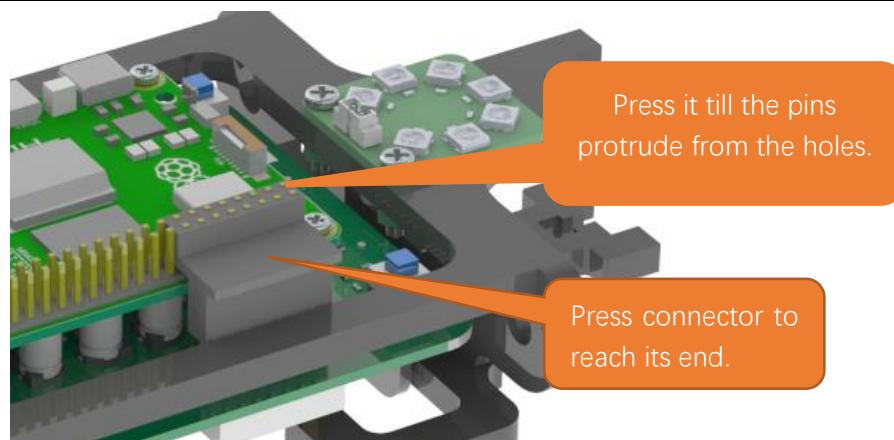
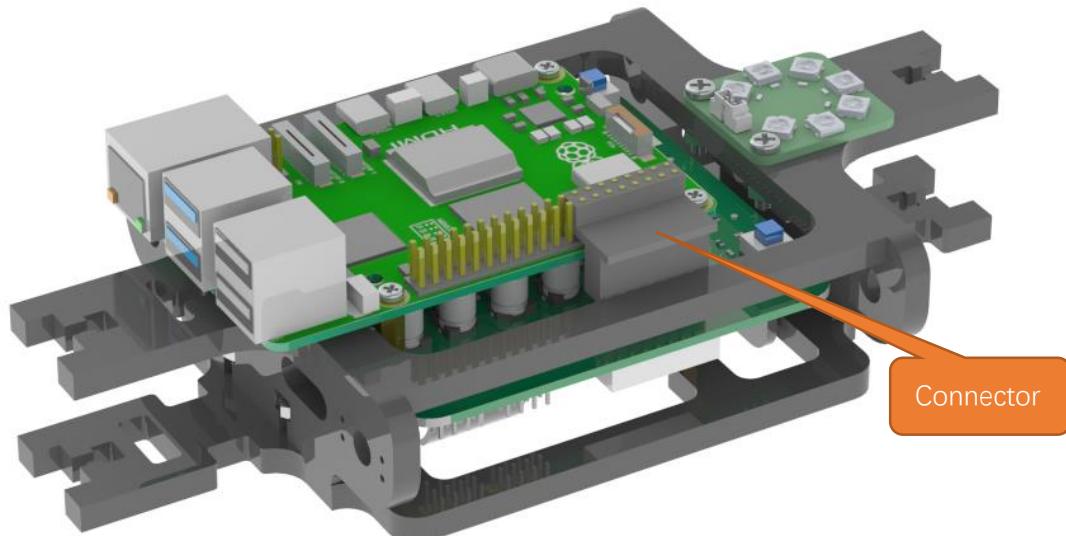
Step 6 Install Raspberry Pi

Attach the Raspberry Pi to the robot dog with four M2.5x8 screws.

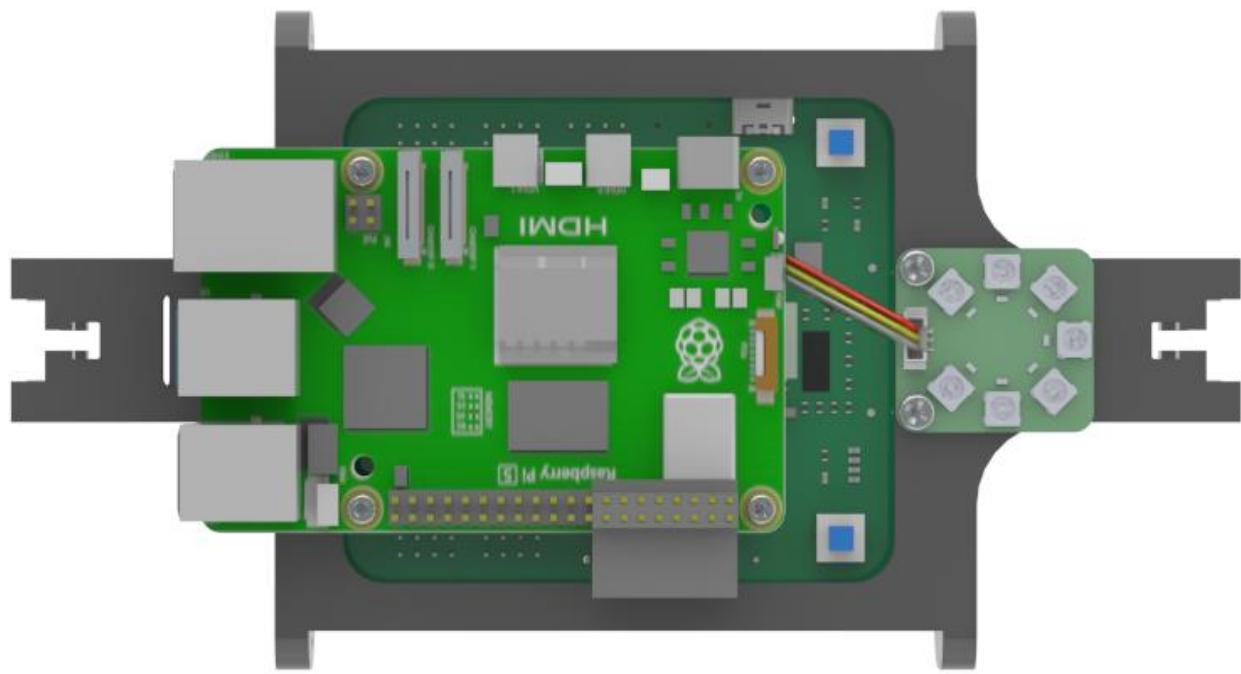


Step 7 Install Connector

Install connector to connect Raspberry Pi and shield.

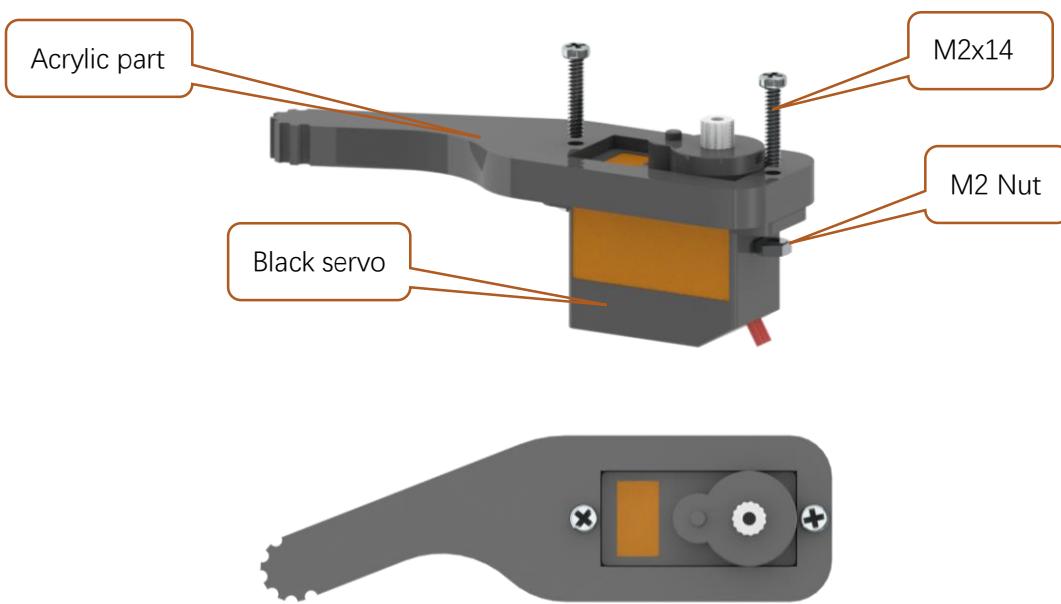


If you have any concerns, please feel free to contact us via support@freenove.com
We will offer you satisfying solution.

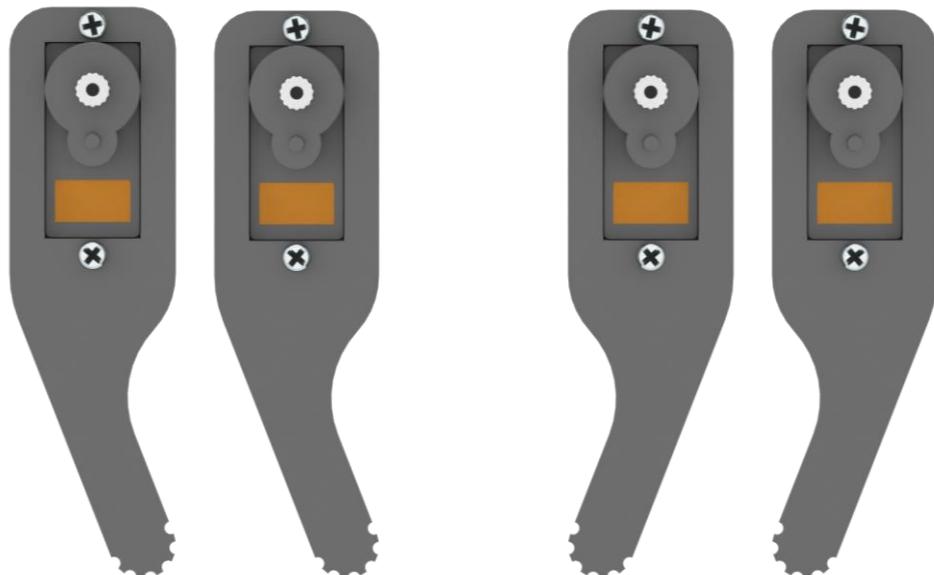


Now we have assembled the main body part. We will assemble leg parts later.

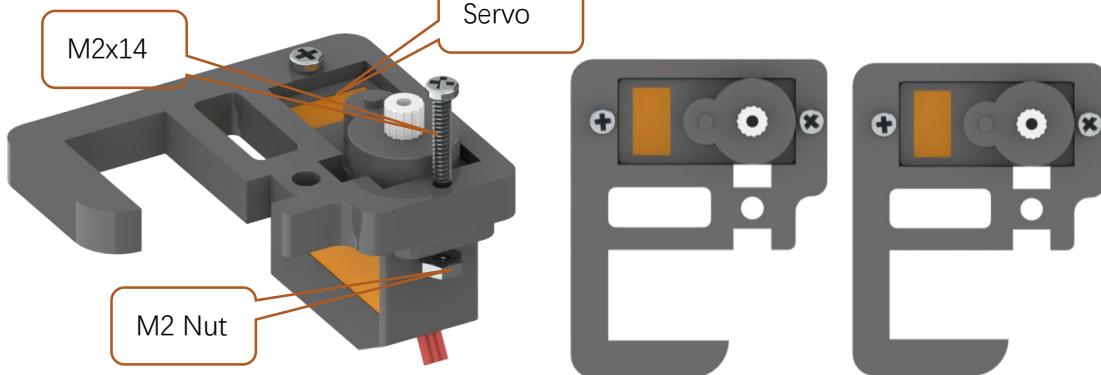
Step 8 Install Servo to Acrylic Board



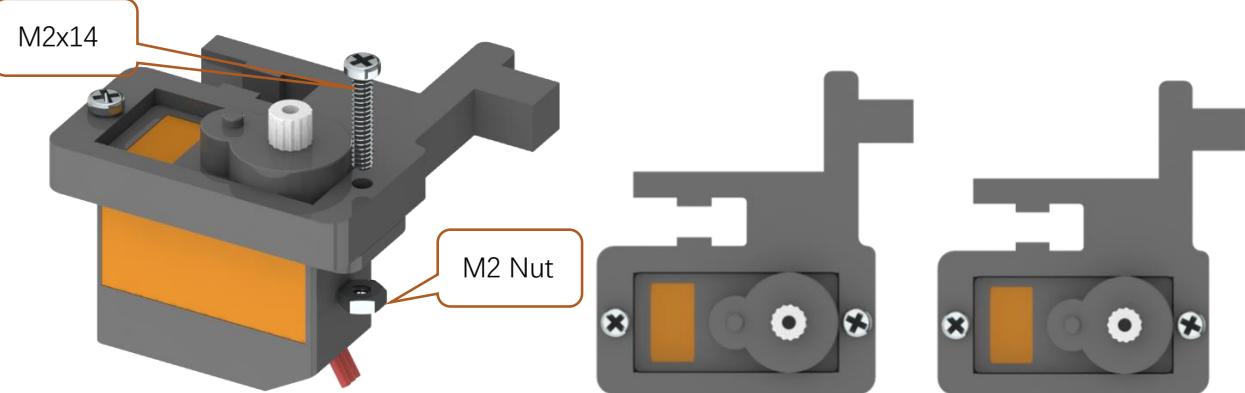
Note: There are four parts. They are different .



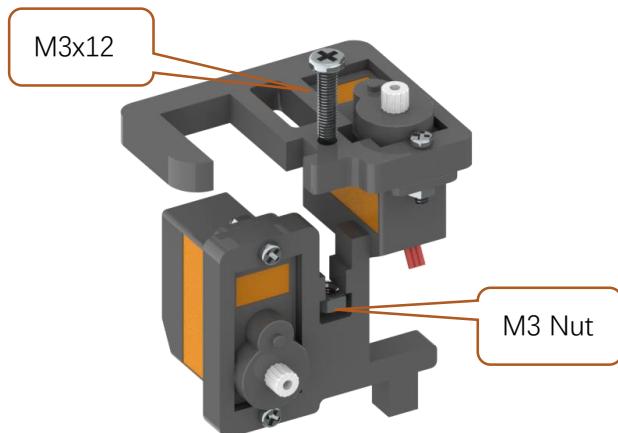
Assemble two sets.



Assemble two sets.



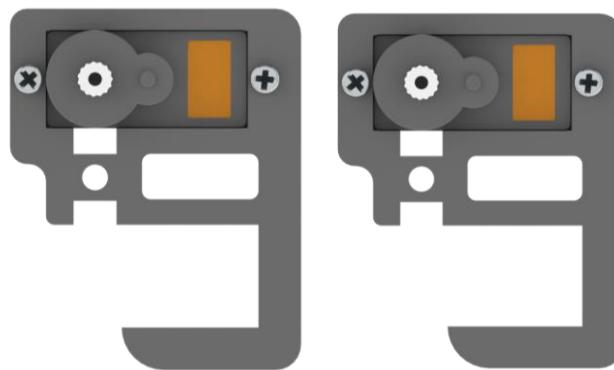
Assemble parts to the top.



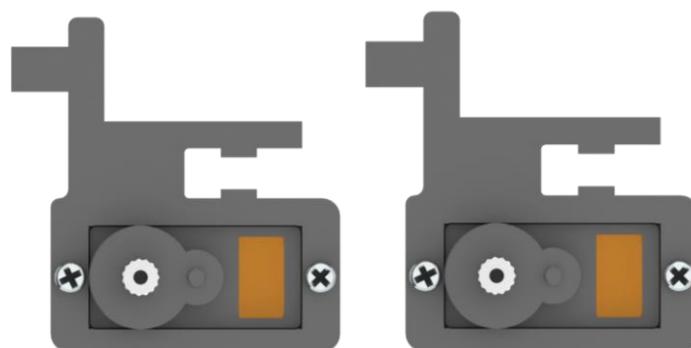
Now you get two sets of joint parts.



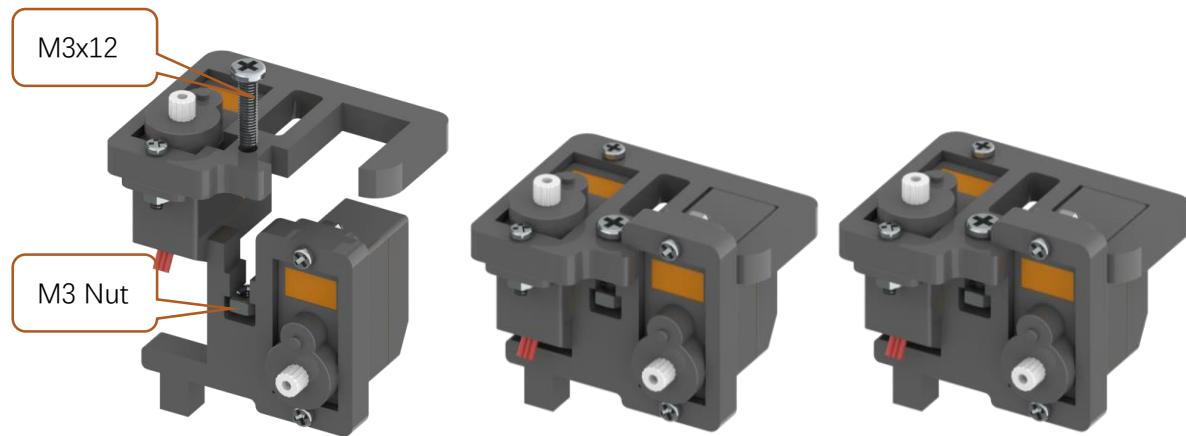
Assemble another two parts. **Note: they are different from parts above.**



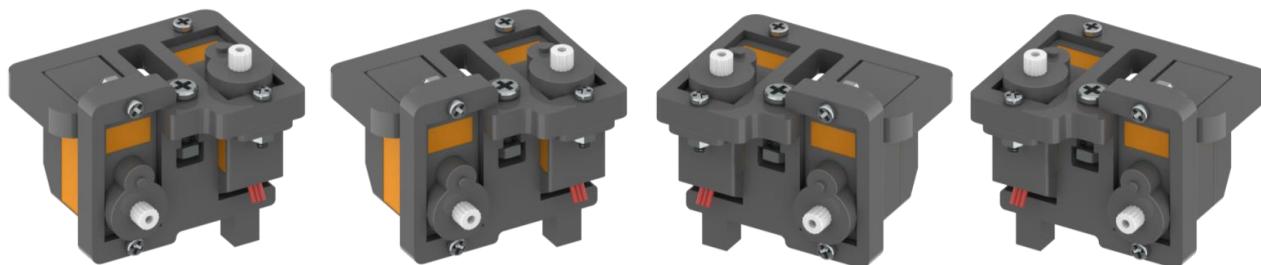
Assemble another two parts. **Note: they are different from parts above.**



Assemble them.

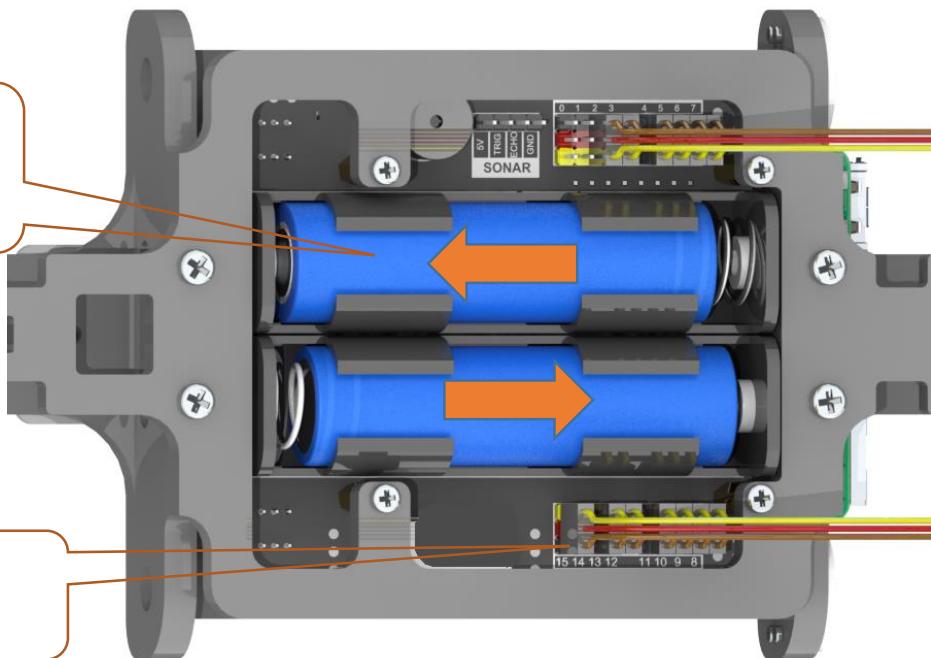


Now you will get four parts as below. **Note, they are different.**

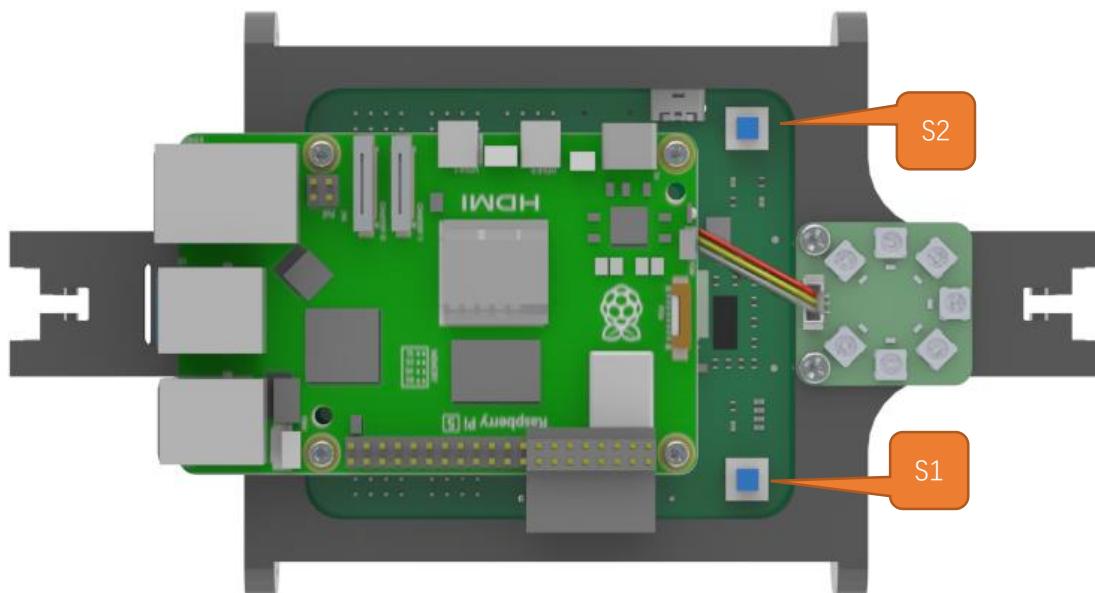


Step 9 Run Servo Program (Necessary)

Connect **All** 12 **black** servos and 1 **blue** servo to servo port **Randomly**. And install **batteries**. Push batteries to “+” ends.



You can still use cable to power Raspberry Pi with switches ON. If you disconnect cable, the batteries will power Raspberry Pi. Press **S1** and **S2** and there will be two indicators ON.



Turn on the Raspberry Pi. Make sure all three steps in **Chapter 1** have been performed correctly. If you haven't done that, please perform the steps in **Chapter 1 first**.

- Type the following command to enter servo code folder "Server".

```
cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
```

- Run Servo.py

```
sudo python Servo.py
```

After running the program, all servos will keep at 90°.

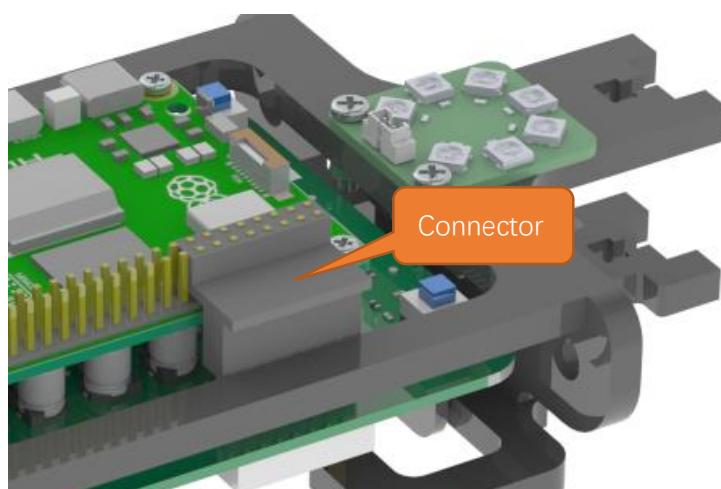
Next we will connect the servos to disk arm.

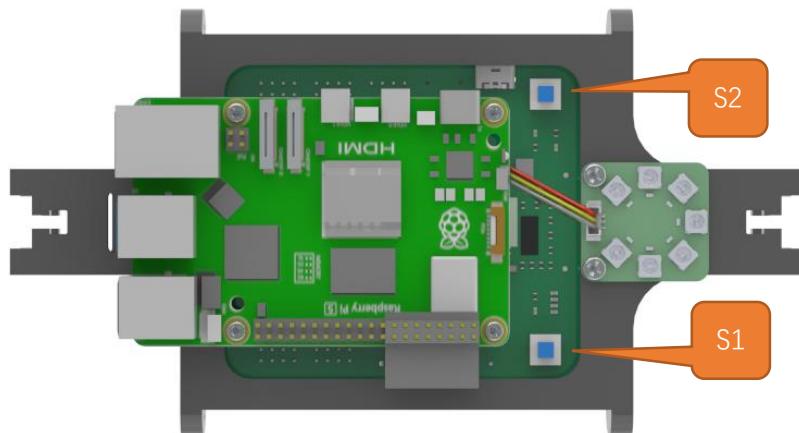
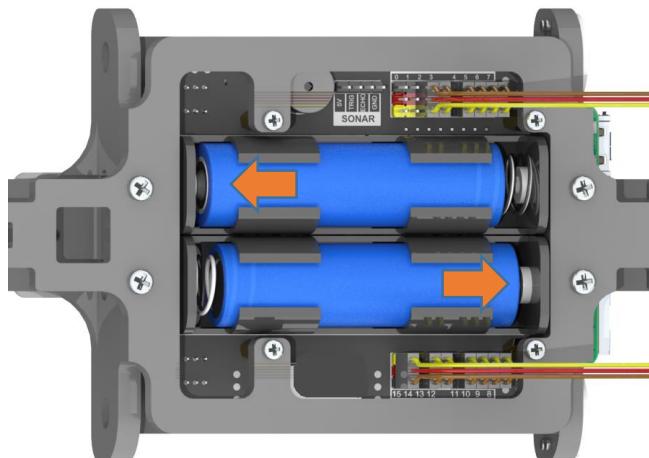
Keep the **power on** and all servos connected **during the assembly**. Don't disconnect **servos**.

<https://www.youtube.com/watch?v=7GkMYdVrong>

When running the code, if it reports "Remote I/O error", please check the following three aspects:

- Whether the connector is connected well

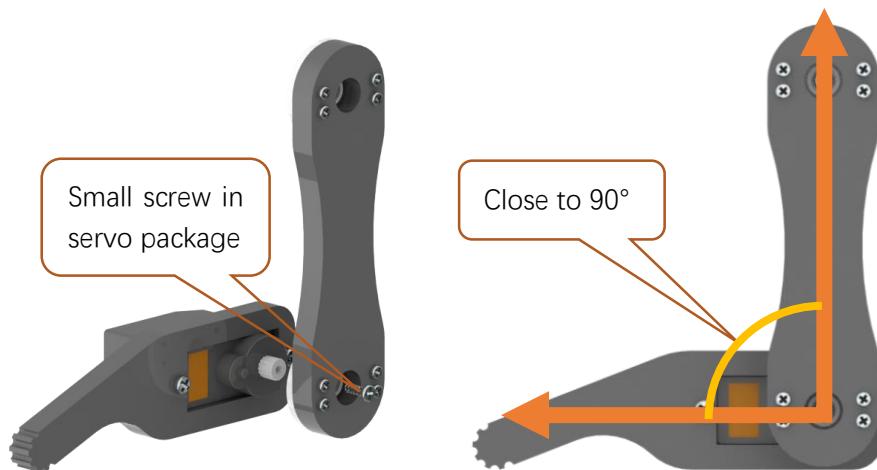


2. Whether both S1 and S2 are turned ON**3. Whether the batteries are contacted well with the battery holder**

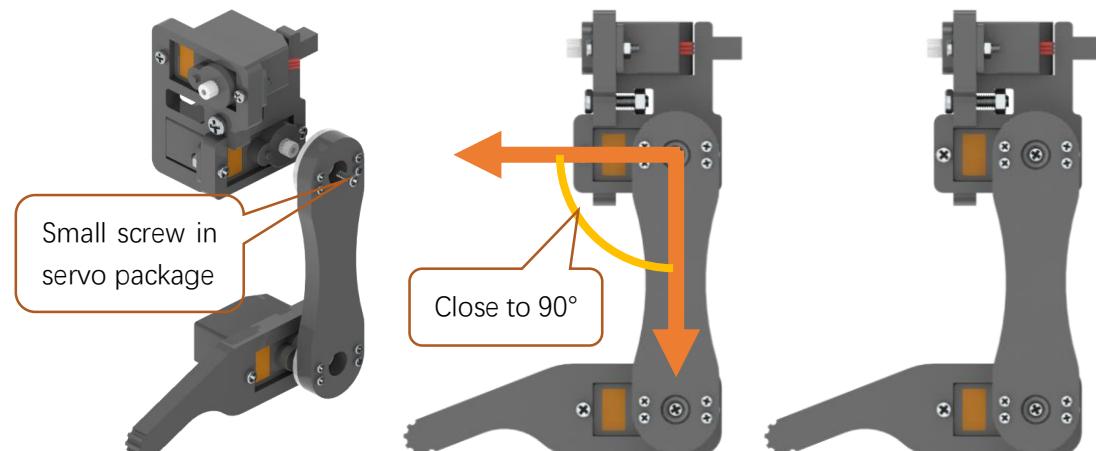
Step 10 Assemble Legs to Body

Keep the power ON and all servos connected to shield. Do NOT disconnect wiring. We need to keep the servo at 90° when connected to them to servo arms. (servo wires are not shown in the following content.)

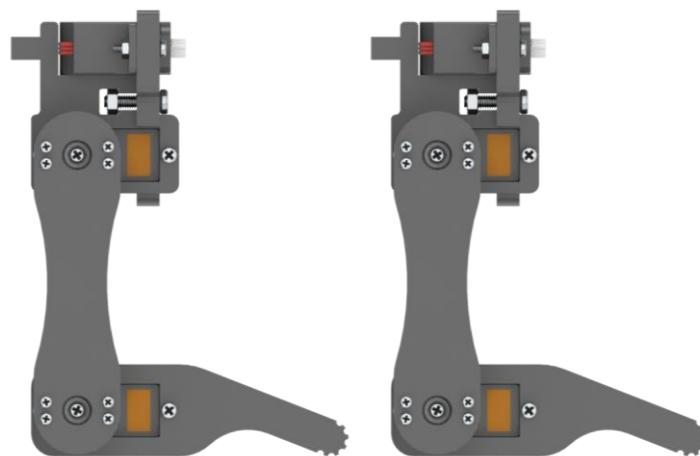
Try to install them close to 90°. The angles are acceptable within 65~115.



Assemble legs of one side. Try to install them at 90°. The angles are acceptable within 65~115.

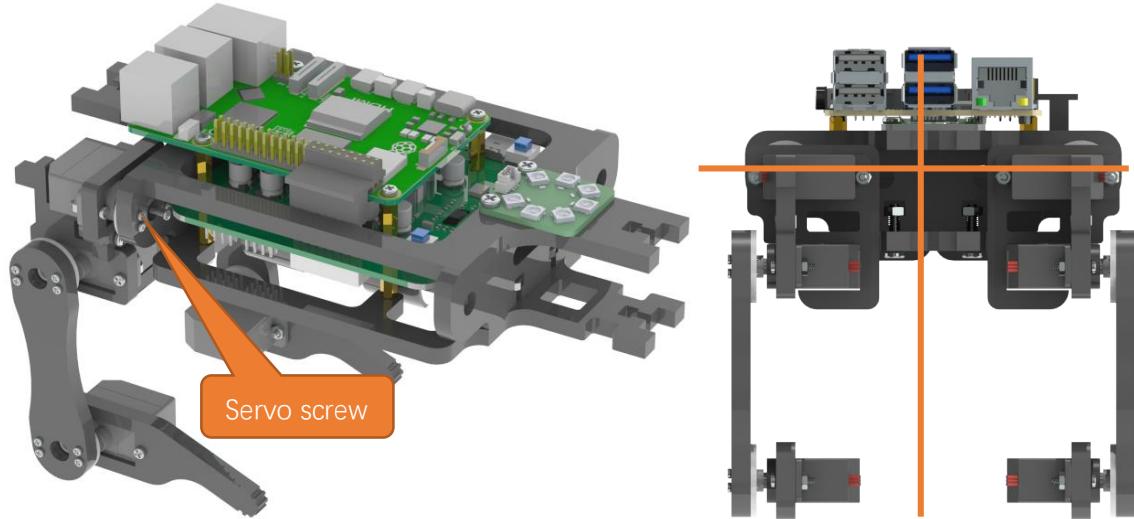


Assemble legs of the other side.

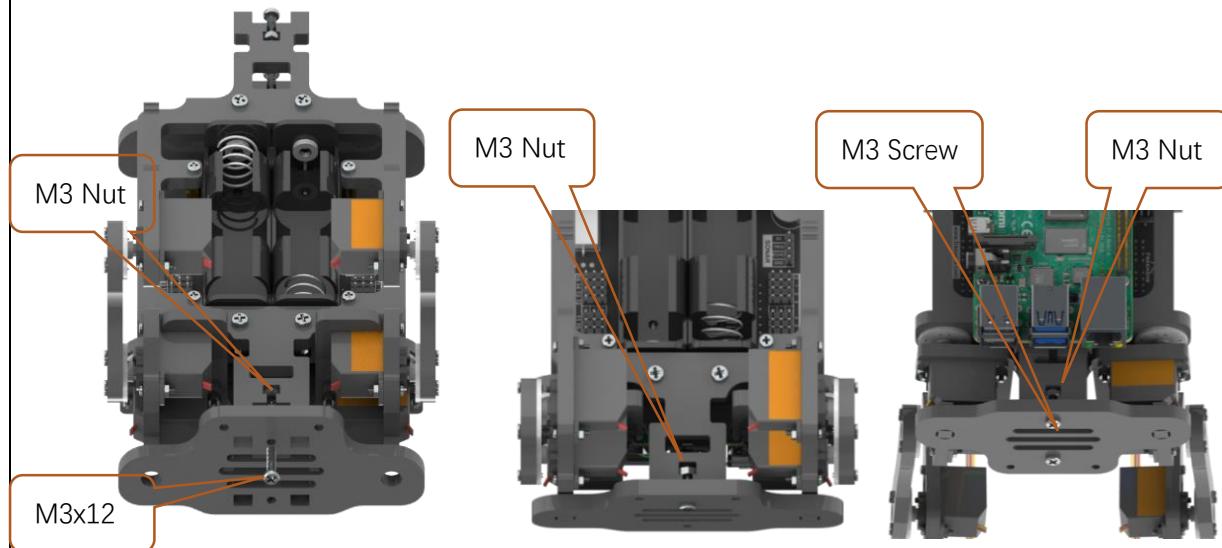


Keep the power ON and all servos connected to shield. Do NOT disconnect wiring.

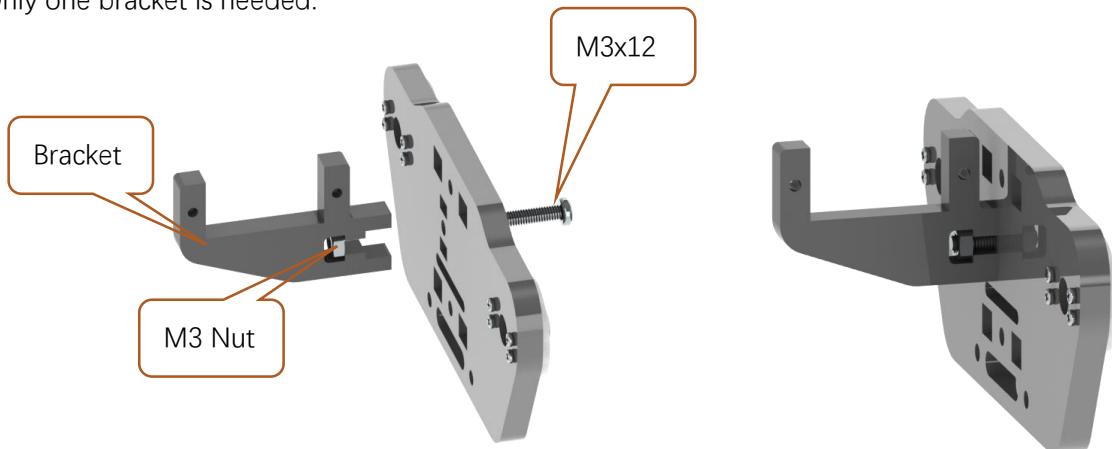
Select two legs of **different sides** as rear legs. And install them as below. Then install the servo screws.



In this step, if you did not cover tape to the holes before, you can turn off **Load S1** to install the screw. After the screw is installed, turn on the **Load S1**.

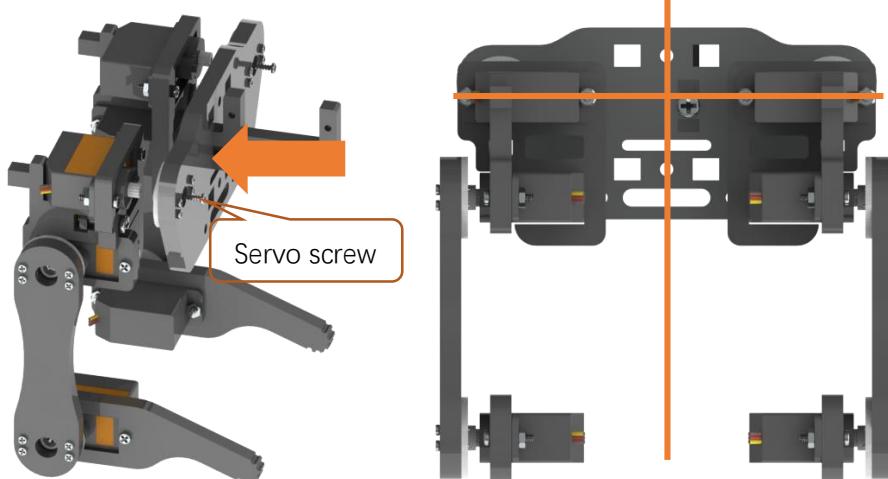


Only one bracket is needed.

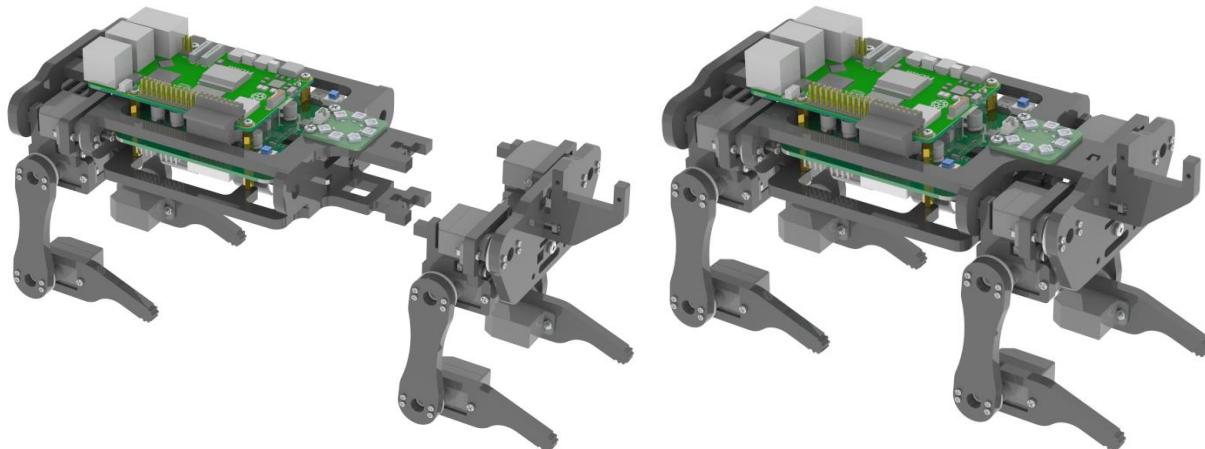


Keep the power ON and all servos connected to shield. Do NOT disconnect wiring.

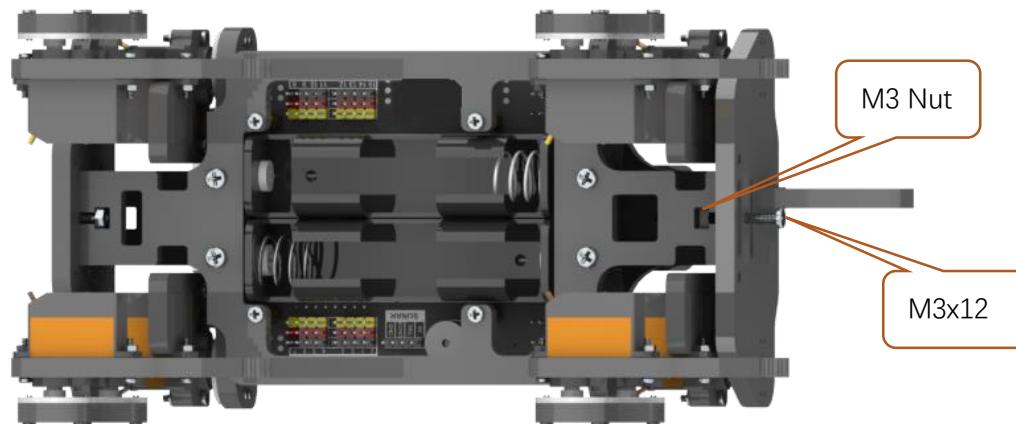
Assemble front legs and install the servo screw.

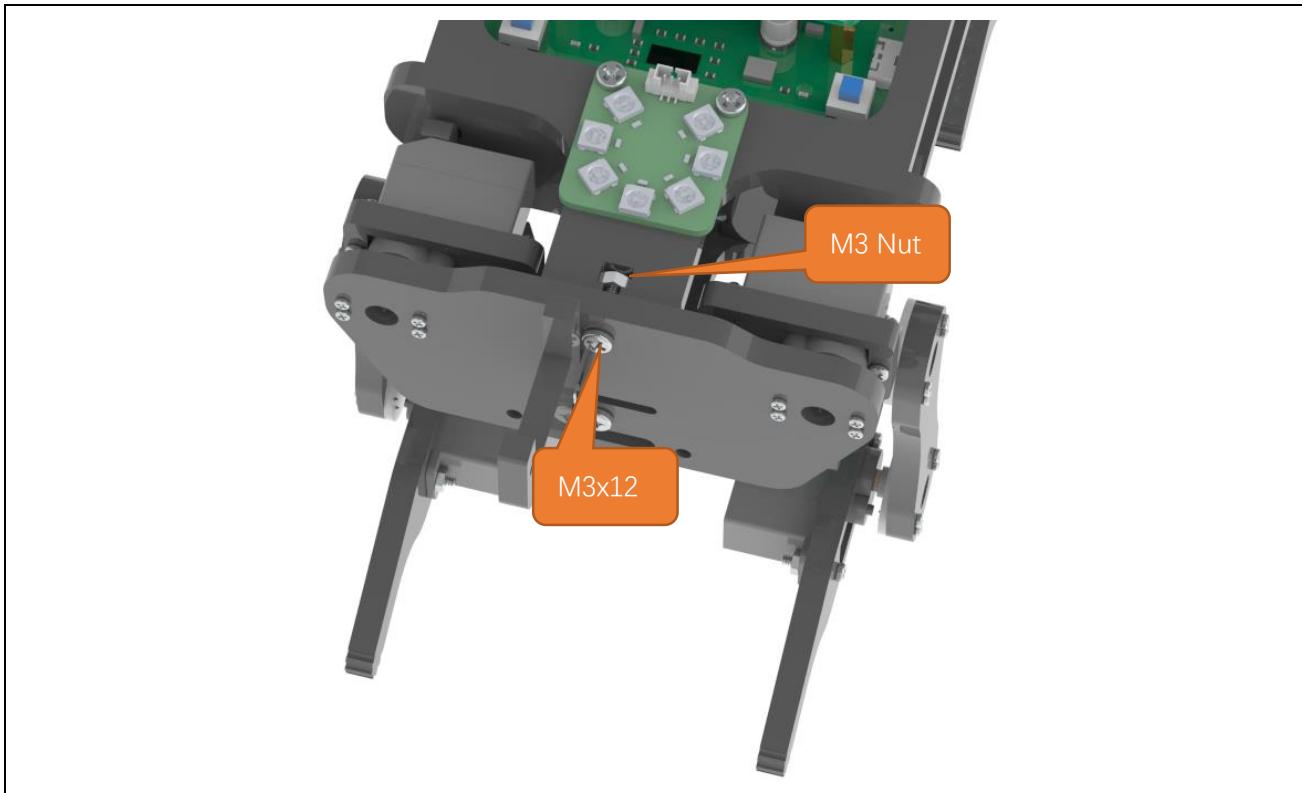


Assemble them.

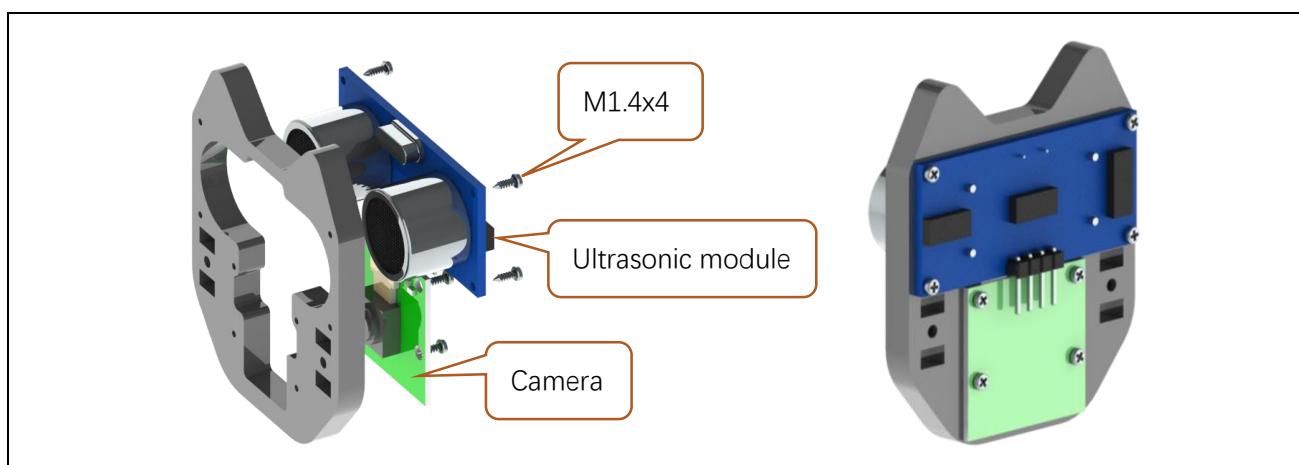


In this step, if you did not cover tape to the holes before, you can turn off **Load S1** to install the screw. After the screw is installed, turn on the **Load S1**.

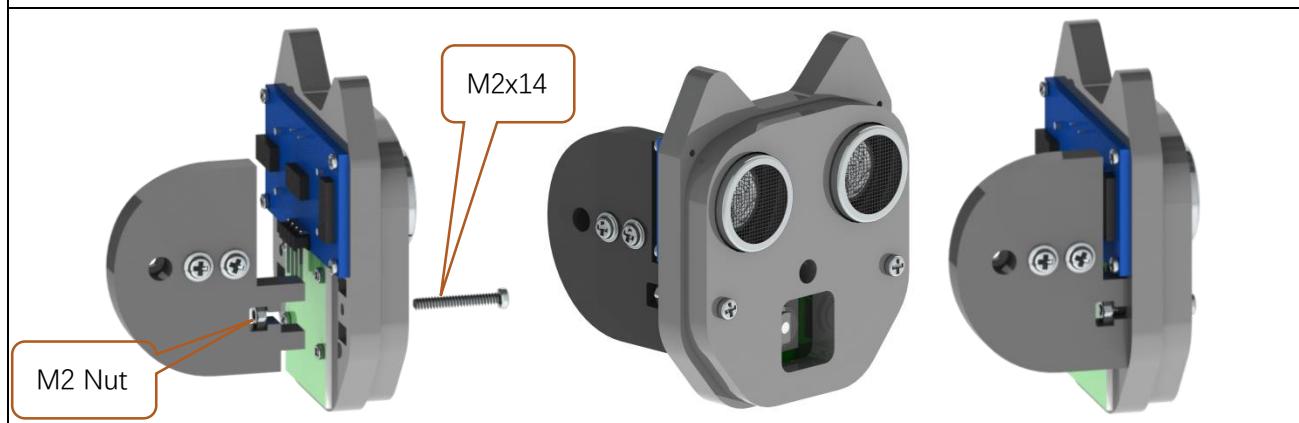




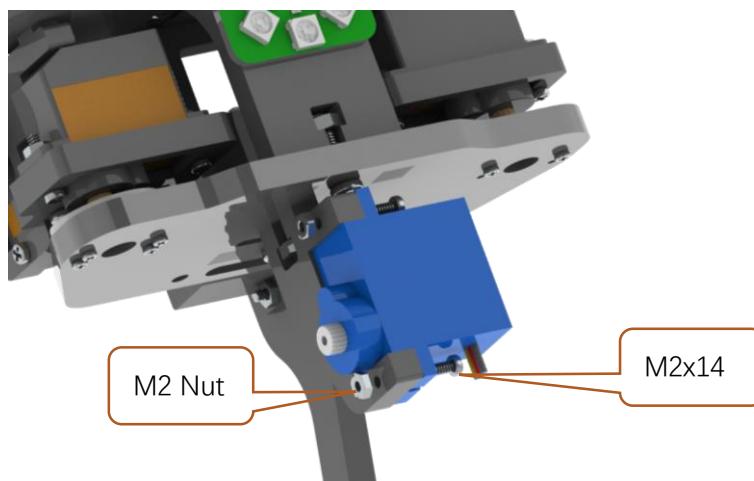
Step 11 Assemble Head



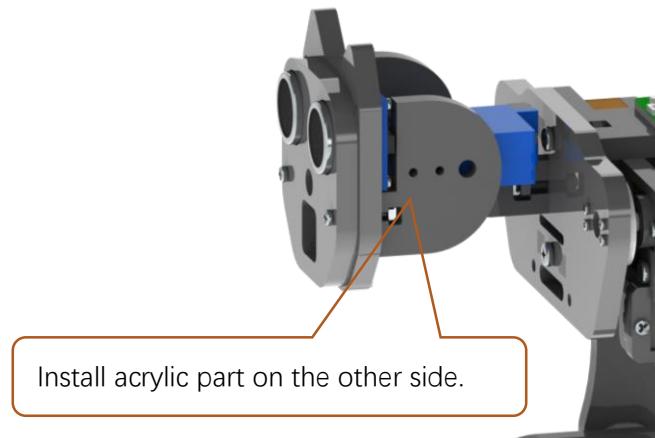
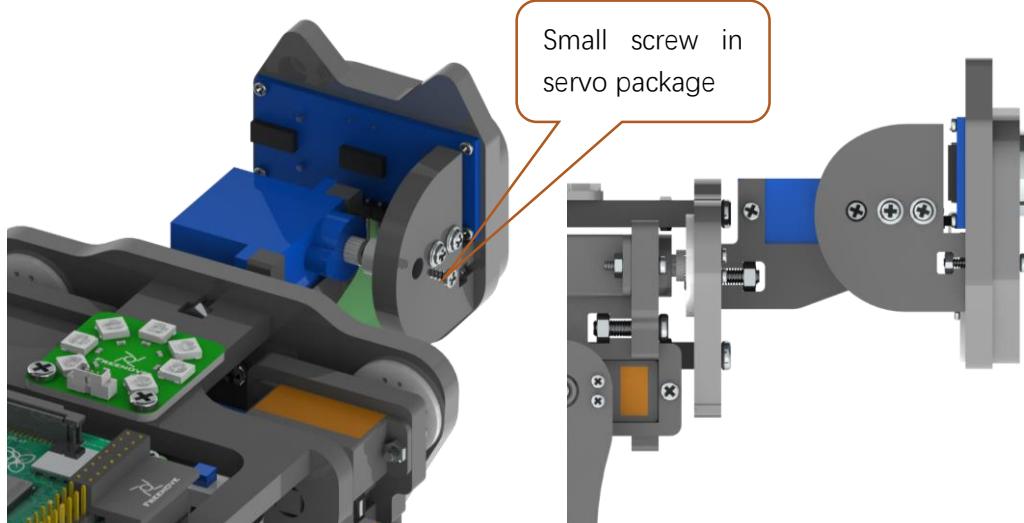
The servo arm and screws are included in the blue servo package.



Step 12 Assemble Head to Body



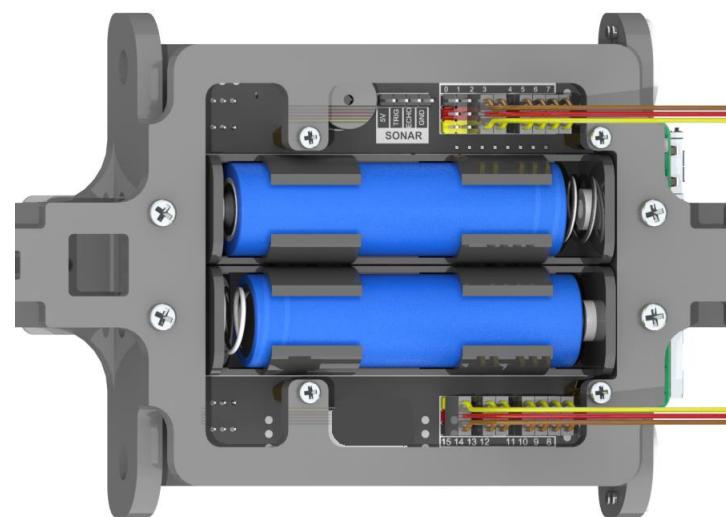
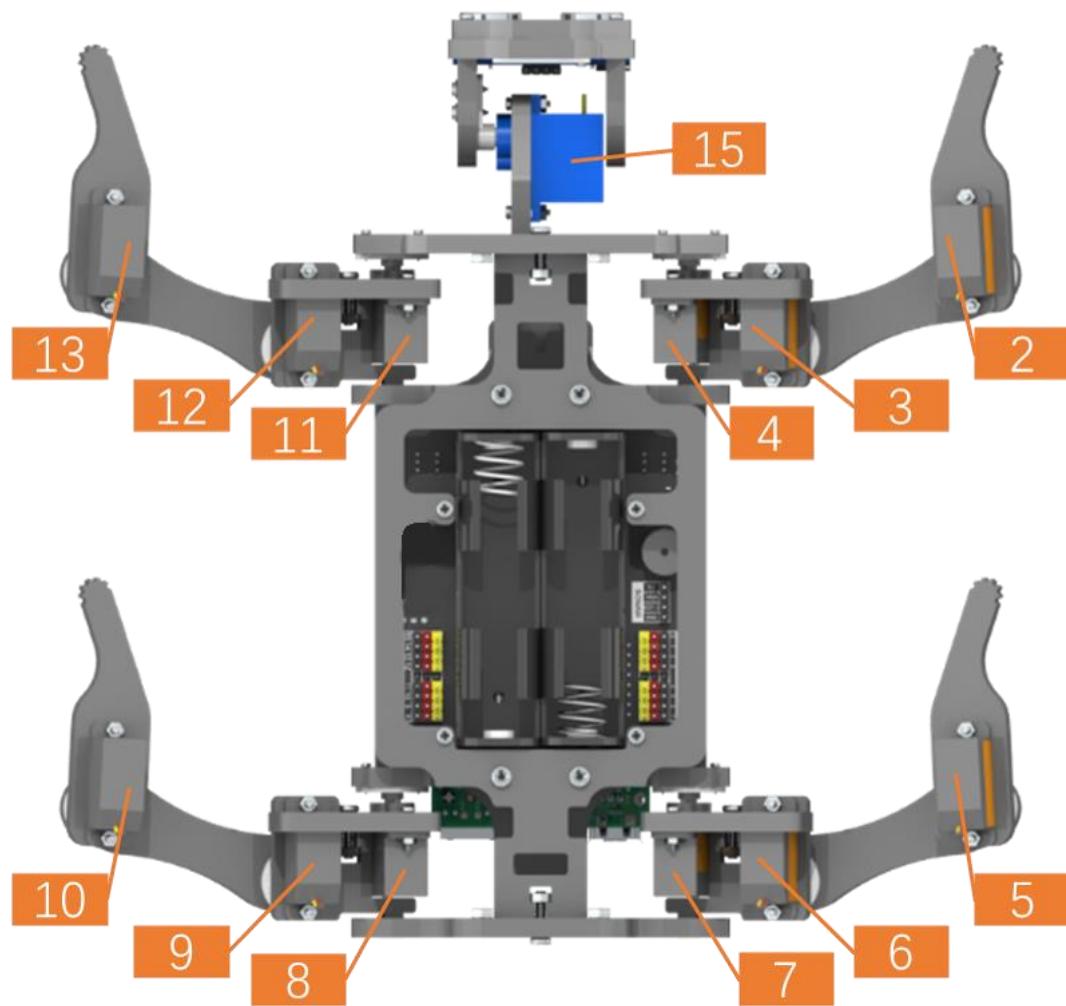
Keep the power ON and servos connected when installing arm to servo.



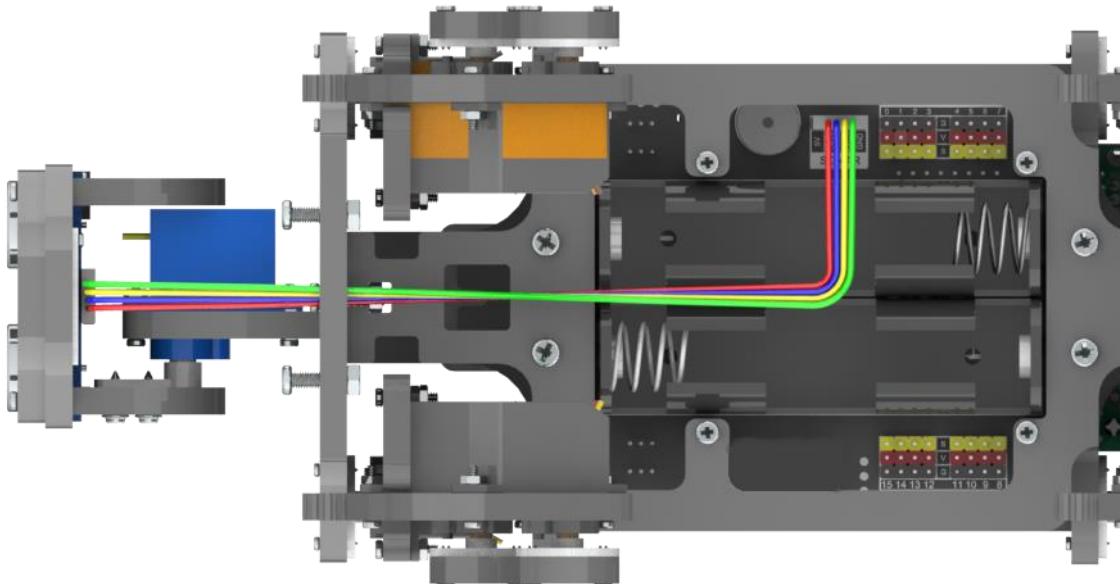
We will complete wiring in next section. Shut down the Raspberry Pi first. Do NOT turn on Raspberry Pi until chapter 3.

Step 13 Wiring

Connect servos according to the numbers. **Note servo ports 0, 1, 14 are not connected to servo.** They are spare.



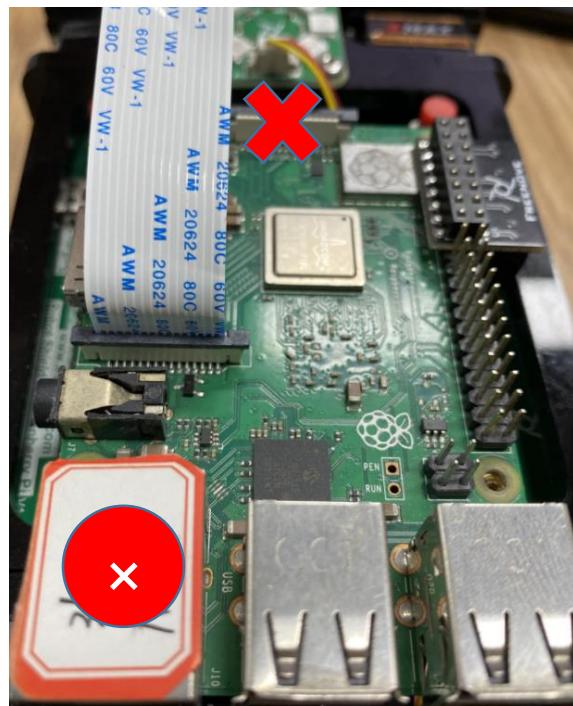
Wiring of Ultrasonic module (Note: **Do NOT connect wrongly. If you connect 5V to GND, it may damage the ultrasonic module**)



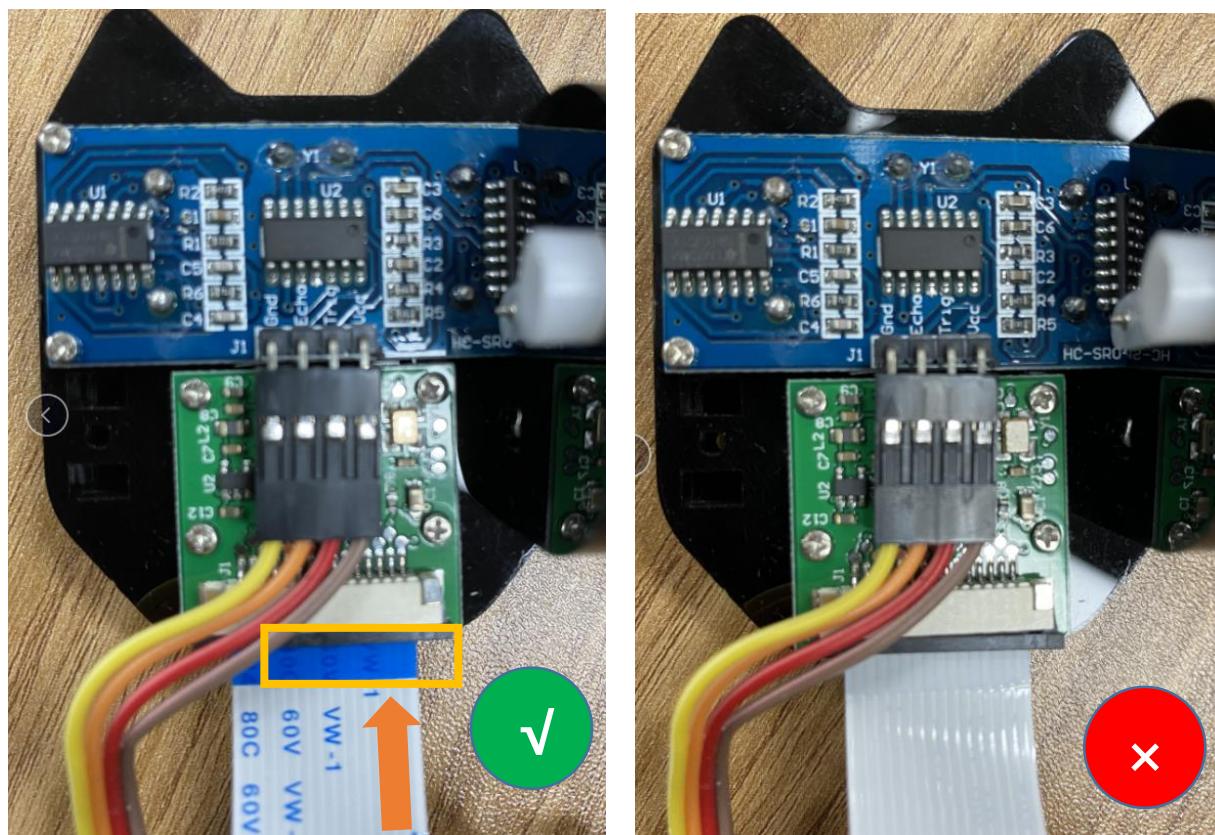
Camera for Pi3/4

Pay attention to the **blue side** of camera cable.

(Note: plugging and unplugging the cable requires the Raspberry Pi to be powered off, otherwise the camera module may be burned.)



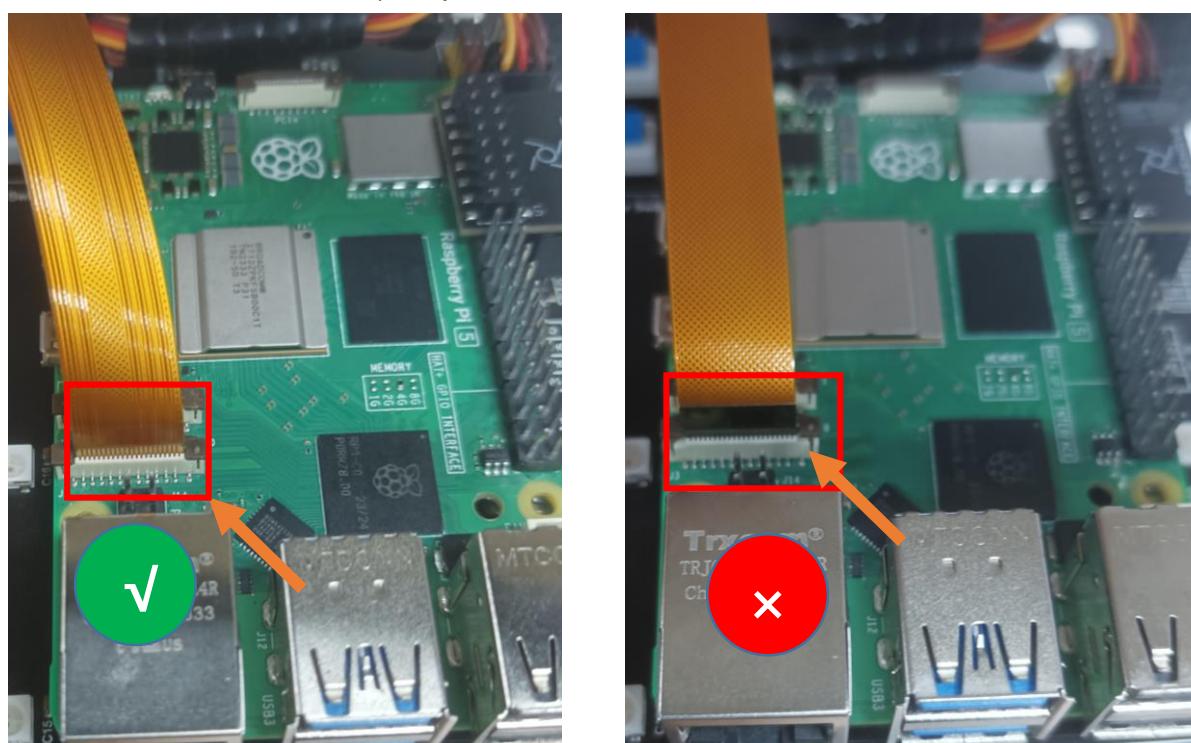
Pay attention to the **blue side** of camera cable.



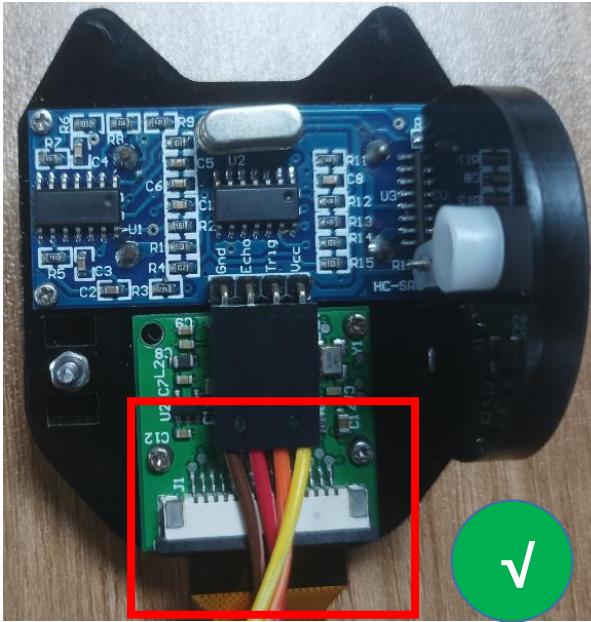
Camera for Pi5

Please note that this cable is only available with the purchase of the Raspberry Pi 5 version.

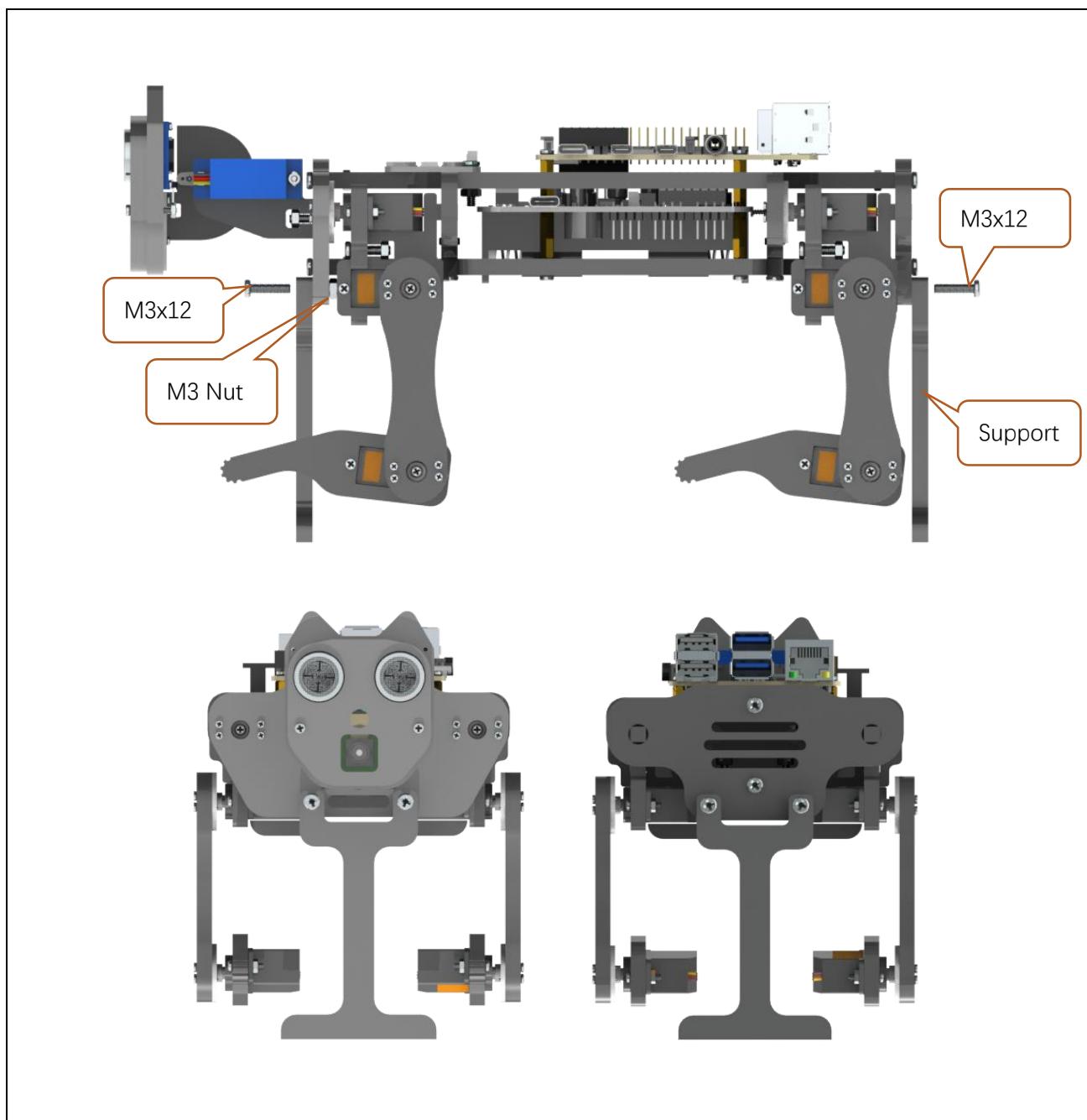
Connect one end of cable to Raspberry Pi. Please note the front and back of the cable.



Connect another end of cable to Raspberry Pi. Please note the front and back of the cable.



Step 14 Install Calibration Support



Step 15 Verify Assembly

Turn on two switches and run following two commands again.

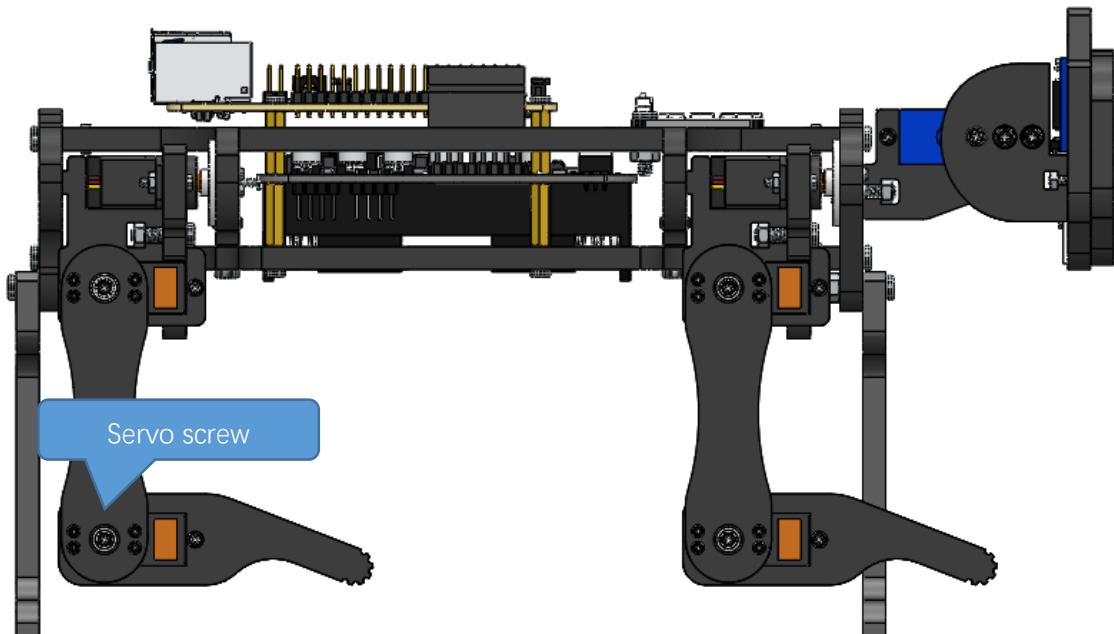
- Type the following command to enter servo code folder "Server".

```
cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
```

- Run Servo.py

```
sudo python Servo.py
```

The robot should show the following posture.



If it does not look like this, you need to disassemble **servo screws** of incorrect servos. Then reassemble the incorrect servo to make the robot look like posture above.

Chapter 3 Module test (Required)

If you have any concerns, please feel free to contact us at support@freenove.com

The robot dog has been assembled in the previous chapter. This chapter will test each module of the robot dog. It is a necessary check for later control.

Before starting, please install the battery for the robot dog and **turn on the S1 and S2 switches**. Place the robot dog with the calibration supports on a horizontal table to ensure that the wiring of each servo is correct.

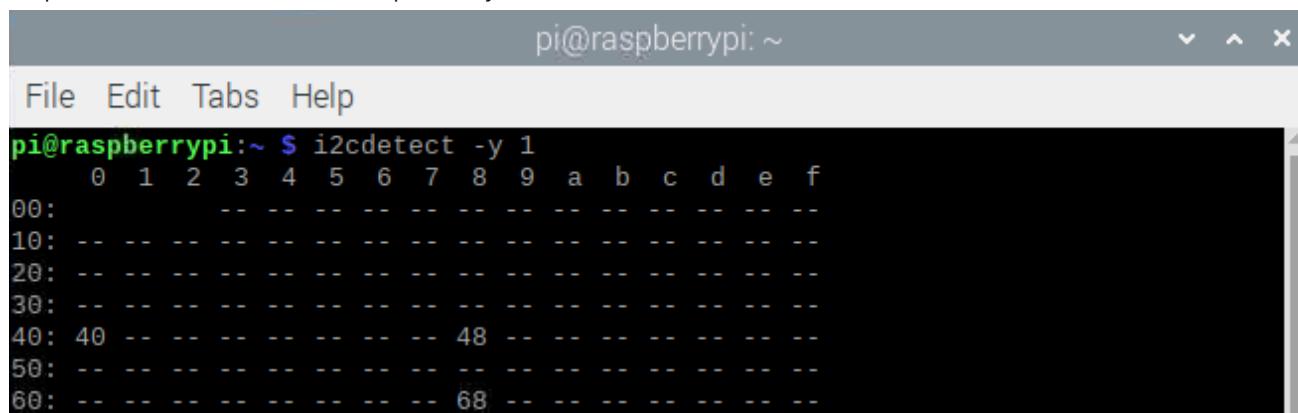
Please use VNC Viewer to build this robot when you use remote mode to login RPi, or there will be errors. Because other desktop remote doesn't support GUI.

Servo

Execute following command to check i2c address.

```
i2cdetect -y 1
```

As shown in the figure below, the addresses 0x40, 0X48, and 0X68 corresponds to the PCA9685 chip, ADS7830 chip, and MPU6050 module, respectively.



A terminal window titled "pi@raspberrypi: ~". The window shows the command "i2cdetect -y 1" being run. The output displays a map of I2C addresses from 00 to FF. Addresses 40, 48, and 68 are marked with solid bars under columns 4, 5, and 6 respectively, indicating they are occupied by the PCA9685, ADS7830, and MPU6050 modules.

```
pi@raspberrypi:~ $ i2cdetect -y 1
  0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00: --
10: --
20: --
30: --
40: 40 -- -- -- -- 48 -- -- -- --
50: --
60: -- -- -- -- -- 68 -- -- -- --
```

Run program

Enter following commands in the terminal to test servos.

If the terminal displays the directory as below (where test.py is located). You can **directly** execute the test.py command.

```
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $
```

1. If not, execute the cd command:

```
cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
```

2. Execute test.py command:

```
sudo python test.py Servo
```

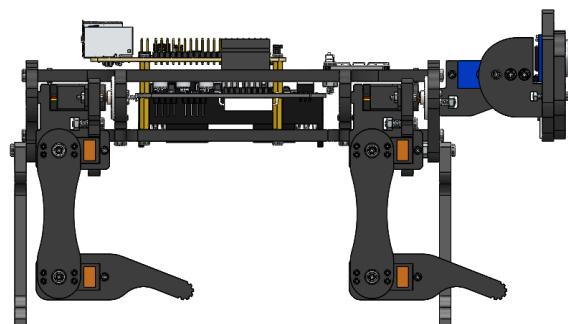
```
pi@raspberrypi: ~/Freenove_Robot..._Kit_for_Raspberry_Pi/Code/Server ~ ^ x
File Edit Tabs Help
pi@raspberrypi:~ $ cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $ sudo python test.py Servo
on test.py Servo
Program is starting ...
```

Result:

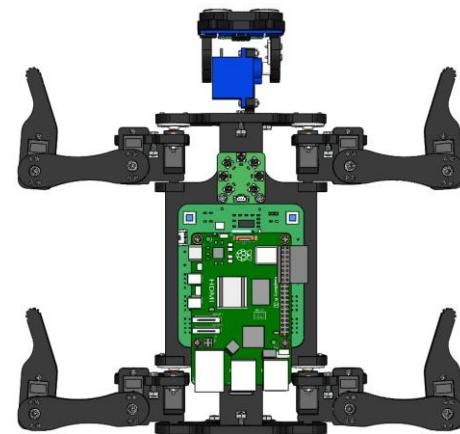
After assembly in the previous chapter, the robot should look as shown in picture A.

After servo test program is executed, the robot's posture will change to A, B, C, D gradually, which indicates the servo channel works normally.

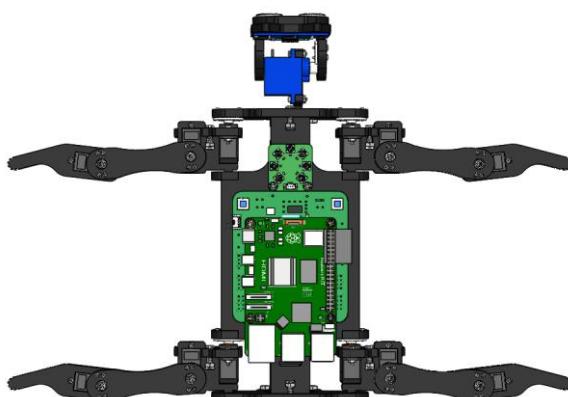
If the situation is not correct, check the servo [wiring](#).



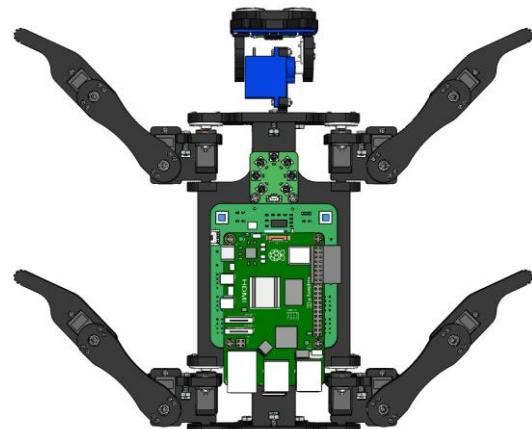
(A)



(B)



(C)



(D)

The code is as below:

```
1  from Servo import *
2  servo=Servo()
3  def test_Servo():
4      try:
5          for i in range(90):
6              servo.setServoAngle(4, 90-i)
7              servo.setServoAngle(7, 90-i)
8              servo.setServoAngle(8, 90+i)
9              servo.setServoAngle(11, 90+i)
10             time.sleep(0.01)
11         for i in range(90):
12             servo.setServoAngle(2, 90-i)
13             servo.setServoAngle(5, 90-i)
14             servo.setServoAngle(10, 90+i)
15             servo.setServoAngle(13, 90+i)
16             time.sleep(0.01)
17         for i in range(60):
18             servo.setServoAngle(3, 90-i)
19             servo.setServoAngle(6, 90-i)
20             servo.setServoAngle(9, 90+i)
21             servo.setServoAngle(12, 90+i)
22             time.sleep(0.01)
23         print ("\nEnd of program")
24     except KeyboardInterrupt:
25         print ("\nEnd of program")
```

Reference

setServoAngle(channel, angle)

This function has two parameters to control the Servo of the corresponding channel to the corresponding angle.

The first parameter indicates the servo channel

The second parameter is the rotation angle

Example:

setServoAngle (0,60) The Servo of channel 0 is turned to 60 degrees

setServoAngle (15,160) The Servo of channel 15 is turned to 160 degrees

ADC Module

Run program

Enter following commands to test ADC module.

If the terminal displays the directory as below (where test.py is located). You can **directly** execute the second command test.py.

```
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $
```

1.If not, execute the cd command:

```
cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
```

2.Execute test.py command:

```
sudo python test.py ADC
```

The screenshot shows a terminal window with a dark background and light-colored text. At the top, it says "pi@raspberrypi: ~ /Freenove_Robot..._Kit_for_Raspberry_Pi/Code/Server". Below that is a menu bar with "File", "Edit", "Tabs", and "Help". The main area of the terminal shows the following text:

```
pi@raspberrypi:~ $ cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $ sudo python test.py ADC
Program is starting ...
The battery voltage is 7.117647058823529V

The battery voltage is 7.0V

The battery voltage is 7.0V

The battery voltage is 7.117647058823529V
```

Result:

Print voltage value of batteries per second. You can press "Ctrl + C" to end the program.

The code is as below:

```
1 from ADS7830 import *
2 adc=ADS7830()
3 def test_Adc():
4     try:
5         while True:
6             Power=adc.readAdc(0)/255.0*5.0*3
7             print ("The battery voltage is "+str(Power)+"V")
8             time.sleep(1)
9             print ('\n')
10        except KeyboardInterrupt:
11            print ("\nEnd of program")
```

Reference

readAdc (channel)

This function has one parameter for reading the ADC value of the corresponding channel.

For example:

readAdc (0)

Read the ADC value of the batteries voltage. The returned number ranges between 0-255. Divide the obtained value by 255.0 and then multiply by the reference voltage of 5.0V, and then triple the value to get the batteries voltage.

Ultrasonic module

Run program

If the terminal displays the directory as below (where test.py is located). You can **directly** execute the test.py command.

```
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $ 
1. If not, execute the cd command:
cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
2. Execute test.py command:
sudo python test.py Ultrasonic
pi@raspberrypi: ~/Freenove_Robot...g_Kit_for_Raspberry_Pi/Code/Server ~ ^ ^ x
File Edit Tabs Help
pi@raspberrypi:~ $ cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $ sudo python
test.py Ultrasonic
Program is starting ...
Obstacle distance is 40CM
Obstacle distance is 60CM
Obstacle distance is 63CM
Obstacle distance is 61CM
Obstacle distance is 3CM
Obstacle distance is 13CM
Obstacle distance is 14CM
Obstacle distance is 42CM
^C
End of program
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $ 
```

Result:

Every 1s, the distance between the obstacle and the ultrasonic module will be printed in, and you can press "Ctrl + C" to end the program.

The code is as below:

```
1 from Ultrasonic import *
2 ultrasonic=Ultrasonic()
3 def test_Ultrasonic():
4     try:
5         while True:
6             data=ultrasonic.getDistance()    #Get the value
7             print ("Obstacle distance is "+str(data)+"CM")
8             time.sleep(1)
9         except KeyboardInterrupt:
10             print ("\nEnd of program")
```

Reference

`getDistance()`

This function is used to obtain the distance between ultrasonic module and the obstacle in front of it in centimeters.

LED

Note: Raspberry PI 5 is temporarily unavailable because the Library rpi-ws281x-python does not support Raspberry PI 5. Please skip this section.

There is an RGB LED module on the robot as below:



Run program

Enter the following commands to test LED.

If the terminal displays the directory as below (where test.py is located). You can **directly** execute the test.py command.

```
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $
```

1.If not, execute the cd command:

```
cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
```

2.Execute test.py command:

```
sudo python test.py Led
```

```
pi@raspberrypi: ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
File Edit Tabs Help
pi@raspberrypi:~ $ cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $ sudo python
test.py Led
Program is starting ...

Red wipe
Green wipe
Blue wipe
White wipe
End of program
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $
```

Result:

The LED module will show red, green, blue and white in turn. Then all LED are turned OFF.

You can end the program ahead of time by pressing "ctrl+c".

If the LED color display order is not correct, open the "**Led.py**" file in the current directory and modify the value of the "self.ORDER" variable on line 16.

The code of test.py is as below:

```

1  from Led import *
2  led=Led()
3  def test_Led():
4      try:
5          #Red wipe
6          led.colorWipe(led.strip, Color(255, 0, 0))
7          time.sleep(1)
8          print ("\nRed wipe")
9
10         #Green wipe
11         led.colorWipe(led.strip, Color(0, 255, 0))
12         time.sleep(1)
13         print ("\nGreen wipe")
14
15         #Blue wipe
16         led.colorWipe(led.strip, Color(0, 0, 255))
17         time.sleep(1)
18         print ("\nBlue wipe")
19
20         #White wipe
21         led.colorWipe(led.strip, Color(255, 255, 255))
22         time.sleep(1)
23         print ("\nWhite wipe")
24
25         led.colorWipe(led.strip, Color(0, 0, 0))    #turn off the light
26         print ("\nEnd of program")
27     except KeyboardInterrupt:
28         led.colorWipe(led.strip, Color(0, 0, 0))    #turn off the light
29         print ("\nEnd of program")

```

Reference

`colorWipe(strip, color, wait_ms)`

This function erases the color of one pixel at a time. It has three input parameters, among which, strip represents the Neopixel object, color represents the color to be erased, and wait_ms represents the erasure interval. The default is 50ms. For example, `colorWipe(strip, Color(255,0,0),20)` means that the LED0 color is red first, waiting for 20ms, and then the LED1 color is also red, and repeat the same to all 8 LEDs until they are all red.

Buzzer

Run the program

Enter following command in the terminal to test buzzer.

If the terminal displays the directory as below (where test.py is located). You can **directly** execute the test.py command.

```
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $
```

1.If not, execute the cd command:

```
cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
```

2.Execute test.py command:

```
sudo python test.py Buzzer
```

The terminal window shows the following session:

```
pi@raspberrypi: ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $ cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server  
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $ sudo python test.py Buzzer  
Program is starting ...  
1S  
2S  
3S  
End of program
```

Result:

The buzzer will be turned ON lasting for 3s. Then the program will automatically end or you can press "Ctrl + C" to end the program.

The code is as below:

```
1 from Buzzer import *
2 buzzer=Buzzer()
3 def test_Buzzer():
4     try:
5         buzzer.run('1')
6         time.sleep(1)
7         print ("1S")
8         time.sleep(1)
9         print ("2S")
10        time.sleep(1)
11        print ("3S")
12        buzzer.run('0')
13        print ("\nEnd of program")
14    except KeyboardInterrupt:
15        buzzer.run('0')
16        print ("\nEnd of program")
```

Reference

buzzer.run(cmd)

This function has one input parameter. If the input is '1', the buzzer will be turned on. If the input is '0', the buzzer will be turned off.

Camera

There are two ways to drive the camera.

First method, use the system's default camera detection function.

1. Open the config.txt file.

```
sudo nano /boot/firmware/config.txt
```

2. Enable the automatic camera detection function.

```
camera_auto_detect=1
```

Second method, manually configure the camera.

1. Disable the automatic camera detection function.

```
camera_auto_detect=0
```

2. Add the following instruction at the very bottom.

If you are a Raspberry Pi 5, add the following command.

```
dtoverlay = ov5647,cam0
```

If you are not a Raspberry Pi 5, add the following command.

```
dtoverlay = ov5647
```

3. Save the file and exit, then restart the Raspberry Pi.

Run program

1. execute the cd command:

```
cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
```

2. Execute command below:

```
python camera.py
```

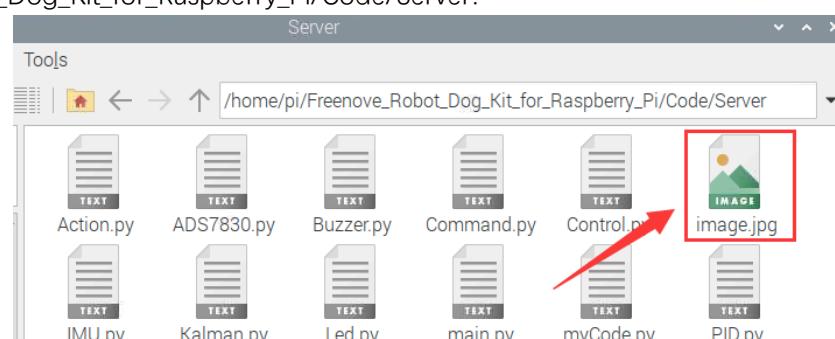
Then please open and check the generated image.jpg under

/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server.

```
[0:43:46.533388841] [2961] INFO Camera camera_manager.cpp:313 libcamera v0.3.0+65-6ddd79b5
[0:43:46.541187170] [2967] INFO RPI pisp.cpp:695 libpisp version v1.0.6 b567f0455680 17-06-2024 (10:20:00)
[0:43:46.551017019] [2967] INFO RPI pisp.cpp:1154 Registered camera /base/axi/pcie@120000/rpi/i2c@88000/ov5647@36
to CFE device /dev/media0 and ISP device /dev/media0 using PiSP variant BCM2712_C0
[0:43:46.5552838708] [2961] INFO Camera camera_manager.cpp:313 libcamera v0.3.0+65-6ddd79b5
[0:43:46.5626052229] [2970] INFO RPI pisp.cpp:695 libpisp version v1.0.6 b567f0455680 17-06-2024 (10:20:00)
[0:43:46.573746897] [2970] INFO RPI pisp.cpp:1154 Registered camera /base/axi/pcie@120000/rpi/i2c@88000/ov5647@36
to CFE device /dev/media0 and ISP device /dev/media0 using PiSP variant BCM2712_C0
[0:43:46.575957510] [2961] WARN V4L2 v4l2_pixelformat.cpp:344 Unsupported V4L2 pixel format RPBP
[0:43:46.576678949] [2961] INFO Camera camera.cpp:1183 configuring streams: (0) 640x480-XBGR8888 (1) 640x480-GBRG
_PISP_COMP1
[0:43:46.576778300] [2970] INFO RPI pisp.cpp:1450 Sensor: /base/axi/pcie@120000/rpi/i2c@88000/ov5647@36 - Selected
d sensor format: 640x480-SGBRG10_1X10 - Selected CFE format: 640x480-PC1g
QStandardPaths: wrong permissions on runtime directory /run/user/1000, 0770 instead of 0700
[0:43:48.531984920] [2974] WARN V4L2 v4l2_pixelformat.cpp:344 Unsupported V4L2 pixel format RPBP
[0:43:48.532711766] [2974] INFO Camera camera.cpp:1183 configuring streams: (0) 2592x1944-BGR8888 (1) 2592x1944-GBRG
_RG_PISP_COMP1
[0:43:48.536032796] [2970] INFO RPI pisp.cpp:1450 Sensor: /base/axi/pcie@120000/rpi/i2c@88000/ov5647@36 - Selected
d sensor format: 2592x1944-SGBRG10_1X10 - Selected CFE format: 2592x1944-PC1g
[0:43:48.945554937] [2974] WARN V4L2 v4l2_pixelformat.cpp:344 Unsupported V4L2 pixel format RPBP
[0:43:48.946127747] [2974] INFO Camera camera.cpp:1183 configuring streams: (0) 640x480-XBGR8888 (1) 640x480-GBRG
_PISP_COMP1
[0:43:48.949655072] [2970] INFO RPI pisp.cpp:1450 Sensor: /base/axi/pcie@120000/rpi/i2c@88000/ov5647@36 - Selected
d sensor format: 640x480-SGBRG10_1X10 - Selected CFE format: 640x480-PC1g
```

Then please open and check the generated image.jpg under

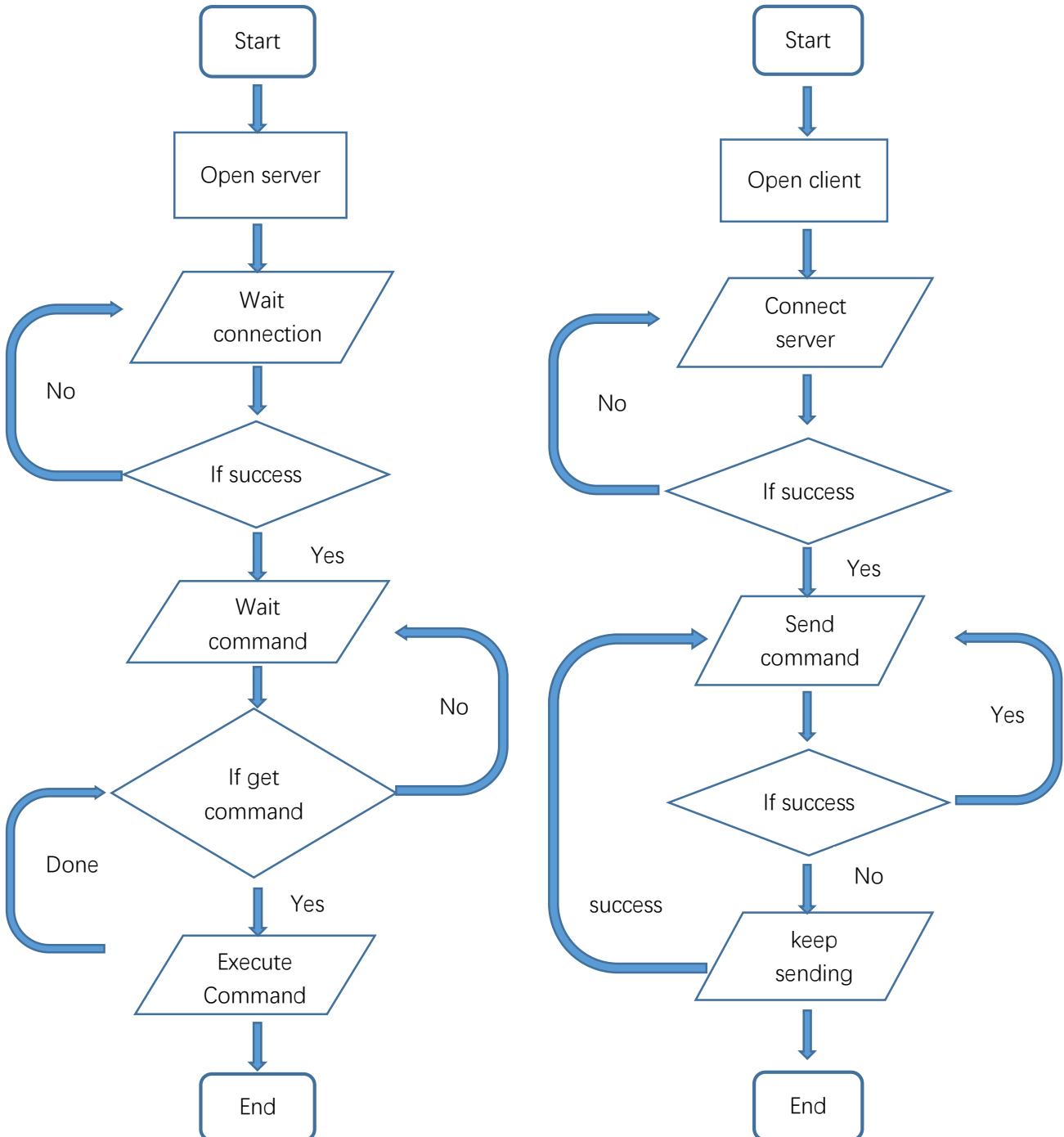
/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server.



Chapter 4 Robot Dog

If you have any concerns, please feel free to contact us at support@freenove.com

This robot has rich functions, such as real-time video, LED, ultrasonic ranging. The server and client are established, based on Python3 and PyQt5. They communicate via TCP/IP protocol. The robot can be controlled remotely within a local area network (LAN).



Server

The server runs on the Raspberry Pi. It sends the camera data and ultrasonic module data to the client, and receive commands from client.

The code in the Server folder is used as an example, or if you has a Raspberry Pi5, refer to the code in the server-Pi5 folder.

Part of server code is as below:

```
1     def get_interface_ip(self):
2         s = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
3         return socket.inet_ntoa(fcntl.ioctl(s.fileno(),
4                                         0x8915,
5                                         struct.pack('256s', b'wlan0')[:15])
6                                         )[20:24])
7
8     def turn_on_server(self):
9         #ip adress
10        HOST=self.get_interface_ip()
11        #Port 8000 for video transmission
12        self.server_socket = socket.socket()
13        self.server_socket.setsockopt(socket.SOL_SOCKET,socket.SO_REUSEPORT,1)
14        self.server_socket.bind((HOST, 8000))
15        self.server_socket.listen(1)
16
17        #Port 5000 is used for instruction sending and receiving
18        self.server_socket1 = socket.socket()
19        self.server_socket1.setsockopt(socket.SOL_SOCKET,socket.SO_REUSEPORT,1)
20        self.server_socket1.bind((HOST, 5000))
21        self.server_socket1.listen(1)
22
23        print('Server address: '+HOST)
24
25    def turn_off_server(self):
26        try:
27            self.connection.close()
28            self.connection1.close()
29        except :
30            print ('\n'+ "No client connection")
```



Reference

For more code details, please open “Server.py” in Server folder to check.

`get_interface_ip()`

This function can get the IP address of WLAN0 of the Raspberry Pi.

`turn_on_server()`

This function is used to open TCP and wait for a client connection. The channel of port 5000 is mainly used to send and receive commands between the client and server. The channel of port 8000 is used to send video data to the client.

`turn_off_server()`

This function is used to close TCP.

`send_data()`

This function is used to send commands to the client.

`reset_serve()`

This function is used to close TCP and restart.

`transmission_video()`

This function is used to transmit video data to the client.

`receive_instruction()`

This function is used to receive commands from the client

Open Server

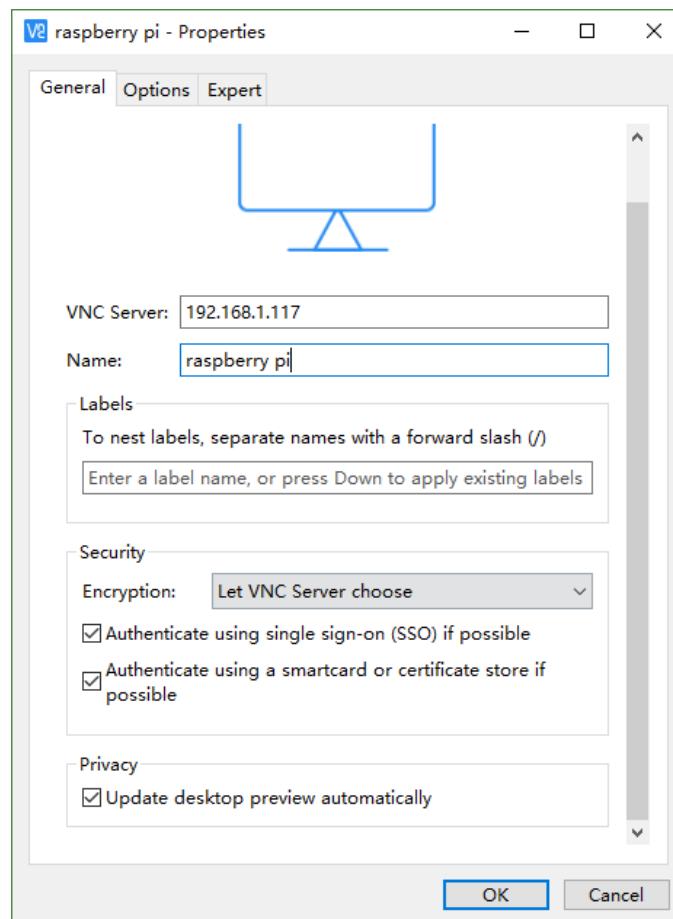
Step 1 Login Raspberry Pi via VNC viewer

Because server and client use GUI. You need use VNC viewer as remote desktop way.

Download and install VNC Viewer according to your computer system by clicking following link:

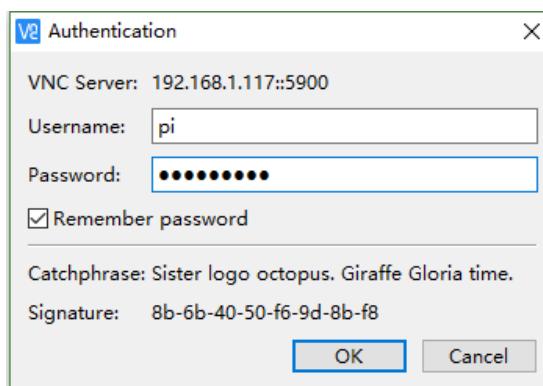
<https://www.realvnc.com/en/connect/download/viewer/>

After installation is completed, open VNC Viewer. And click File → New Connection. Then the interface is shown below.

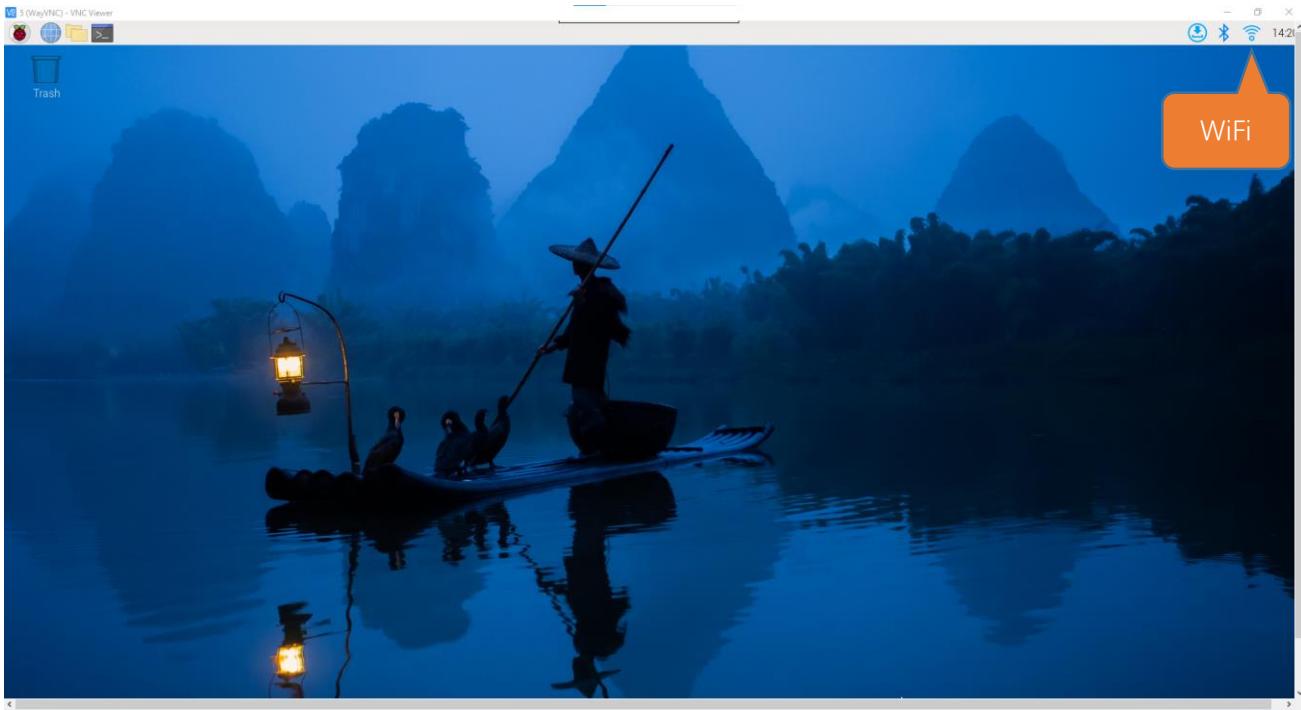


Enter IP address of your Raspberry Pi and fill in a Name. And click OK.

Then on the VNC Viewer panel, double-click new connection you just created, and the following dialog box pops up. Enter username: **pi** and Password: **raspberry**. And click OK.

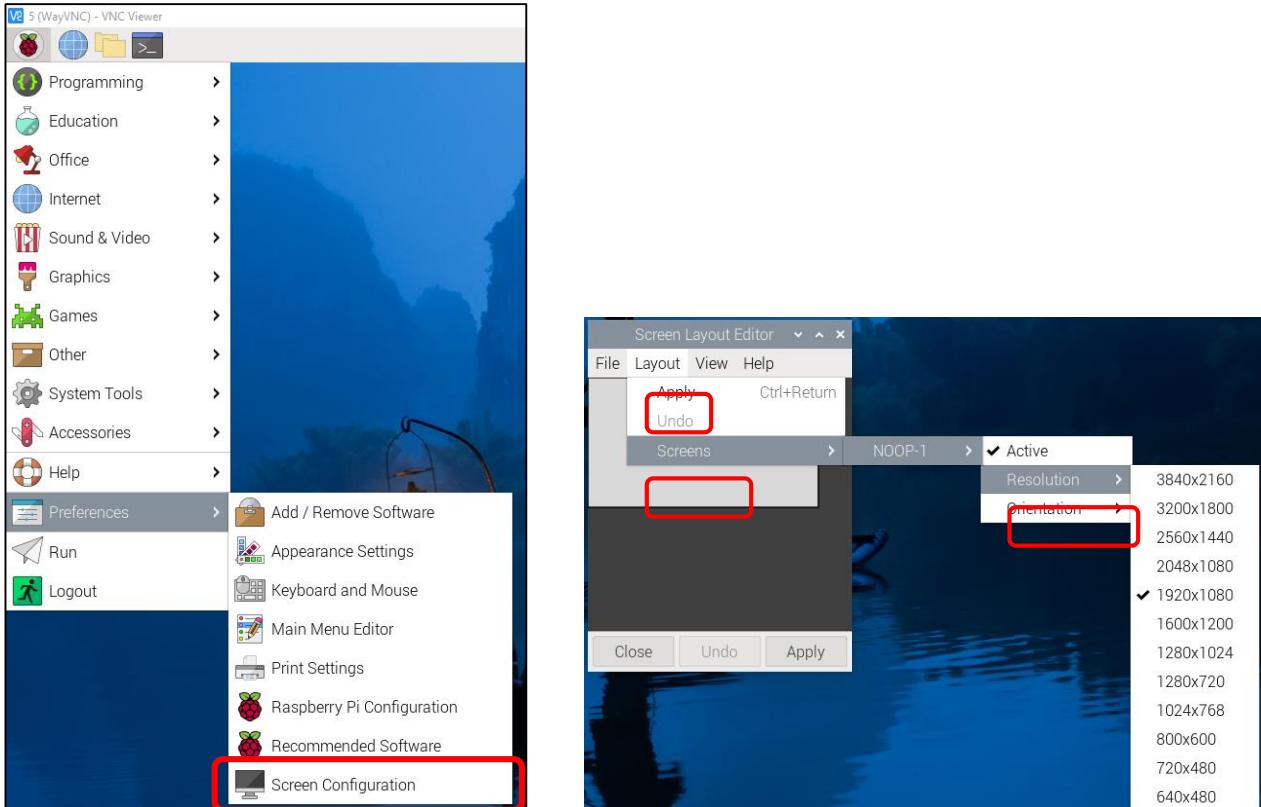


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If the resolution ratio is not great or there is just a **little window**, you can set a proper resolution ratio via steps below.

Select Screen Configuration. Select the appropriate resolution in the new window. Click Apply.



In addition, your VNC Viewer window may zoom your Raspberry Pi desktop. You can change it. On your VNC View control panel, click right key. And select Properties->Options label->Scaling. Then set proper scaling.

Step 2 Run commands

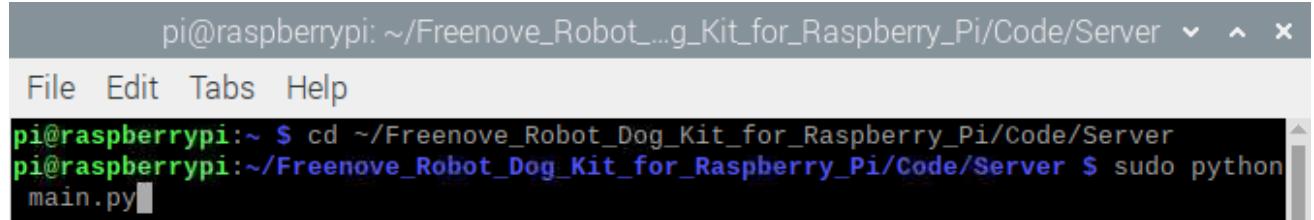
Enter following command in the terminal.

1. Use cd command to enter directory where main.py is located:

```
cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
```

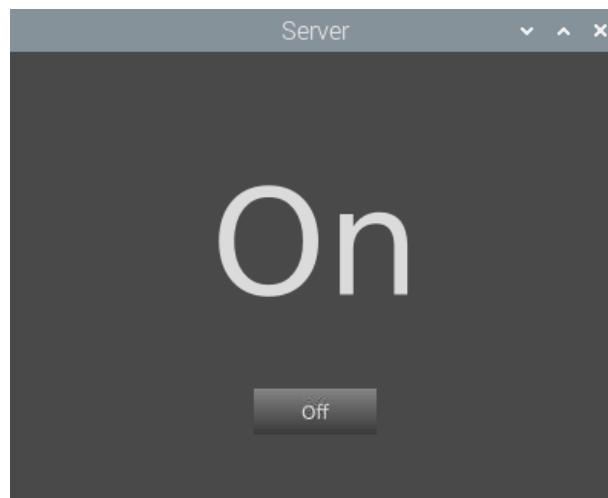
2. Run main.py:

```
sudo python main.py
```

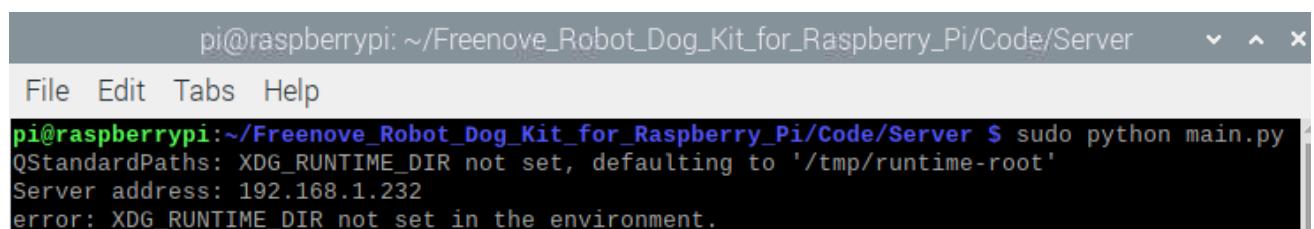


```
pi@raspberrypi:~ $ cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server  
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $ sudo python  
main.py
```

The interface is as below:

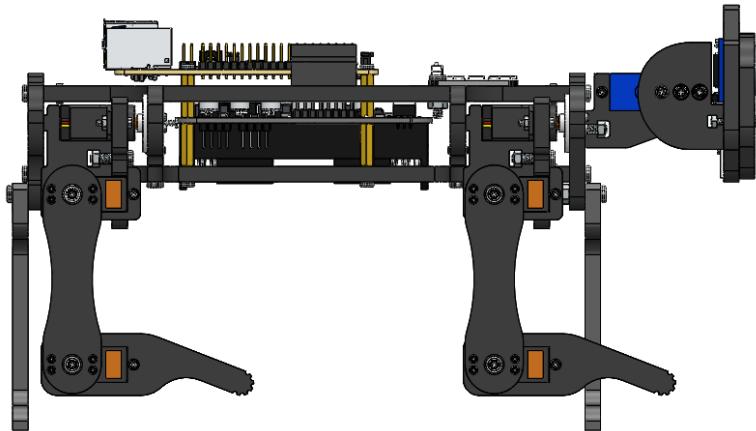


You will see your server address (Raspberry Pi IP), Which is the LAN IP address of your Raspberry Pi. In the next chapter, you will need to enter this IP address to connect the Raspberry Pi client with the server.



```
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server  
File Edit Tabs Help  
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $ sudo python main.py  
QStandardPaths: XDG_RUNTIME_DIR not set, defaulting to '/tmp/runtime-root'  
Server address: 192.168.1.232  
error: XDG_RUNTIME_DIR not set in the environment.
```

The robot will start from this posture. We define it as **Relax mode**. It will also be referenced later.



If you don't like the interface, you can also enter the commands to open the server. It is more convenient.

1. Use cd command to enter directory where main.py is located:

```
cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
```

2. Run main.py:

```
sudo python main.py -t -n
```

or Run main.py with following command:

```
sudo python main.py -tn
```

“-t” means open TCP communication. “-n” means don’t show interface.

Server Auto Start

- 1 Open the terminal and execute the following two commands respectively to create a “start.sh” file.

```
cd ~
sudo touch start.sh
```

- 2 Open “start.sh”.

```
sudo nano start.sh
```

- 3 Add the following contents to “start.sh” file.

```
#!/bin/sh
cd "/home/pi/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server"
pwd
sleep 10
sudo cp point.txt /home/pi
sudo python main.py
```

Press Ctrl + O and then press Enter to save it. Press Ctrl+X to exit.

```
pi@raspberrypi: ~
File Edit Tabs Help
GNU nano 3.2          start.sh          Modified
#!/bin/sh
cd "/home/pi/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server"
pwd
sudo cp point.txt /home/pi
sudo python main.py

AG Get Help  ^O Write Out  ^W Where Is  ^K Cut Text  ^J Justify  ^C Cur Pos
AX Exit      ^R Read File  ^\ Replace   ^U Uncut Text  ^T To Spell  ^_ Go To Line
```

4 Modify permissions.

```
sudo chmod 777 start.sh
```

5 Enter the following command to create a directory.

```
mkdir ~/.config/autostart/
```

6 create and open “start.desktop” file

```
sudo nano .config/autostart/start.desktop
```

7 Add the following content to “start.desktop” file.

```
[Desktop Entry]
```

```
Type=Application
```

```
Name=start
```

```
NoDisplay=true
```

```
Exec=/home/pi/start.sh
```

Press Ctrl + O and then press Enter to save it. Press Ctrl+X to exit.

8 Modify permissions.

```
sudo chmod +x .config/autostart/start.desktop
```

9 Finally enter the following content to reboot Raspberry Pi.

```
sudo reboot
```

Note: To cancel auto start, please delete the files “start.sh” and “start.desktop” created above.

Client

The client can receive video data and commands from the server, and can send commands to the server. And it can run on different systems, such as windows, macOS and so on. However, you need to install related software and libraries when running it.

Part of client code is as below:

```

1   def turn_on_client(self, ip):
2       self.client_socket1 = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
3       self.client_socket = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
4       print (ip)
5   def turn_off_client(self):
6       try:
7           self.client_socket.shutdown(2)
8           self.client_socket1.shutdown(2)
9           self.client_socket.close()
10          self.client_socket1.close()
11      except Exception as e:
12          print(e)
13  def receiving_video(self, ip):
14      stream_bytes = b' '
15      try:
16          self.client_socket.connect((ip, 8000))
17          self.connection = self.client_socket.makefile('rb')
18      except:
19          #print ("command port connect failed")
20          pass
21      while True:
22          try:
23              stream_bytes= self.connection.read(4)
24              leng=struct.unpack('L', stream_bytes[:4])
25              jpg=self.connection.read(leng[0])
26              if self.is_valid_image_4_bytes(jpg):
27                  if self.video_flag:
28                      self.image = cv2.imdecode(np.frombuffer(jpg, dtype=np.uint8),
29                      cv2.IMREAD_COLOR)
30                      if self.ball_flag:
31                          self.Looking_for_the_ball()
32                          self.video_flag=False
33              except BaseException as e:
34                  print (e)
35                  break

```

Reference

For more code details, please open “Client.py” in Client folder to check.

`turn_on_client ()`

This function is used to connect client to the server.

`turn_off_client ()`

This function is used to disconnect from the server.

`receiving_video()`

This function is used to receive video data sent from the server.

`is_valid_image_4_bytes ()`

This function is used to check whether each frame of video data is complete.

`Looking_for_the_ball ()`

This function is used to find the small ball in the video image.

`send_data ()`

This function is used to send commands to the server.

`receive_data ()`

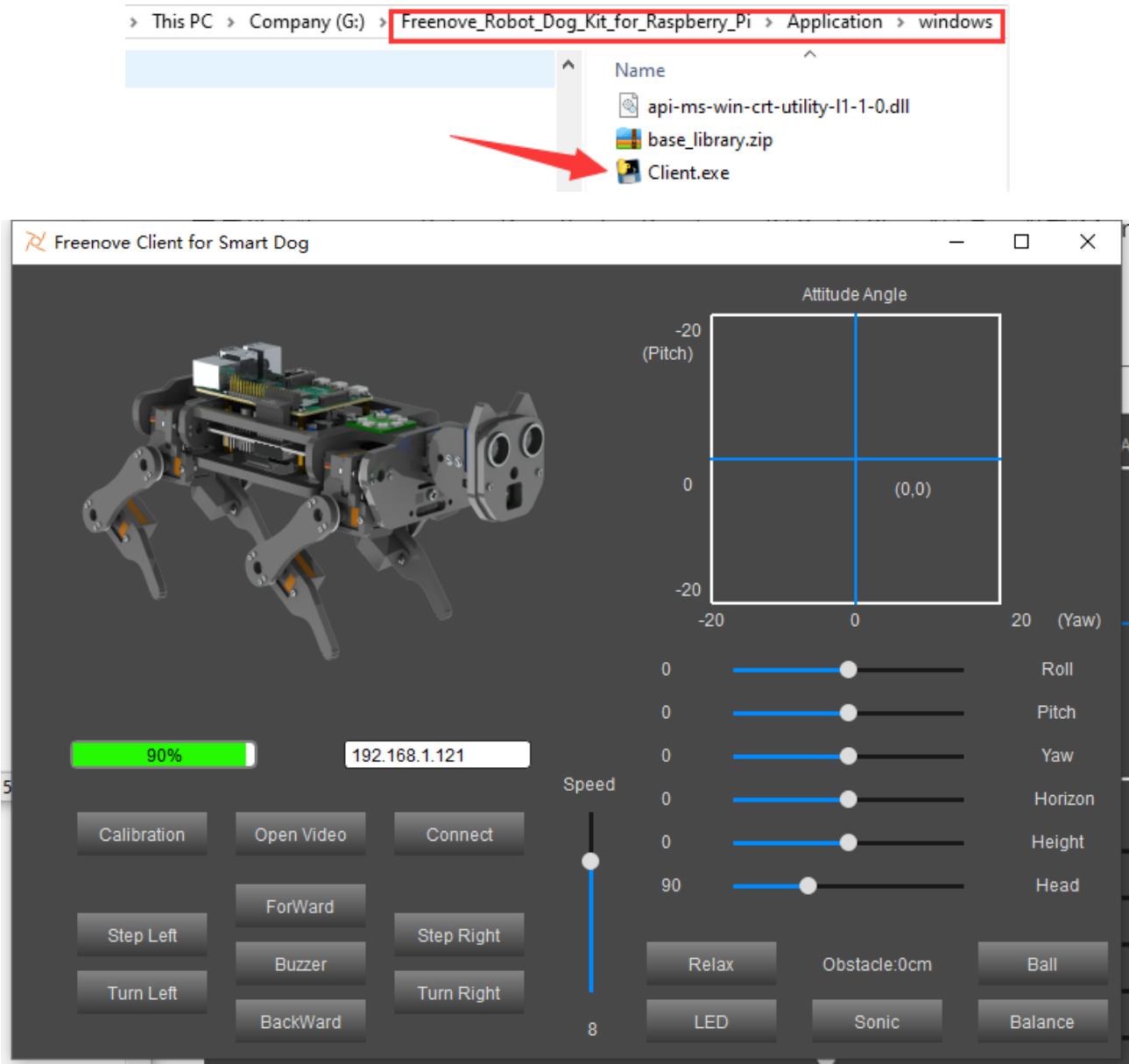
This function is used to receive commands from the server.

Run Client on Windows system

There are two ways to run Client on Windows.

Option 1 Running executable file directly

Find the "Client.exe" file in the specified directory, double click it and the Client is opened.



After the client is successfully opened,

1. You need to open the Raspberry Pi and [Turn on the server](#),
2. Enter the Raspberry Pi's IP address in the white IP edit box,
3. Click "**Connect**" to connect client to the Raspberry Pi.

After the connection is successful, you need to calibrate the robot in [Calibration](#) section. After the calibration is completed, the robot dog can be controlled to move.

You can refer to this video: <https://youtu.be/l2v9PdwQdvY>

Note: when Raspberry Pi is shut down, server will be closed. You need open server again the next time.

Option 2 Install python3 and some related python libraries to run client

If you want to modify the client, you can follow this section.

This section will be completed in your **computer with windows system, not Raspberry Pi**.

To run the client on a Windows system, you need to install some software and libraries, which takes some time. During this process, it does not need to run a server and a Raspberry Pi. You can turn off the Raspberry Pi first. After the installation is completed, turn on the Raspberry Pi and the server.

Install python3

Download the installation file via the below link:

<https://www.python.org/downloads/windows/>

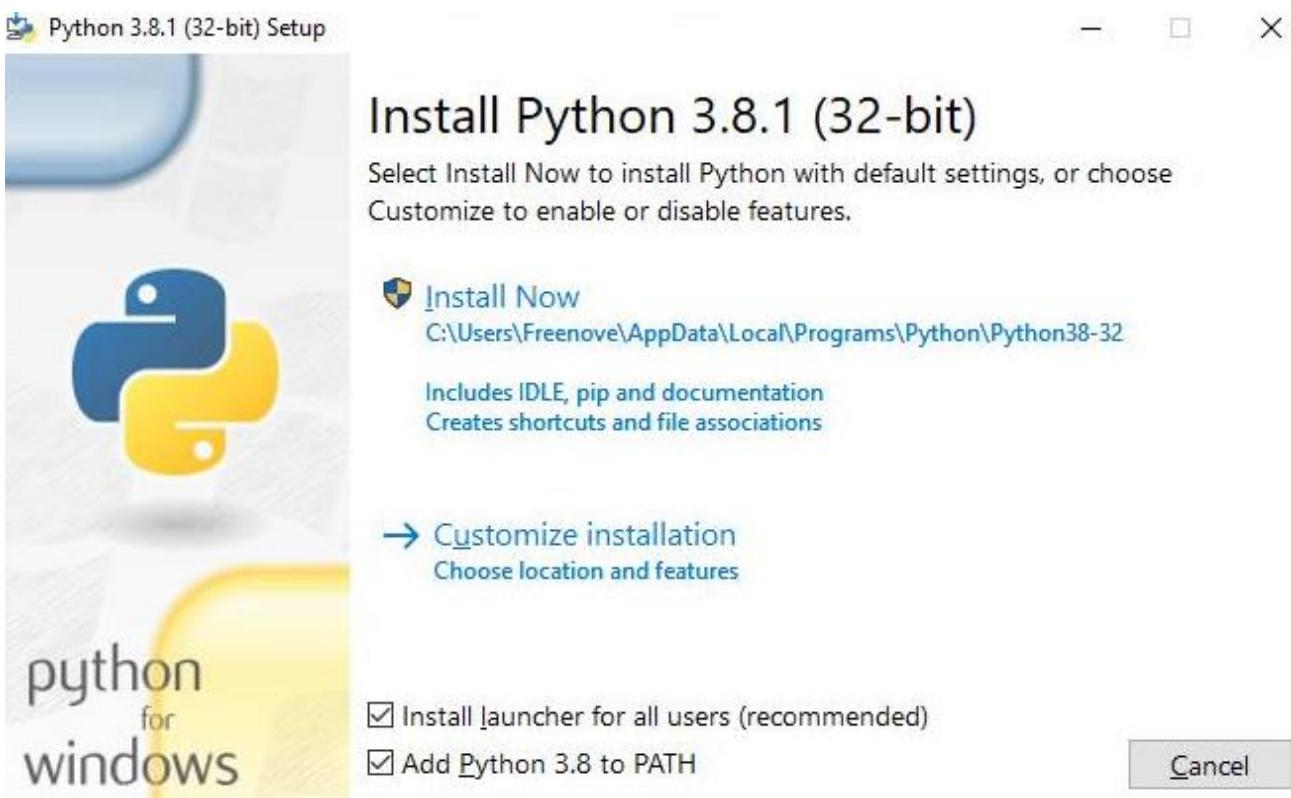
The screenshot shows the Python Releases for Windows page. At the top, there is a navigation bar with three tabs: "About", "Downloads", and "Documentation". Below the navigation bar, the text "Python >>> Downloads >>> Windows" is displayed. The main title "Python Releases for Windows" is centered above two lists of releases. The first list is for Python 3.8.1 and the second is for Python 2.7.17. Both lists include links for "Latest Python 3 Release - Python 3.8.1" and "Latest Python 2 Release - Python 2.7.17".

Version	Operating System	Description
Gzipped source tarball	Source release	
XZ compressed source tarball	Source release	
macOS 64-bit installer	Mac OS X	for OS X 10.9 and later
Windows help file	Windows	
Windows x86-64 embeddable zip file	Windows	for AMD64/EM64T/x64
Windows x86-64 executable installer	Windows	for AMD64/EM64T/x64
Windows x86-64 web-based installer	Windows	for AMD64/EM64T/x64
Windows x86 embeddable zip file	Windows	
Windows x86 executable installer	Windows	
Windows x86 web-based installer	Windows	

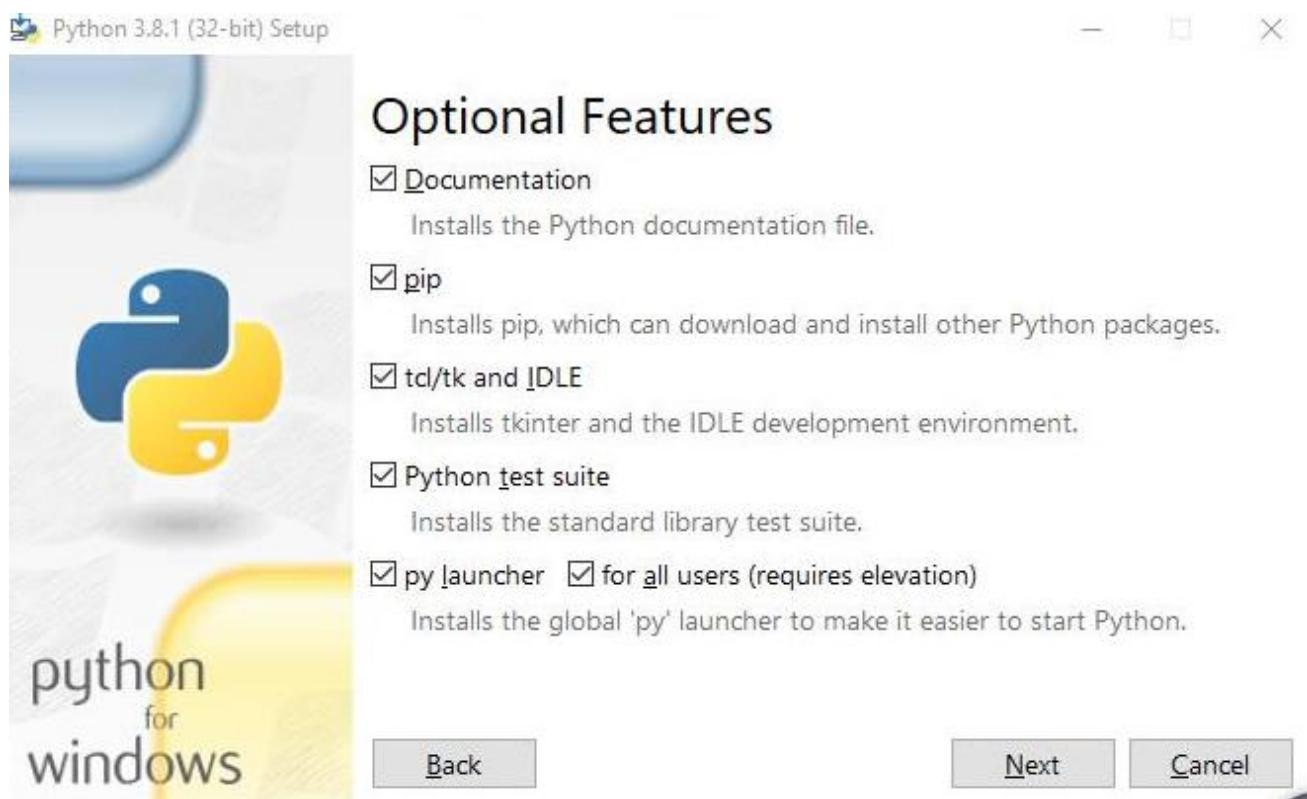
Click **Latest Python 3 Release - Python 3.8.1** (as an example).

Version	Operating System	Description
Gzipped source tarball	Source release	
XZ compressed source tarball	Source release	
macOS 64-bit installer	Mac OS X	for OS X 10.9 and later
Windows help file	Windows	
Windows x86-64 embeddable zip file	Windows	for AMD64/EM64T/x64
Windows x86-64 executable installer	Windows	for AMD64/EM64T/x64
Windows x86-64 web-based installer	Windows	for AMD64/EM64T/x64
Windows x86 embeddable zip file	Windows	
Windows x86 executable installer	Windows	
Windows x86 web-based installer	Windows	

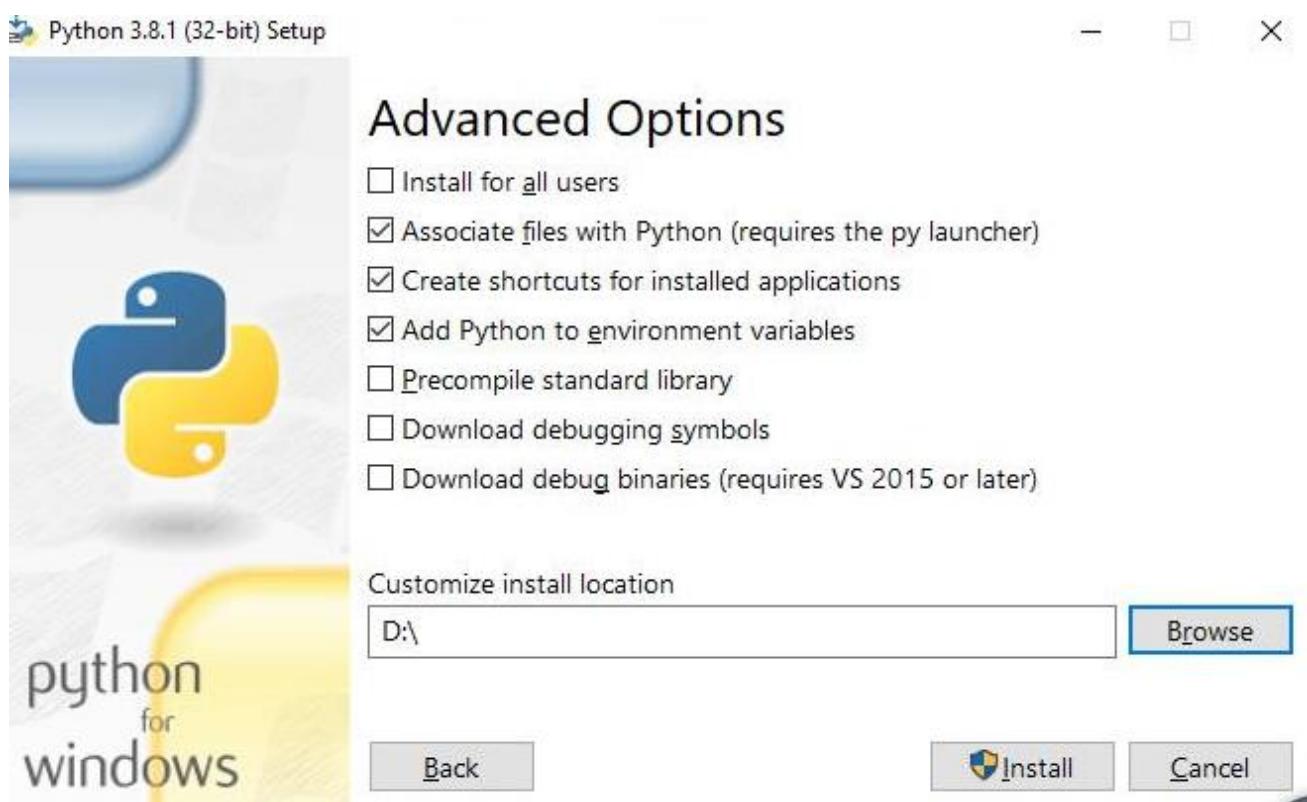
Choose “Windows x86-64 executable installer” to download and install.



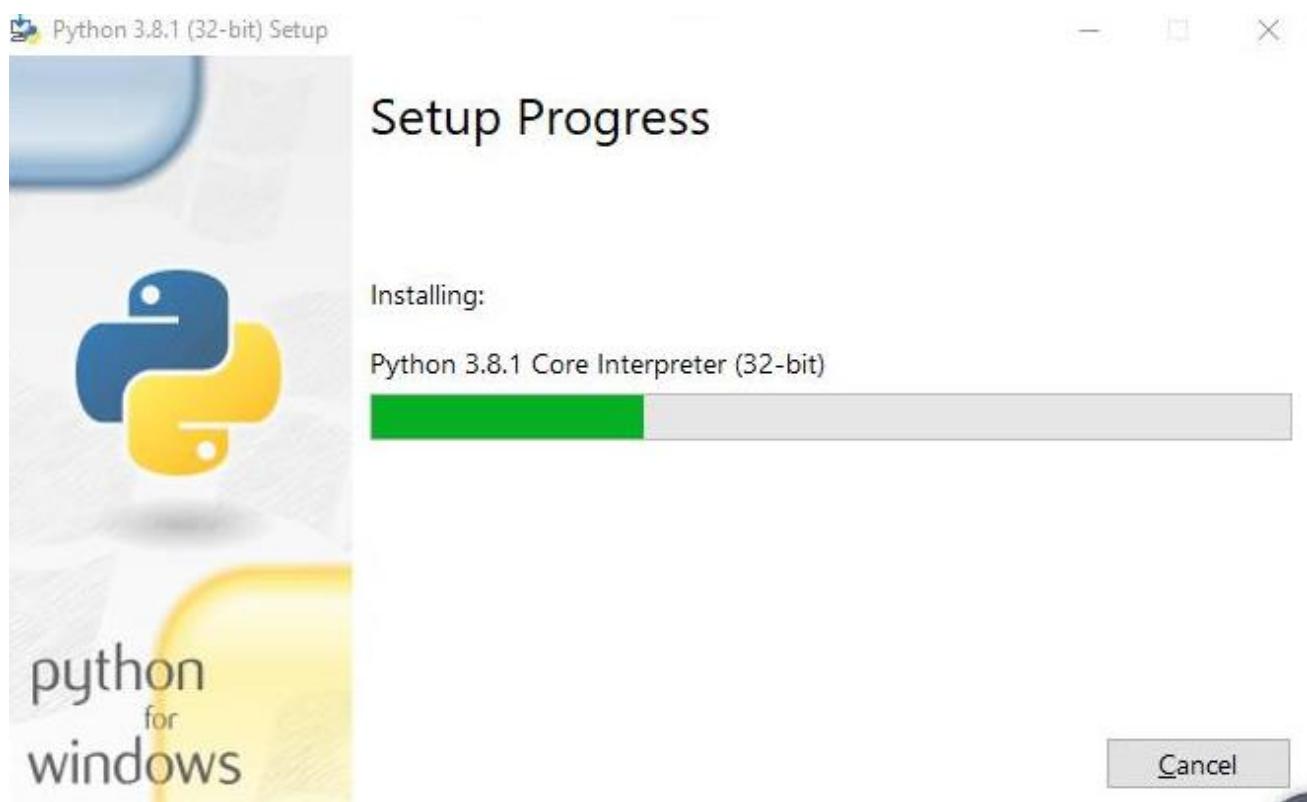
Select "Add Python 3.8 to PATH". And choose Customize installation.



Select all options and click Next.



Here python is installed into D disk as an example (You can choose your own installation path). Click Install.



Wait for installation.



Installation is successful.

Install PyQt5, opencv, numpy and other libraries

If you have not download the zip file, download it via below link:

https://github.com/Freenove/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/archive/master.zip

Then unzip it and delete “-master” to rename it to “Freenove_Robot_Dog_Kit_for_Raspberry_Pi”.

Then put it into D disk, for example.

You can also place it into other disks (like E), but the path in following command should be modified accordingly (replace D: by E:).

Press “win + R” and enter cmd, and click ok. Then enter following commands.

1.Enter D disk. If you put it into E, it should be E:

D:

2.Enter directory where setup_windows.py is located:

cd D:\Freenove_Robot_Dog_Kit_for_Raspberry_Pi\Code

3.Run: setup_windows.py

Python setup_windows.py

C:\Users\Freenove>D:

D:>cd D:\Freenove_Robot_Dog_Kit_for_Raspberry_Pi\Code

D:\Freenove_Robot_Dog_Kit_for_Raspberry_Pi\Code>Python setup_windows.py

Or double-click "setup_windows.py" to execute the installation program, under following path:

Freenove_Robot_Dog_Kit_for_Raspberry_Pi\Code

Or use python3 to run "setup_windows.py".

Note: If the default python in your windows system is not python3 but python2, then change all "python" in "setup_windows.py" to "python3" and run the command "setup_windows.py" as shown below.

```
import os
import sys
import time
flag=0x00
for x in range(1,4):
    if os.system("python -m pip install --upgrade pip") == 0:
        flag=flag | 0x01
        break
for x in range(1,4):
    if os.system("pip3 install PyQt5") == 0:
        flag=flag | 0x02
```

Python3 setup_windows.py



Installation takes some time, please be patient. If all installations are successful, it will prompt "Press any key to continue..." and "All libraries installed successfully".

```

Package      Version
-----
click        7.1.1
numpy         1.18.2
opencv-python 4.2.0.32
Pillow        7.0.0
pip           20.0.2
PyQt5         5.13.2
PyQt5-sip     12.7.1
pyqt5-tools   5.13.2.1.6rc1
python-dotenv 0.12.0
setuptools    41.2.0
Press any key to continue . . .

All libraries installed successfully
  
```

If some libraries are not installed successfully, it will prompt "Some libraries have not been installed yet. Please run '**python setup_windows.py**' again". Then you need to execute the python3 setup_windows.py command again. Most installation failures are caused by a poor network. You can check the network before installing.

Open client

Press "win + R" and enter cmd, and click ok. Then enter following commands.

1.Enter D disk. If you put it into E, it should be E:

D:

2.Enter directory where Main.py is located:

cd D:\Freenove_Robot_Dog_Kit_for_Raspberry_Pi\Code\Client

3.Run Main.py:

Python Main.py

```

C:\Users\Freenove>D:
D:>cd D:\Freenove_Robot_Dog_Kit_for_Raspberry_Pi\Code\Client
D:\Freenove_Robot_Dog_Kit_for_Raspberry_Pi\Code\Client>Python Main.py
  
```

Or double-click "Main.py". under following path:

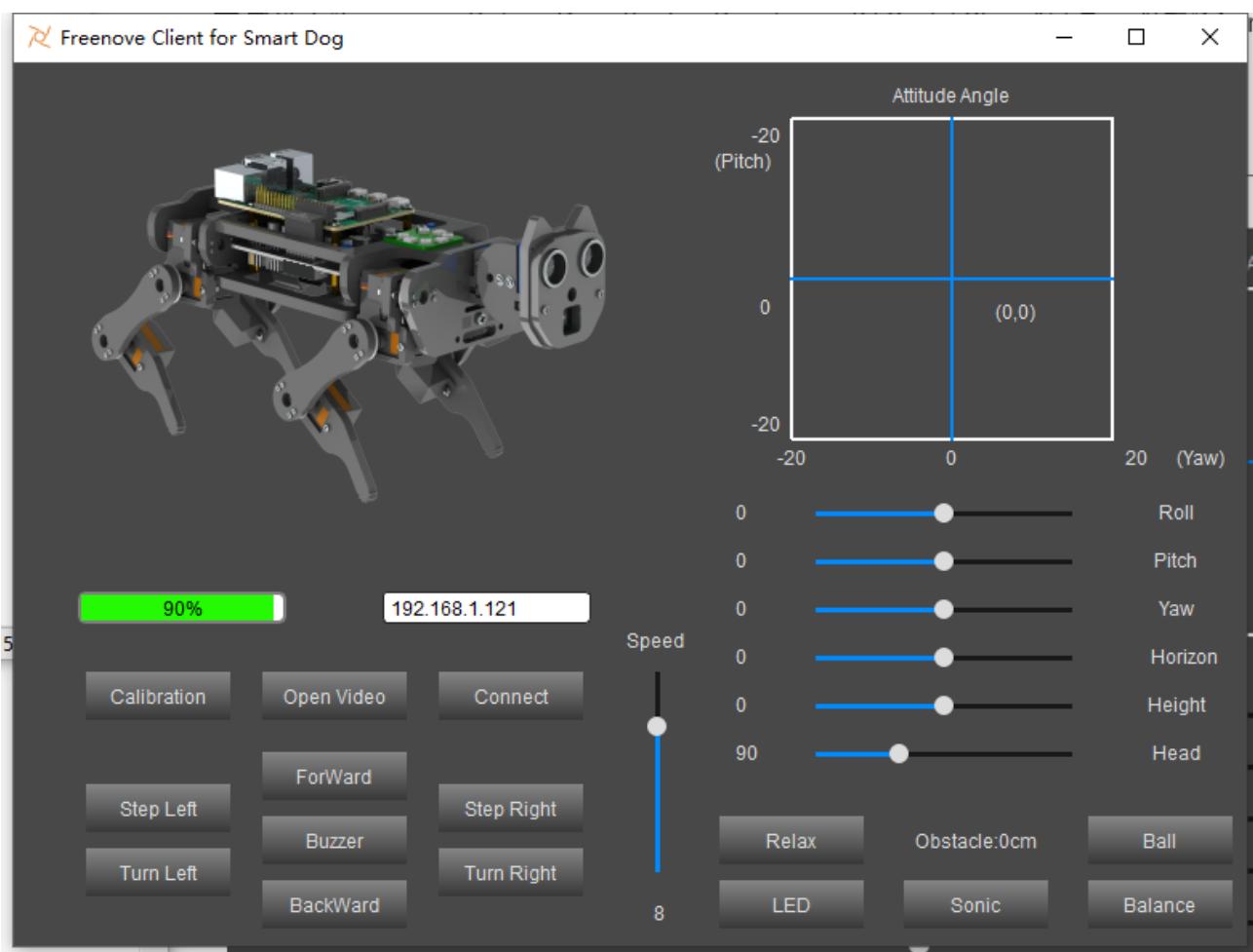
Freenove_Robot_Dog_Kit_for_Raspberry_Pi\Code\Client

Or use python3 to run "Main.py".

Note: If the default python in your windows system is not python3, then change the command to run Main.py as shown below.

Python3 Main.py

The client interface is shown below:



After the client is successfully opened,

1. You need to open the Raspberry Pi and [Turn on the server](#),
2. Enter the Raspberry Pi's IP address in the white IP edit box,
3. Click "**Connect**" to connect client to the Raspberry Pi.

After the connection is successful, you need to calibrate the robot in [Calibration](#) section. After the calibration is completed, the robot dog can be controlled to move.

Note: when Raspberry Pi is shut down, server will be closed. You need open server again the next time.

Run Client on macOS system

Here take MacOS 10.13 as an example. To run the client on MacOS, you need to install some software and libraries. During the installation, it does not need to run a server and use a Raspberry Pi. You can turn off the Raspberry Pi first. After the installation is completed, turn on the Raspberry Pi and run the server. MacOS 10.13 comes with python2, but no python3. The programs of this robot can only run on python3.

Install python3

Download installer, link <https://www.python.org/downloads/>

Python 3.8.1	Dec. 18, 2019	 Download
Python 3.7.6	Dec. 18, 2019	 Download

Click Python 3.8.2.

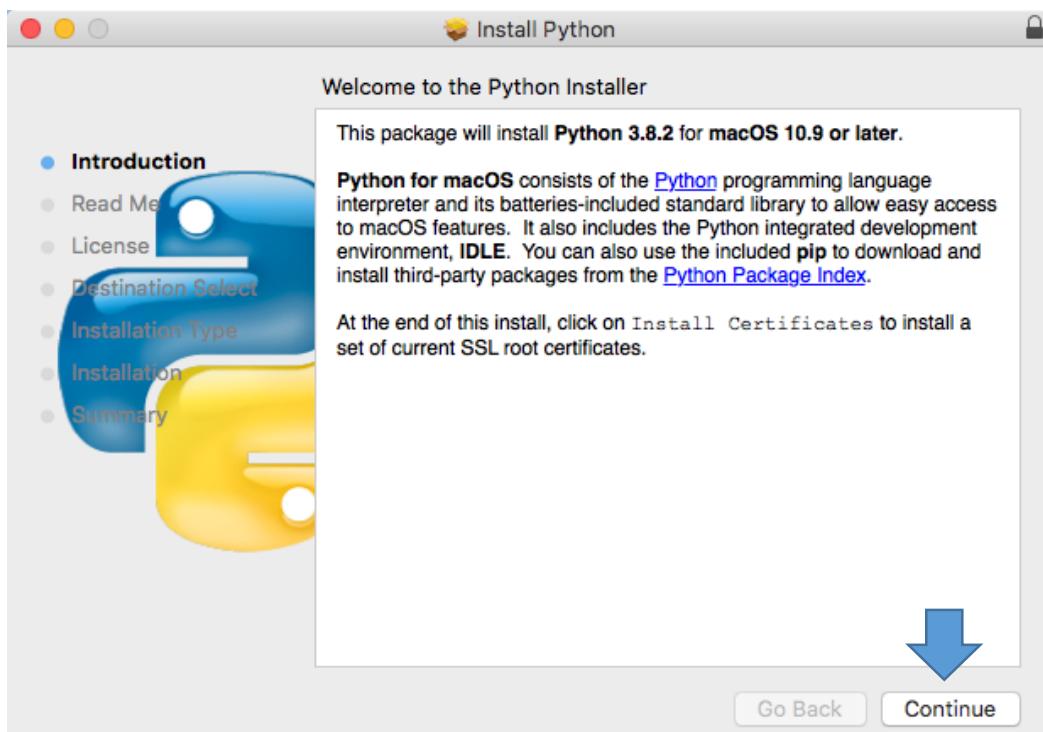
If your macOS is 11. Like 11.0, please install **python 3.9**.

If your macOS is NOT 11, like 10.15, please install **python 3.8**. If you have installed python 3.9. You need uninstall it first.

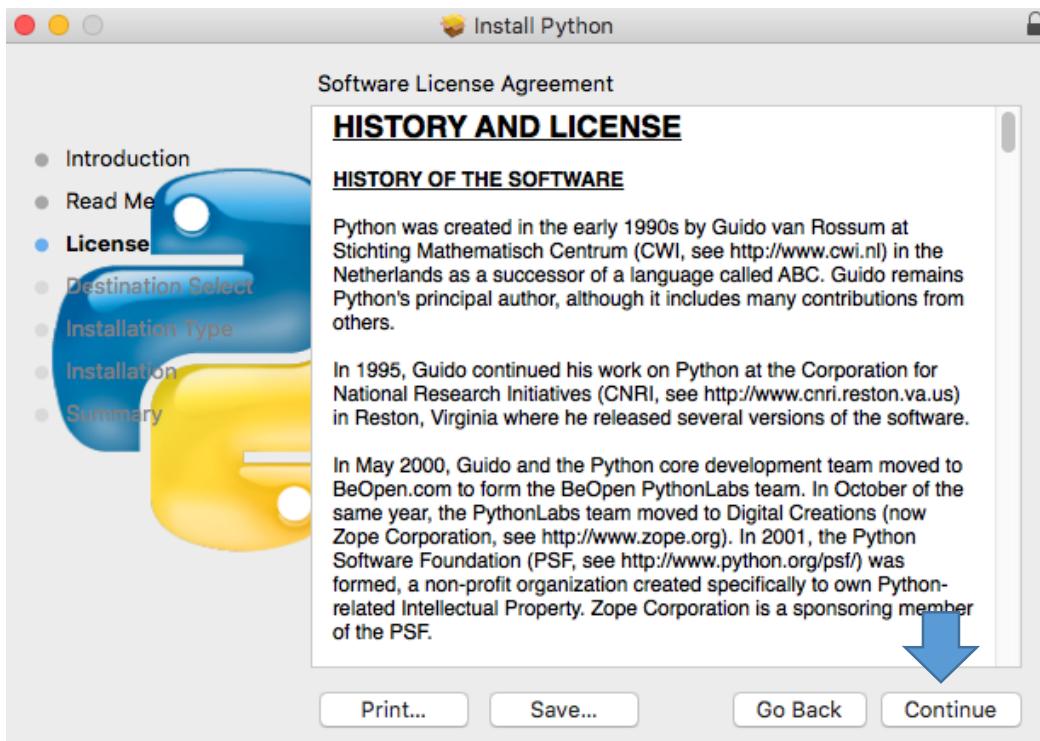
Version	Operating System	Description
Gzipped source tarball	Source release	
XZ compressed source tarball	Source release	
macOS 64-bit installer	Mac OS X	for OS X 10.9 and later
Windows help file	Windows	
Windows x86-64 embeddable zip file	Windows	for AMD64/EM64T/x64
Windows x86-64 executable installer	Windows	for AMD64/EM64T/x64
Windows x86-64 web-based installer	Windows	for AMD64/EM64T/x64
Windows x86 embeddable zip file	Windows	
Windows x86 executable installer	Windows	
Windows x86 web-based installer	Windows	

On the bottom of the page, click macOS 64-bit installer to download installer.

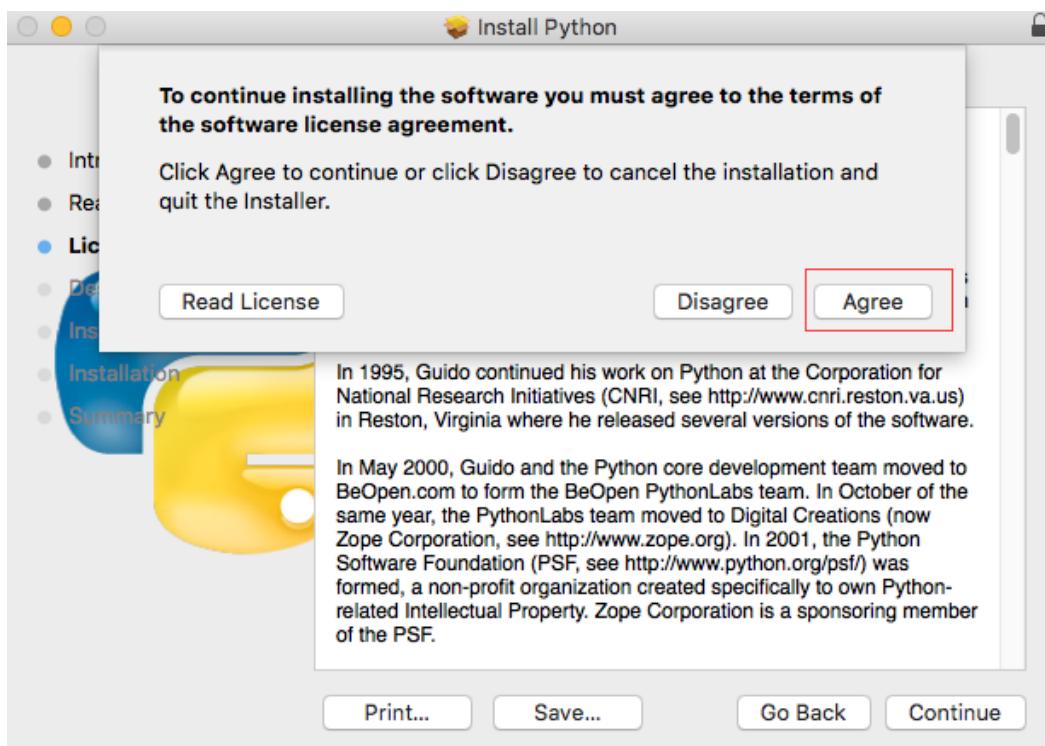
Then install python.



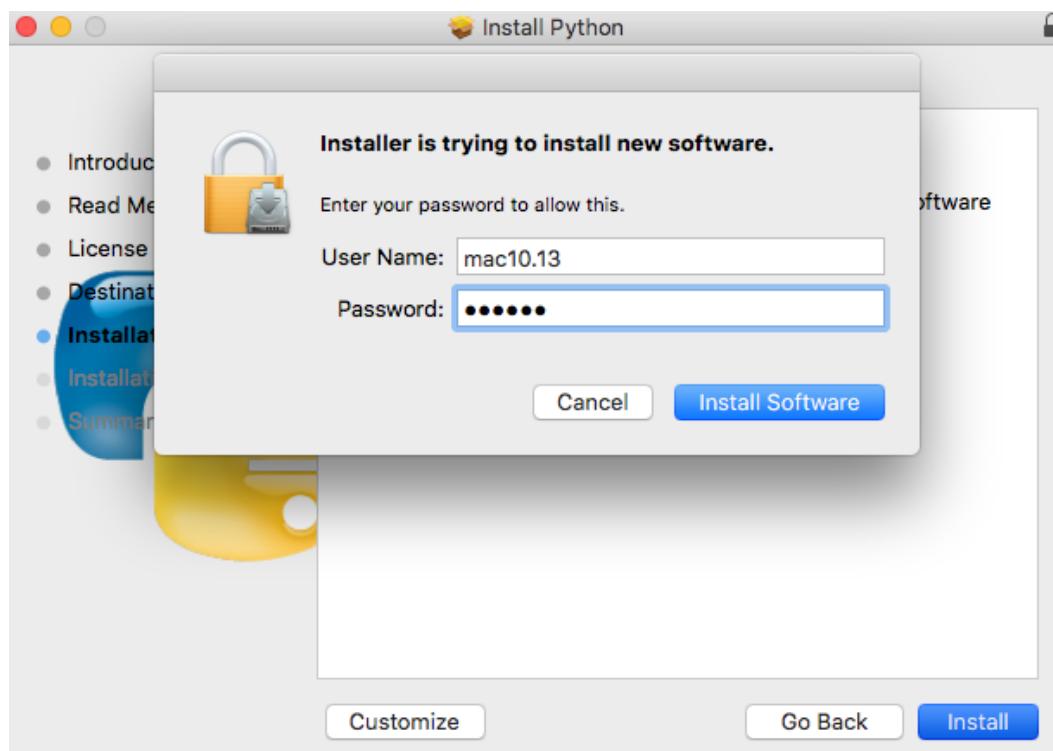
Click Continue.



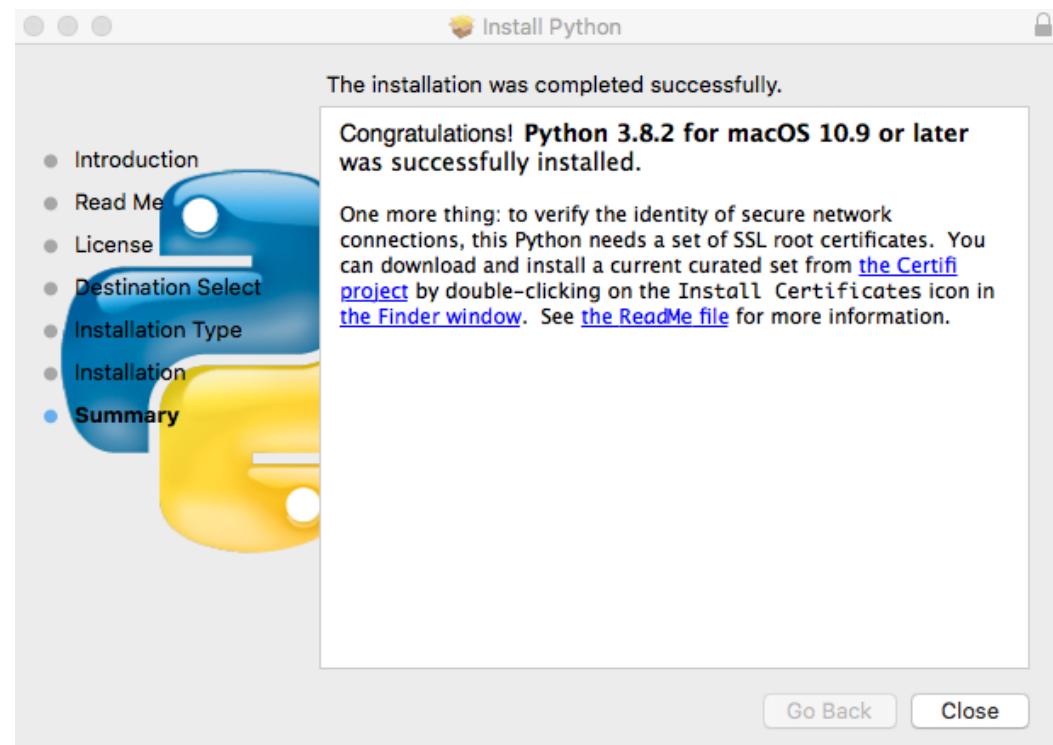
Click Continue.



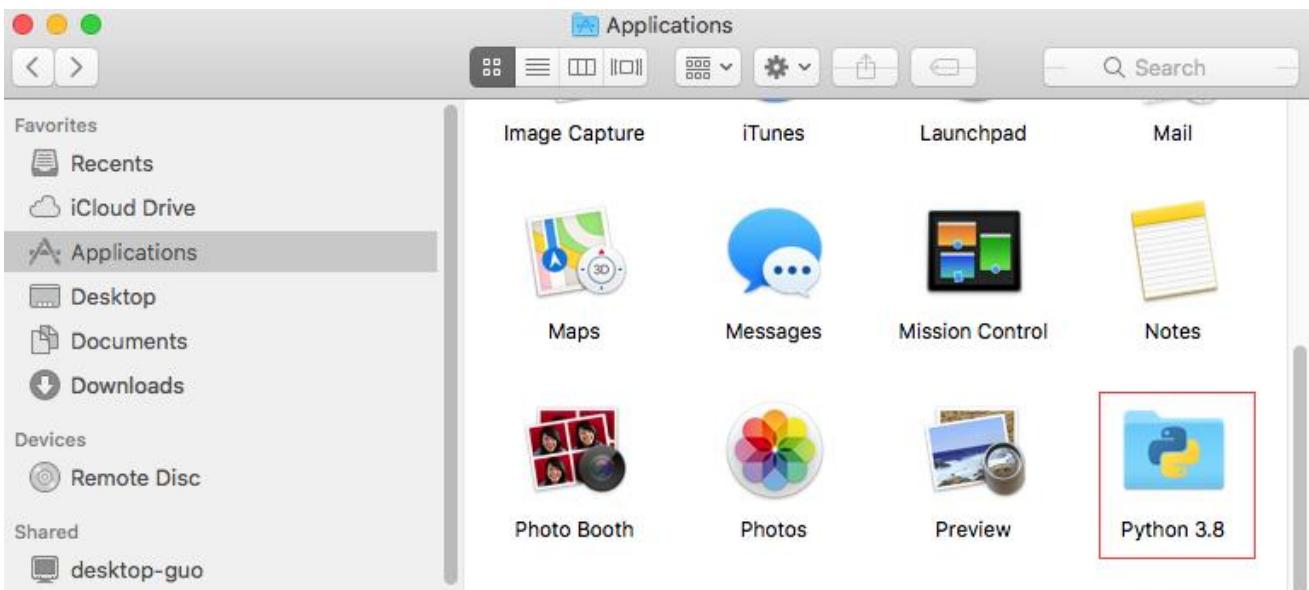
Click Agree.



Click Install. If your computer has a password, enter the password and click Install Software.



Now the installation is completed successfully.



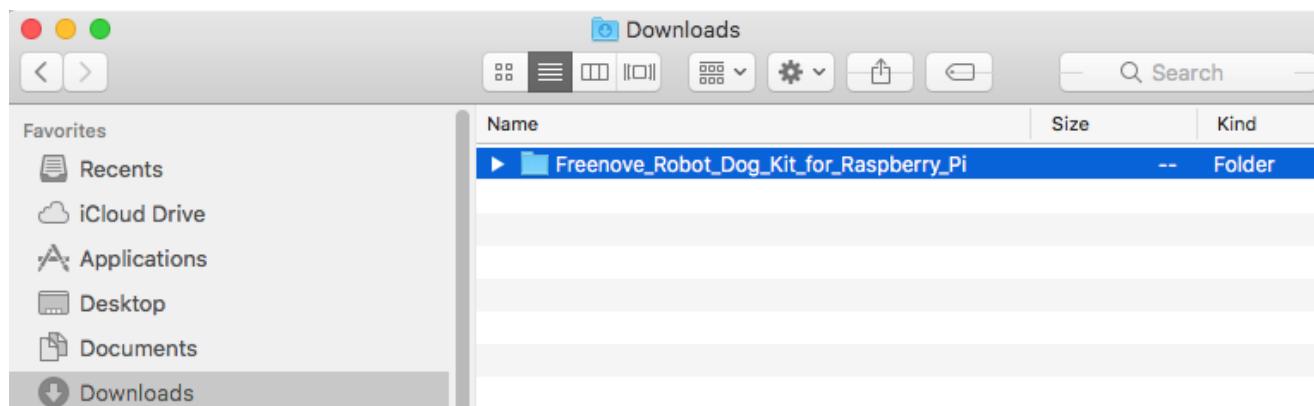
You can find in Applications.

Install PyQt5、opencv、numpy and other libraries

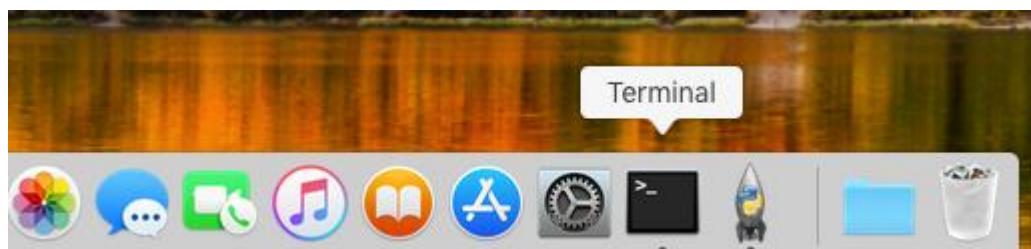
If there is no robot dog code in your macOS, you can download it via link below:

https://github.com/Freenove/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/archive/master.zip

After downloading successfully, you can find it under “Downloads”.



Open “Terminal”.



Type following command in Terminal.

1. Enter "Downloads" where the code is located. If your path is different, please modify the command.

```
cd Downloads
```

2. Enter directory where setup_macos.py is located:

```
cd Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/
```

3. Run setup_macos.py:

```
python3 setup_macos.py
```

Installation takes some time, please wait patiently.

Package	Version
numpy	1.18.1
opencv-python-headless	4.2.0.32
Pillow	7.0.0
pip	20.0.2
PyQt5	5.14.1
PyQt5-sip	12.7.1
setuptools	41.2.0

```
All libraries installed successfully  
mac13deMac:Code mac10.13$
```

If some libraries are not installed successfully, it will prompt "Some libraries have not been installed yet. Please run 'python3 setup_windows.py' again". Then you need to execute the python3 setup_windows.py command again. Most installation failures are caused by a poor network. You can check the network before installing.

If you are using **macOS under 11.0, like 10.15**. Just skip to "Open client".

If you are using **macOS 11.0 or later version**. Please run commands below:

```
pip3 uninstall PyQt5  
pip3 install PyQt5
```

Open client

After installation is completed in previous step, now it is in the directory that setup_macos.py is located.

```
Package           Version
-----
numpy            1.18.1
opencv-python-headless 4.2.0.32
Pillow           7.0.0
pip              20.0.2
PyQt5            5.14.1
PyQt5-sip        12.7.1
setuptools       41.2.0
```

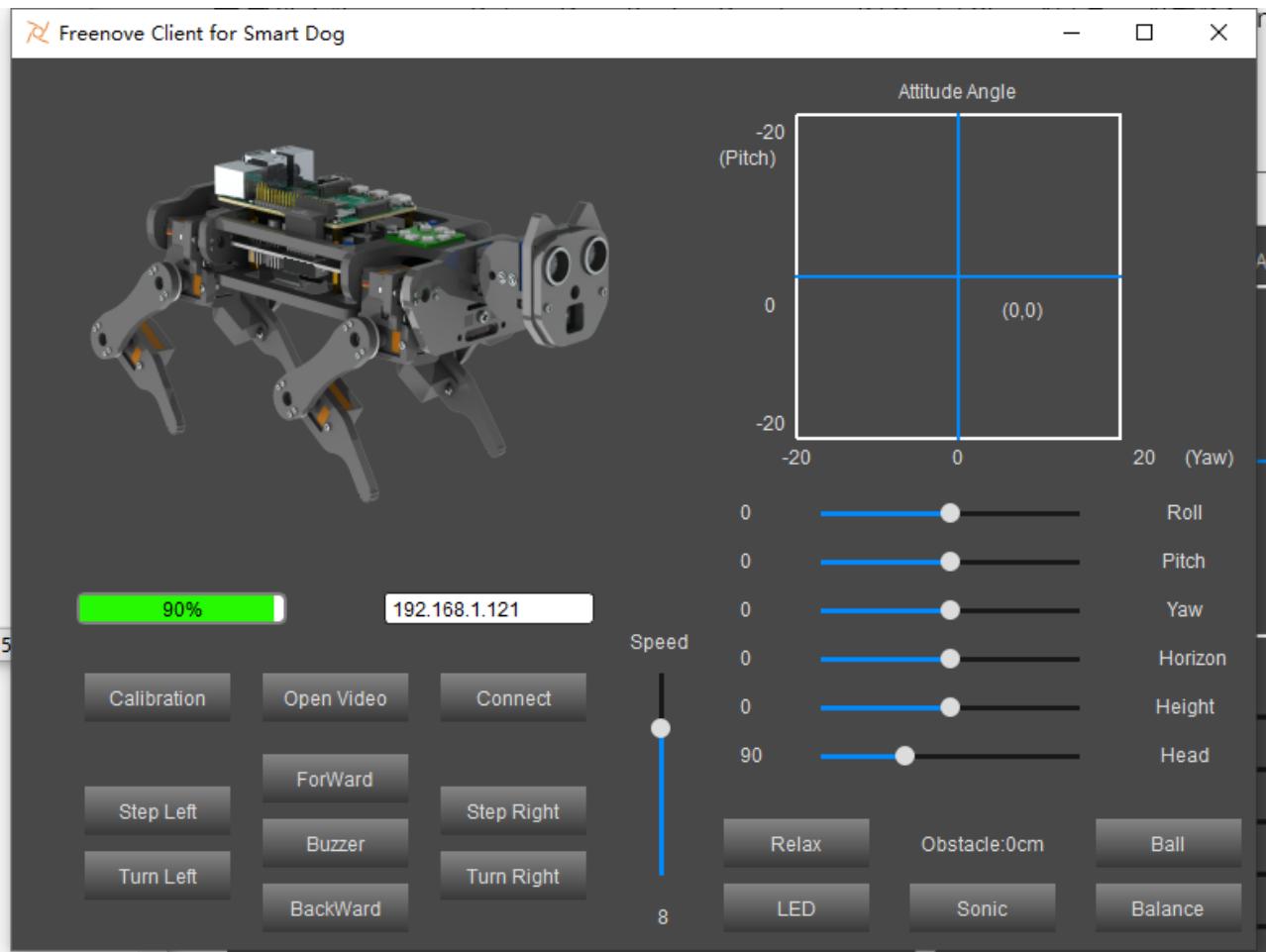
```
All libraries installed successfully
mac13deMac:Code mac10.13$
```

1. Type following command to enter where the program is located.

```
cd Client/
```

2. Type following command to run the program.

```
python3 Main.py
```



After the client is successfully opened,

- 1.You need to open the Raspberry Pi and [Turn on the server](#),
- 2.Enter the Raspberry Pi's IP address in the white IP edit box,
- 3.Click "Connect" to connect client to the Raspberry Pi.

Then you need calibrate the robot in the [Calibration](#) section. After the calibration is completed, robot dog can be controlled to move.

Note: when Raspberry Pi is shut down, server will be closed. You need open server again the next time.

Run client on Raspberry Pi(Linux) system

Install openCv library

Execute following 3 commands in turn.

```
sudo apt-get install -y libopencv-dev python3-opencv
```

```
sudo pip3 install opencv-contrib-python
```

```
sudo apt-get install -y libatlas-base-dev libjasper-dev
```

Open client

Enter the following commands at the terminal.

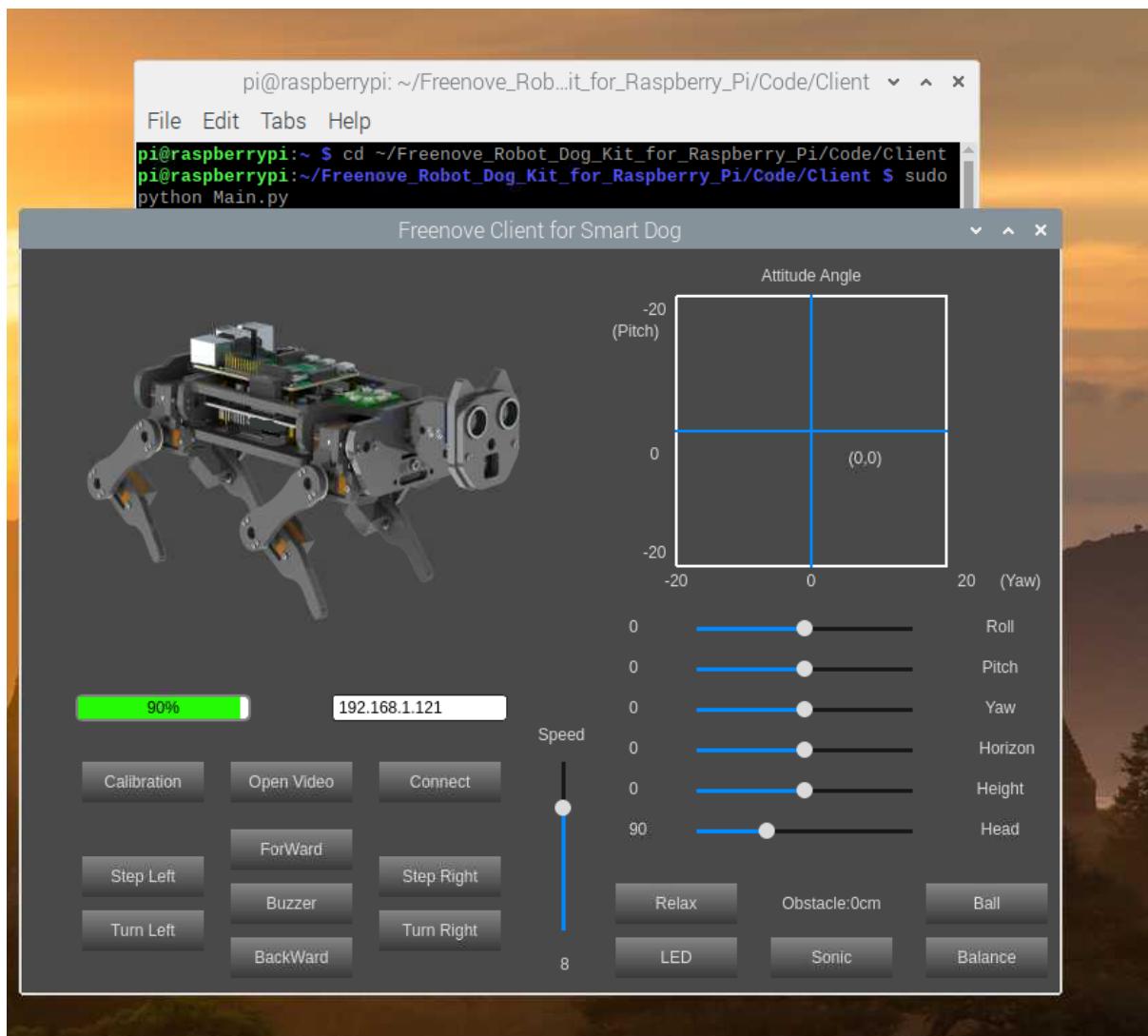
1. Use the cd command to go to the directory where Main.py is located.

```
cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Client
```

2. Run Main.py:

```
sudo python Main.py
```

The interface is shown below. The face recognition cannot work well because it need more computing power than Raspberry Pi has.



After the client is successfully opened,

- 1.You need to open the Raspberry Pi and [Turn on the server](#),
- 2.Enter the Raspberry Pi's IP address in the white IP edit box,
- 3.Click "Connect" to connect client to the Raspberry Pi.

After the connection is successful, you need to calibrate the four legs of the robot dog in [Calibration](#) section.

After the calibration is completed, the robot dog can be controlled to move.

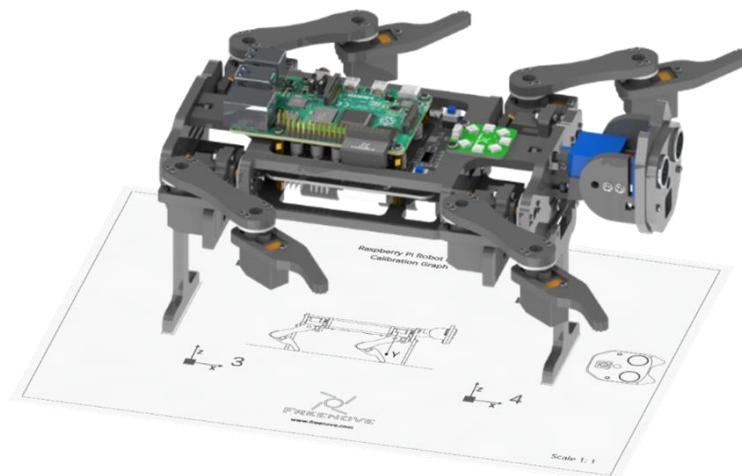
Note: when Raspberry Pi is shut down, server will be closed. You need open server again the next time.

Calibration

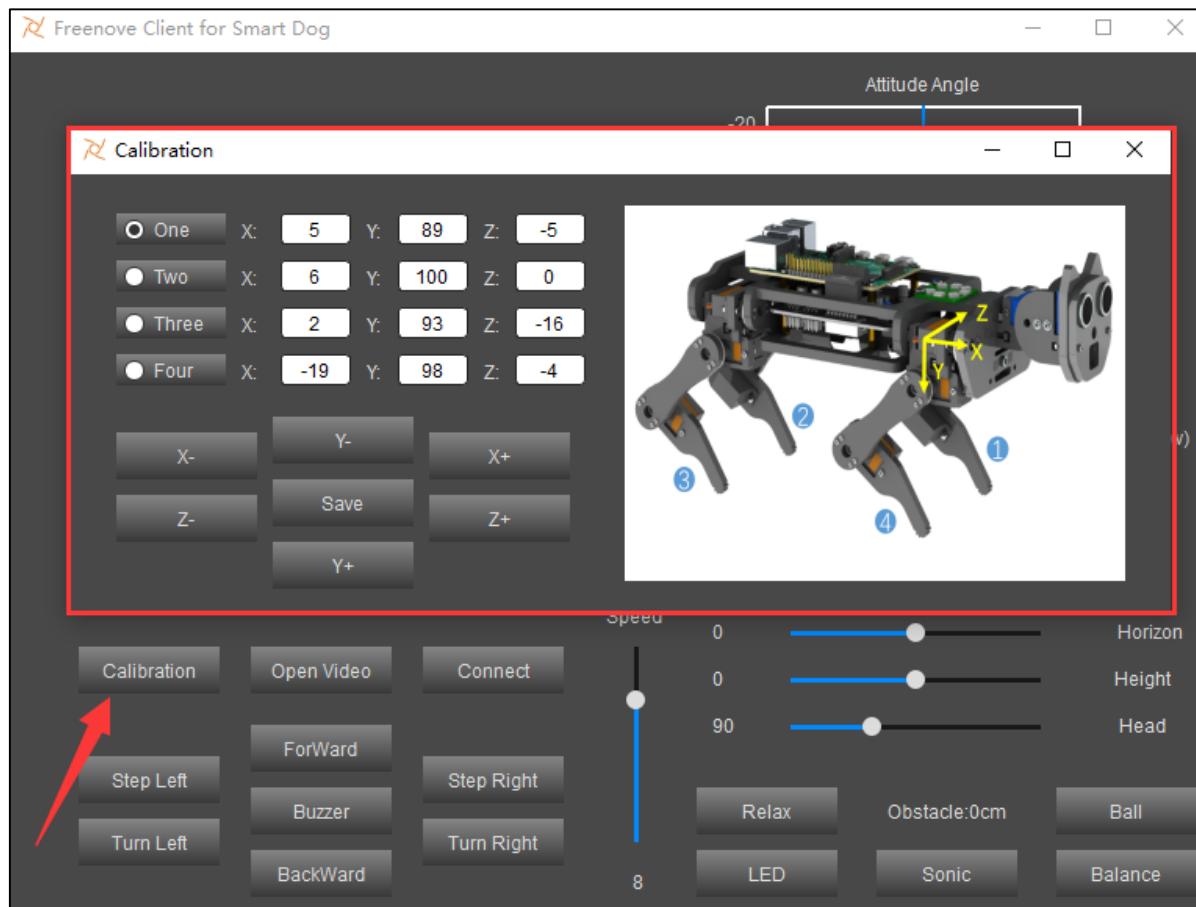
You can refer to this video: <https://youtu.be/l2v9PdwQdvY>

Calibrate the robot.

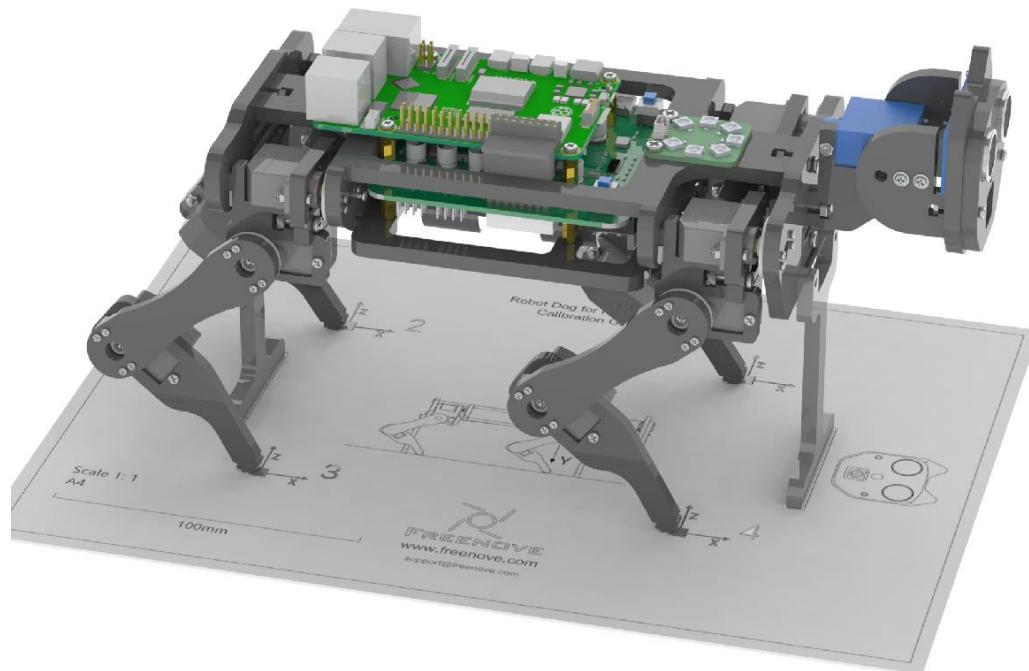
1. Lay the calibration paper on a horizontal hard table.
2. Install the calibration supports on the robot dog and place it on the corresponding position on the calibration paper.



3. Connect client with server successfully, click the "Calibration" button on the client, then a calibration window pops up. And the robot's legs will automatically put to the following position.



4. Calibrate the four legs to make 4 foot points fall to the corresponding positions. Feel the contact force between the robot dog and the ground during calibration. Future control depends on this step.



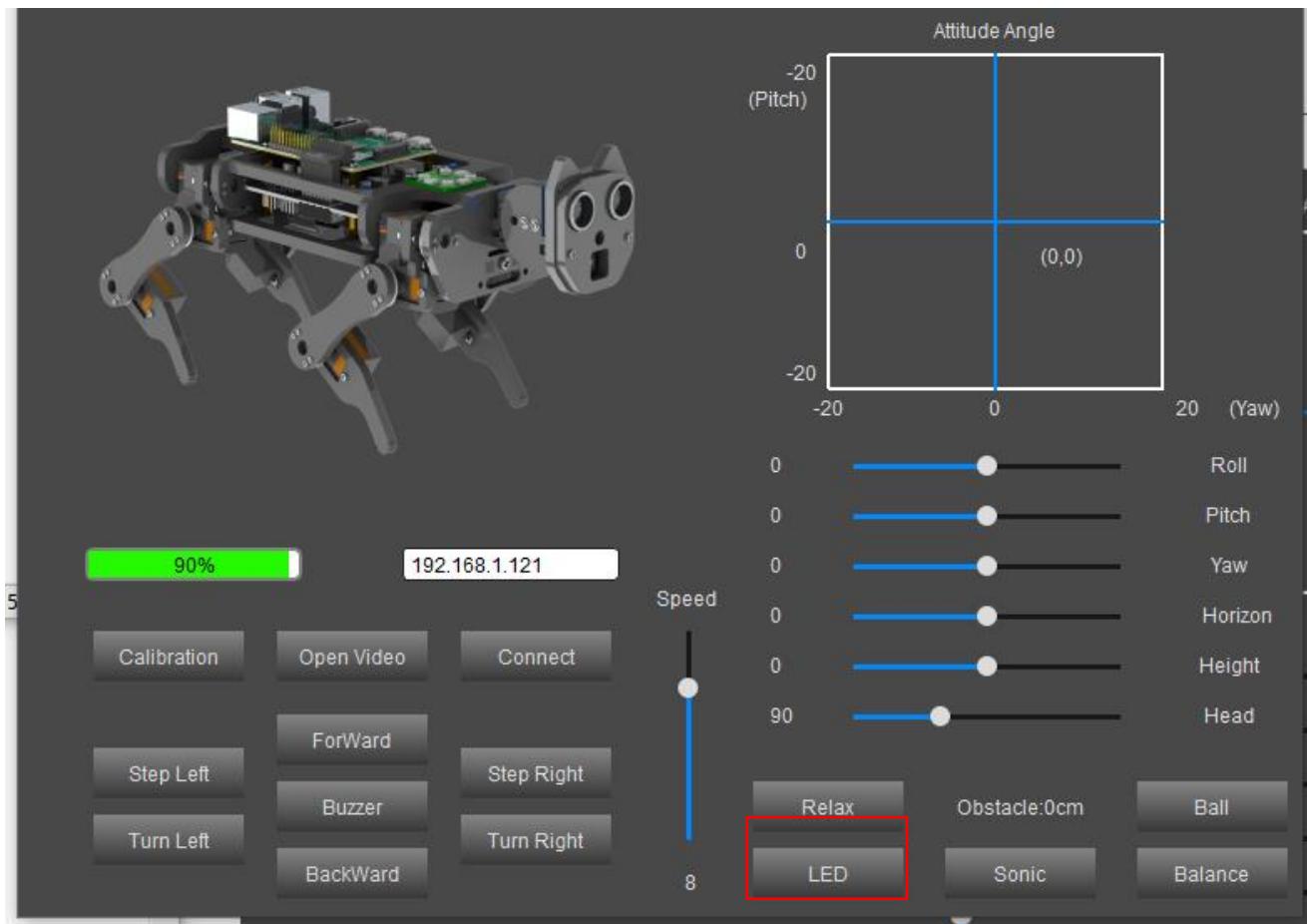
5. After all the 4 points have reached the designated position, click "Save" to save. Now calibration is completed.

NOTE:

1. It is best to have the robot dog walk on a **flat hard** floor. The robot dog may not walk well on other grounds.
2. **There is an offset when controlling the robot dog to walk straightly, which is normal.** It is caused by the installation error and the error of the servo itself. As a result, the left and right legs cannot be completely symmetrical, and may differ by 1mm or 2mm. As the walking distance accumulates, this error is constantly superimposed. Then there will be a large offset from the original position.
3. If the calibration is not good enough, it will affect walking. You can **recalibrate** the robot with same steps.

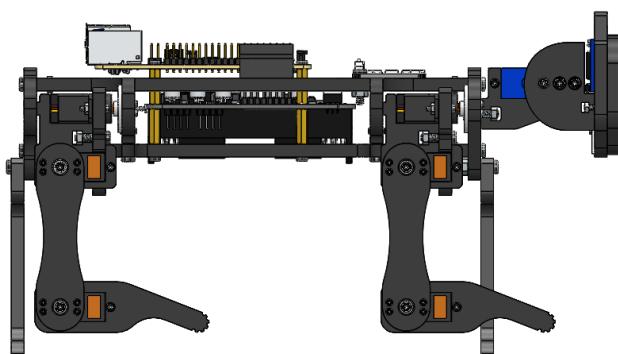
Control

After calibrating successfully, you can control the robot dog to move.

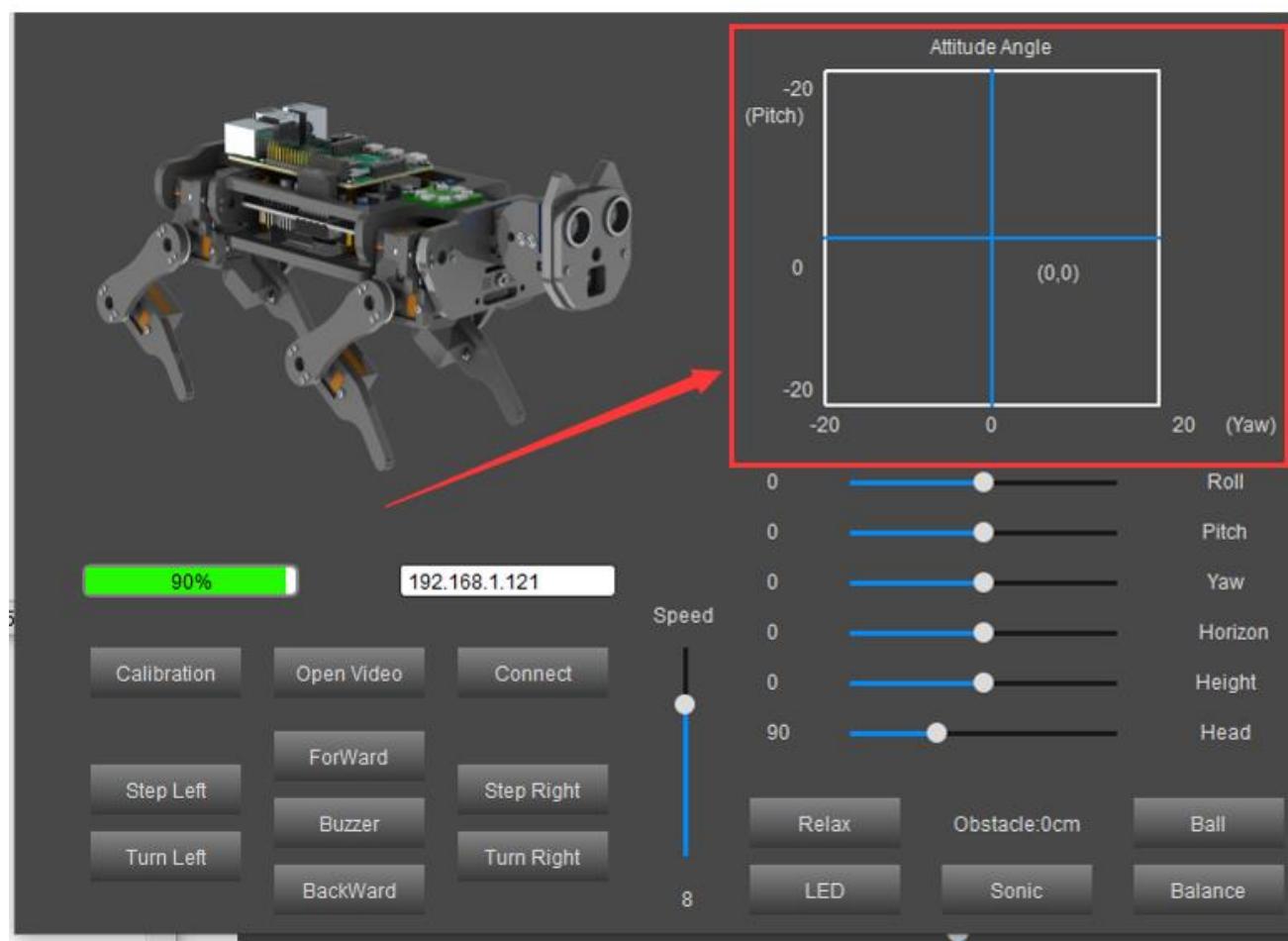


Relax mode.

- When the robot dog moves for 3 minutes at a time, it will feel tired (the servo will get hot). In order to protect the servo, the robot will get into relax mode for 1 minute. **During this time, it won't respond to any motion command.** You can still use the functions of LED, buzzer, real-time video and so on.
- When the robot dog moves for less than 3 minutes and rests for 1 minute. The timer will start from 0. Then the robot can move for 3 minutes again.
- If the robot isn't tired and is standing, when the robot does not receive motion command for 10s, it will get into relax mode. In this situation, it will respond to all commands.



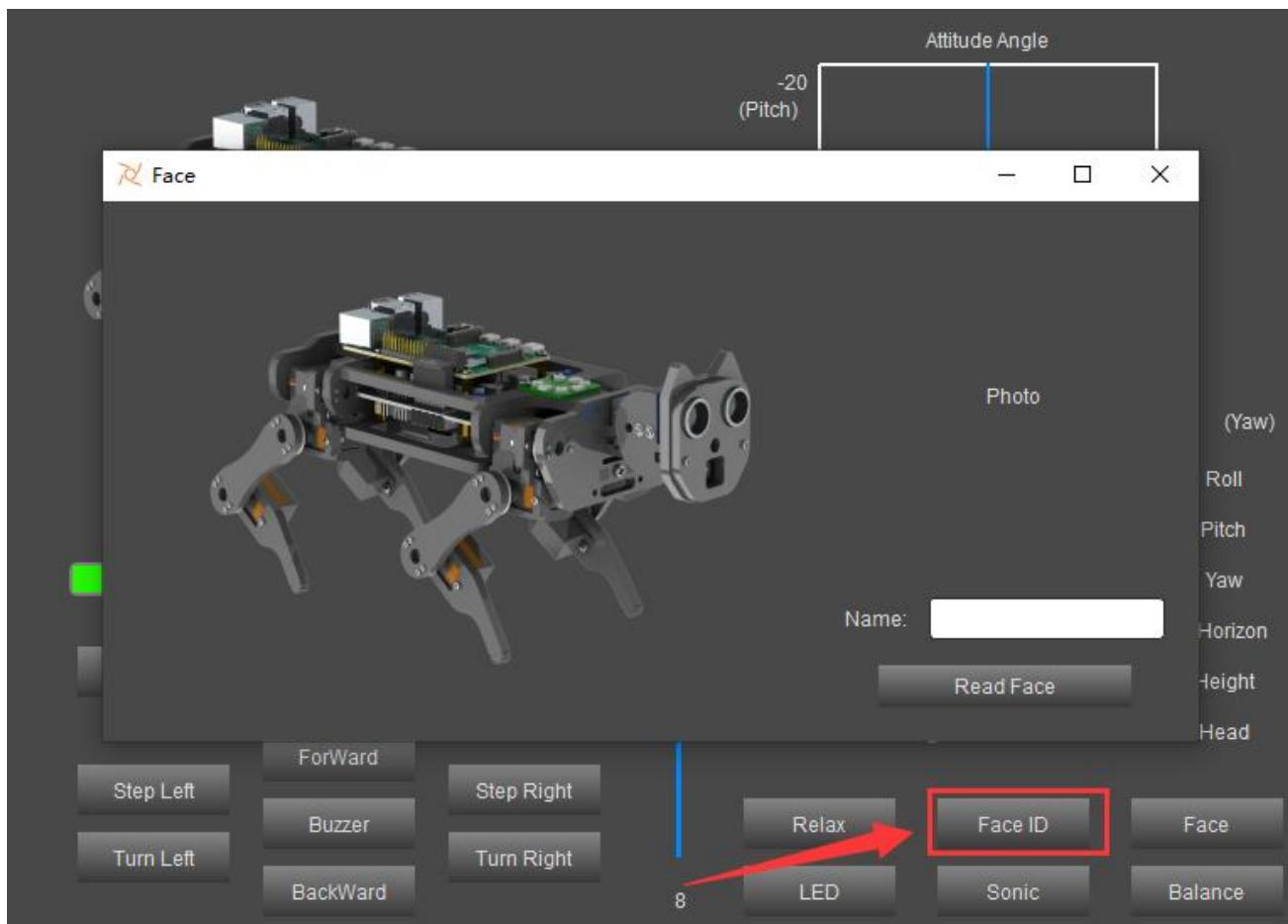
You can click and drag the cross cursor in the coordinate system to adjust the yaw and pitch angle of body.



The following is the corresponding operation of the buttons and keyboards.

Button on Client	Key	Action
ForWard	W	Move
BackWard	S	Back off
Turn Left	A	Turn left
Turn Right	D	Turn right
Step Left	Q	Step Left
Step Right	E	Step Right
Connect/ Disconnect	C	On/Off Connection
Open Video/ Close Video	V	On/Off Video
Calibration	M	Open calibration interface
Buzzer/Noise	Space	On/Off Buzzer
Relax	R	Relax station
LED	L	Open LED control interface
Sonic	U	Measure and display distance from obstacle
Balance	B	Open/Close balance mode
Face/Ball/Close	F	Face recognition and ball tracking
Face ID		Input images of human faces

Input images of human faces and recognize them.



1. Click "Face ID".
2. Enter name in the box of the pop-up window.
3. Click "Read Face".
4. A picture is taken and recorded every two seconds, and a total of 30 images will be taken. **Try to show faces at different distances and angles during the shooting process.** (When the face is not recognized, the picture will not be recorded until the face is recognized again.)
5. **After the 30 images are recorded, you can close the window** and click "Face" on the Right to identify the face.

Note: Do NOT use different names when re-entering images of the same person to avoid client working abnormally.

The function of SliderBar is below:

SliderBar	Function
Head	Adjust head angle.
Height	Control body height.
Horizon	Make body move forward or back.
Yaw	Adjust Yaw angle of body
Pitch	Adjust Pitch angle of body
Roll	Adjust Roll angle of body

Note:

If the robot work abnormally, please check following contents.

1. Check the battery level. Low battery level will make the server shut down.
2. Check if the wireless connection is disconnected.
3. Check if the Raspberry Pi is stuck.
4. If all three points above work well, please restart server and client. If there still is any abnormality, please contact us by email (support@freenove.com). We will help you.

Free your innovation

If you have any concerns, please feel free to contact us via support@freenove.com

If you want to write your own program to control the robot dog, you can follow this chapter.

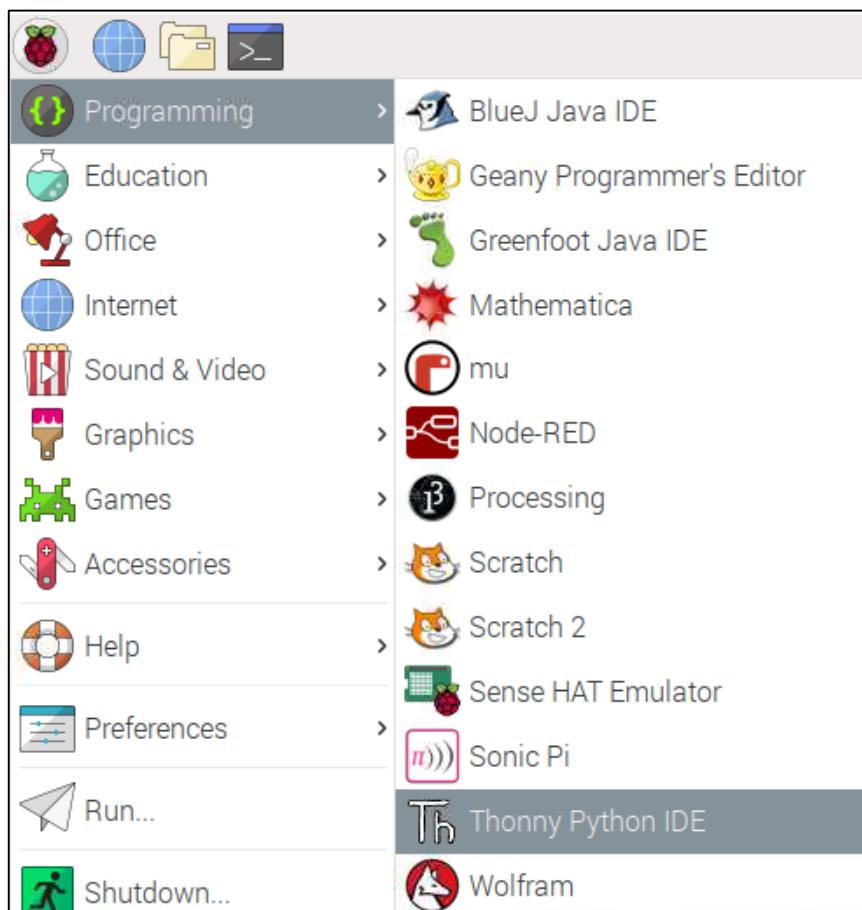
The robot dog program is based on python3. If your python is python2 by default, please change to python3.

If you have never learned python before, you can learn some basics through the following links:

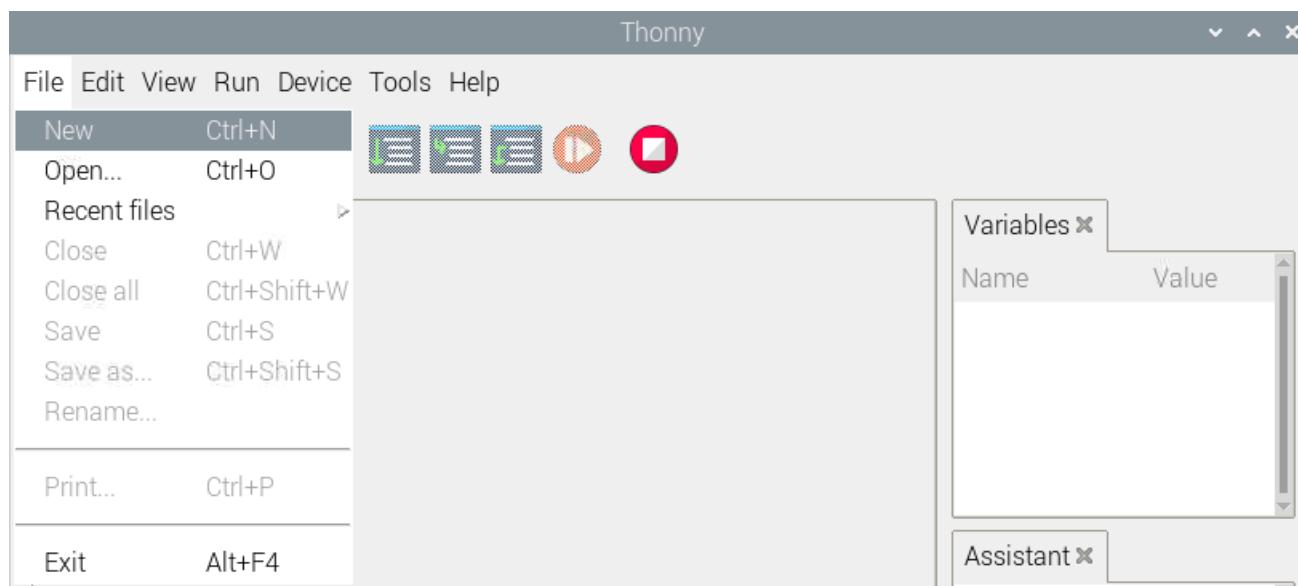
<https://python.swaroopch.com/basics.html>

Program

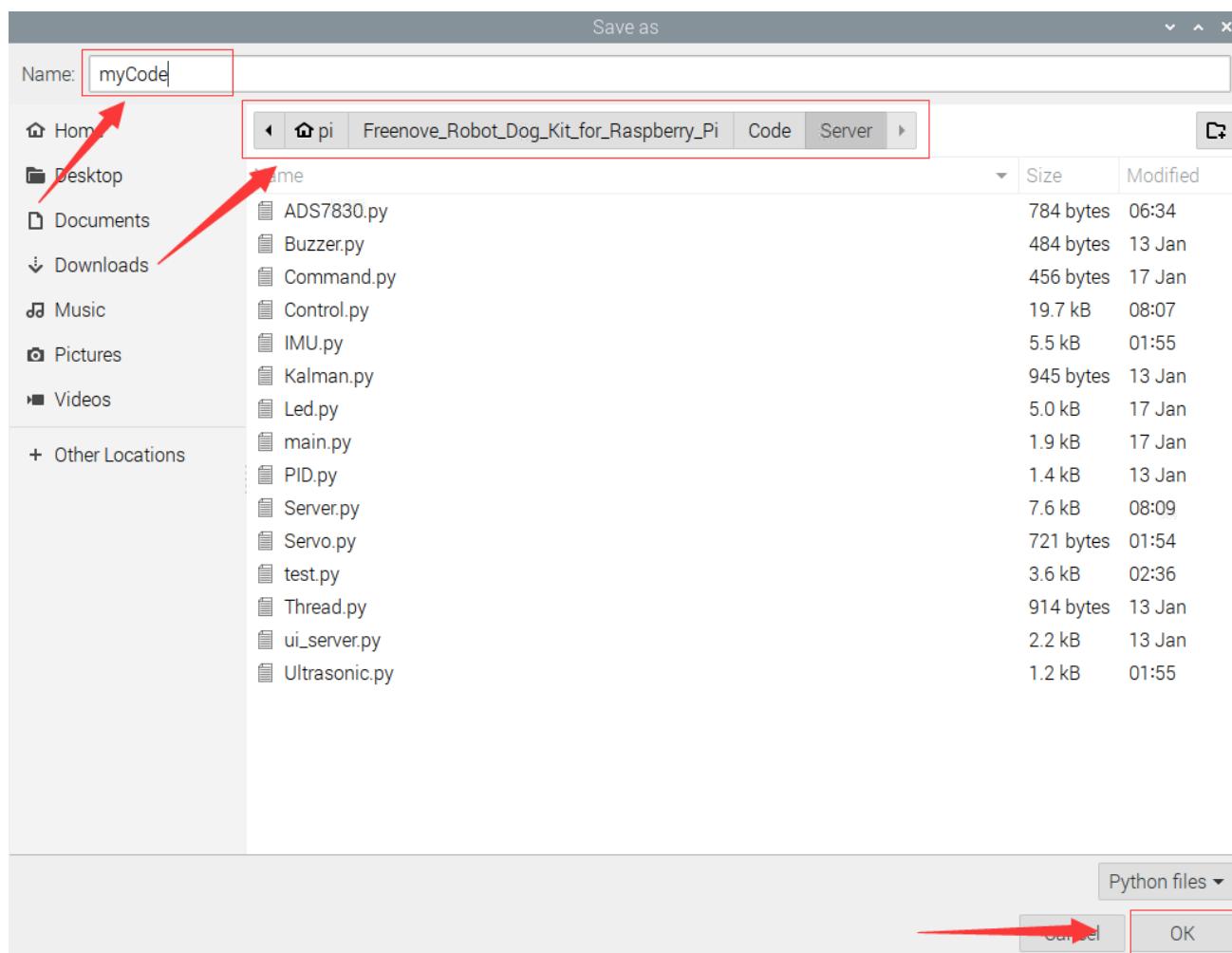
First, open Thonny Python IDE which is easy to use for beginners.



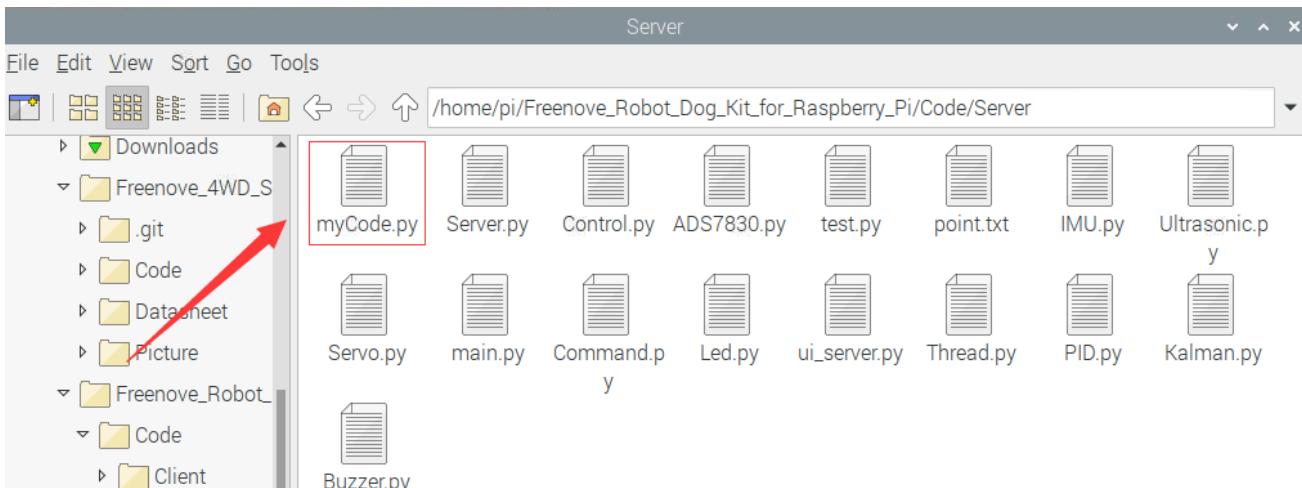
Create a new file.



Name it with myCode as an example and save it in Server folder of robot code folder.



Open the Server folder of the robot dog code and you can see the file you created.



Write the code in myCode.py as below and click save after finished, as shown below.

```

1 #Import everything in the control module,
2 #including functions, classes, variables, and more.
3
4 from Control import *
5
6 #Creating object 'control' of 'Control' class.
7 control=Control()
8
9 #Using the forward function, let the robot dog move forward five steps and keep standing.
10 for i in range(5):
11     control.forward()
12 control.stop()
13
14 #Turn the robot dog's body 10 degrees to the right
15 for i in range(10):
16     control.attitude(0,0,i)
17     time.sleep(0.1)
18
19 #Turn the robot dog's body 20 degrees to the left
20 for i in range(10,-10,-1):
21     control.attitude(0,0,i)
22     time.sleep(0.1)
23
24 #Straighten the robot dog's body
25 for i in range(-10,0,1):
26     control.attitude(0,0,i)
27     time.sleep(0.1)
28
29 #Using the forward function, let the robot dog move forward five steps and keep standing.
30 for i in range(5):
31     control.forward()
32 control.stop()

```

The Thonny IDE interface includes a menu bar (File, Edit, View, Run, Device, Tools, Help), a toolbar with icons for new file, open file, save, run, and stop, and a status bar at the bottom indicating 'Python 3.7.3 (/usr/bin/python3)' and '>>>'. A red arrow points to the 'Save' icon in the toolbar.

Type the following command to enter the directory where myCode.py is located.

```
cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
```

Run myCode.py

```
sudo python myCode.py
```

```
pi@raspberrypi:~ $ cd ~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server
pi@raspberrypi:~/Freenove_Robot_Dog_Kit_for_Raspberry_Pi/Code/Server $ sudo
python myCode.py
```

You can see that your robot dog moves forward for 5 steps, then twists its body at 10 degrees to the right, then 20 degrees to the left, then returns to the original attitude and move forward 5 steps and then stops.

Related py files

Some important functions included in the py files are listed below. If you want to see more detailed code content, please open the corresponding py file to check directly.

ADS7830.py

Function	Description
power(channel)	Enter 0 to return the battery voltage value.

Buzzer.py

Function	Description
run(command)	Enter 0, then the buzzer will not sound. Enter 1, the buzzer will sound.

Contorl.py

Function	Description
coordinateToAngle(x,y,z)	Enter the foot coordinate then return servo angle of each joint in one leg.
angleToCoordinate(a,b,c)	Enter the leg joint angle then return the foot coordinate.
Condition()	Execute corresponding action commands
map()	Mapping a value from one range to another
backWard()	Move backward one step
forward()	Move forward one step
turnLeft()	Turn left one step
turnRight()	Turn right one step
stop()	Stop.
setpLeft()	Move to left one step
setpRight()	Move to right one step
upAndDown()	Adjust height of body
beforeAndAfter()	Make body move forward or backward
attitude(r,p,y)	Set roll, pitch, and yaw angle of the robot.

IMU.py

Function	Description
imuUpdate()	Update the current roll, pitch, and yaw angle of the robot.

Led.py

Function	Description
ledIndex(Index, R, G, B)	Turn on one LED and set color.
wheel(pos)	Create different RGB values.
LED_TYPR(order,R_G_B)	Change the order in which the LED color data is transmitted. When the value of the order parameter is "RGB", the order of data transmission should be: R-G-B; when the value of the order parameter is "GBR", and the order of data transmission should be: G-B-R
theaterChaseRainbow(strip, wait_ms)	The function is used to make 7 LEDs show one color at the same time, and change various colors to blink. The blinking interval is wait_ms, and the default value is 50ms
rainbow(strip, wait_ms)	This function achieves the effect of rainbow breathing. It makes 8 LEDs display same color at the same time, and then change all various colors like breathing. The interval is wait_ms. The default value is 20ms.
rainbowCycle(strip, wait_ms)	This function also achieves the effect of rainbow breathing. but unlike rainbow(), it makes eight LEDs to display different colors at the same time, and then change various color separately. The interval is wait_ms. The default value is 20ms

Servo.py

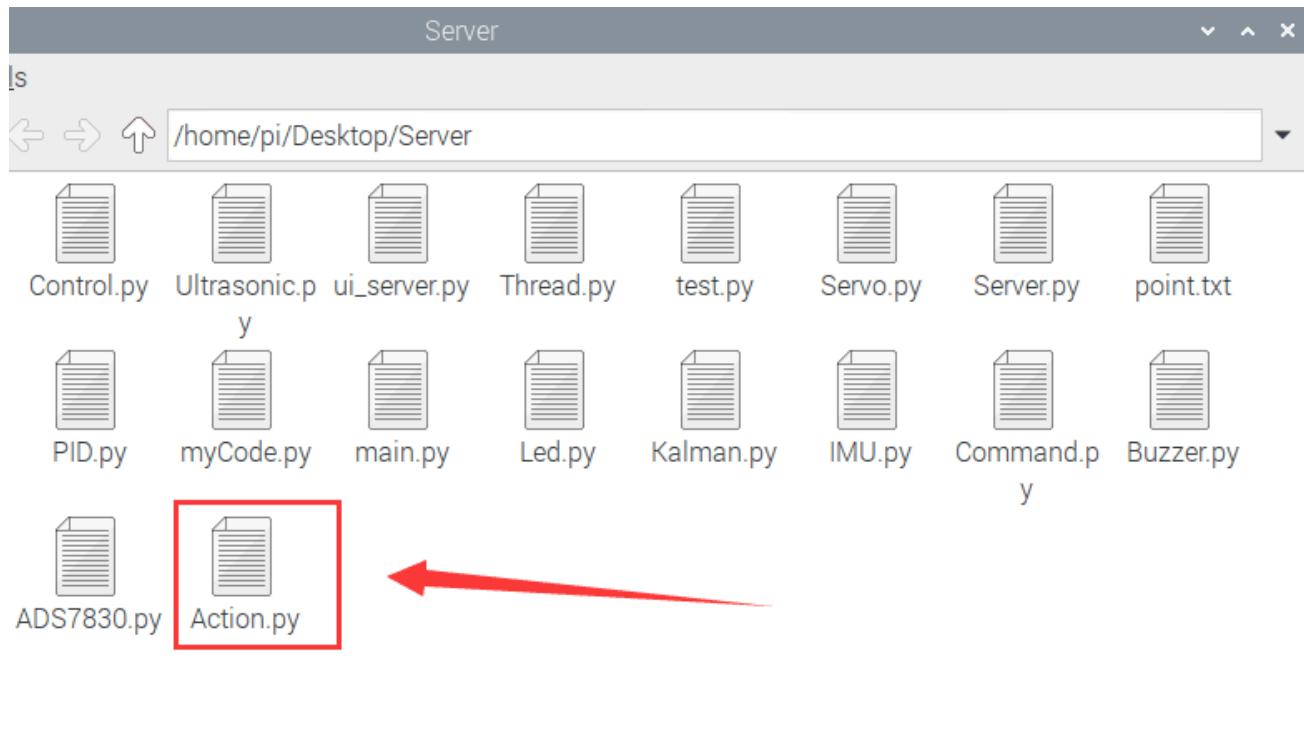
Function	Description
setServoAngle(channel, angle)	Turn the servo of the specified channel to specified angle.

Ultrasonic.py

Function	Description
getDistance()	Obtain the distance between the obstacle in front and the ultrasound.

Custom Action

We have also customized some specific actions, such as push-up, greeting, etc. You can run "Action.py" to play.



Android and iOS app

You can download and install the Freenove **Android app** from below links:

On Google play:

<https://play.google.com/store/apps/details?id=com.freenove.suhayl.Freenove>

On GitHub:

https://github.com/Freenove/Freenove_App_for_Android

In this GitHub repository, you can find the App instruction (Tutorial.pdf).

You can download and install the Freenove **iOS app** by searching **freenove** in app store.



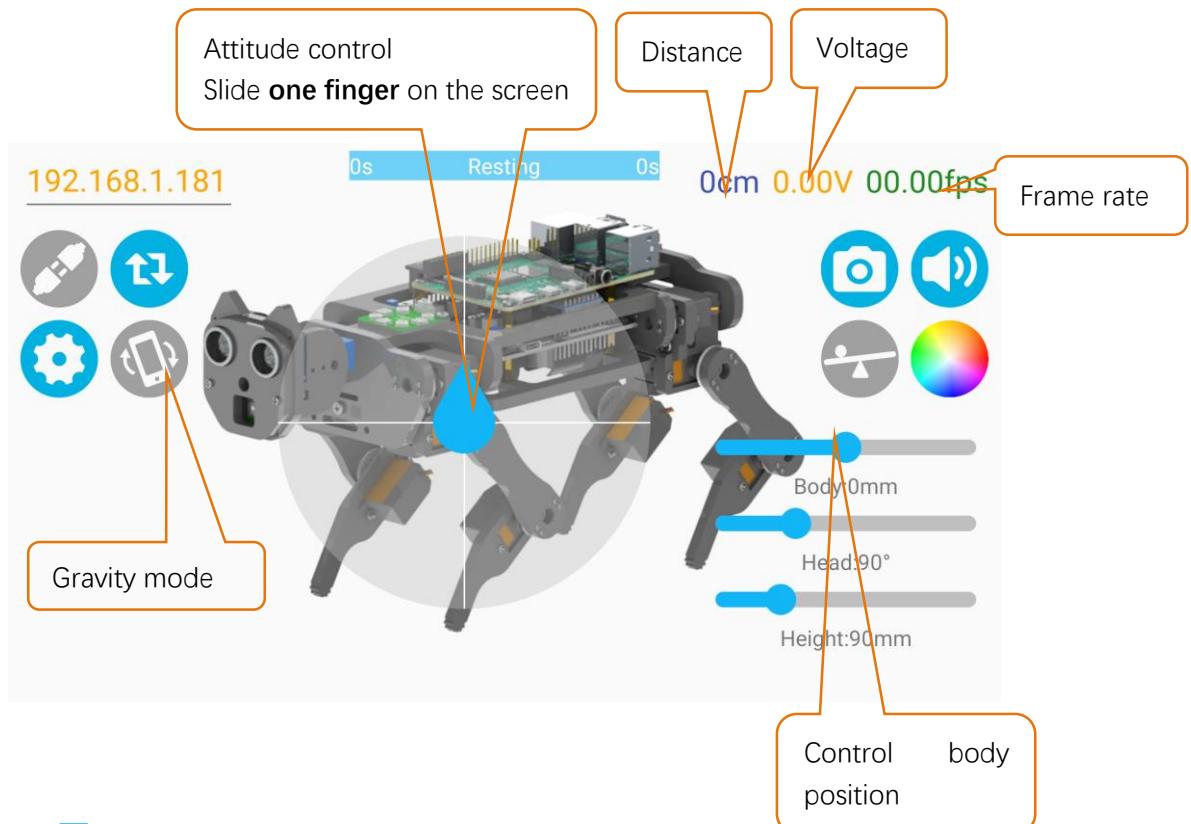
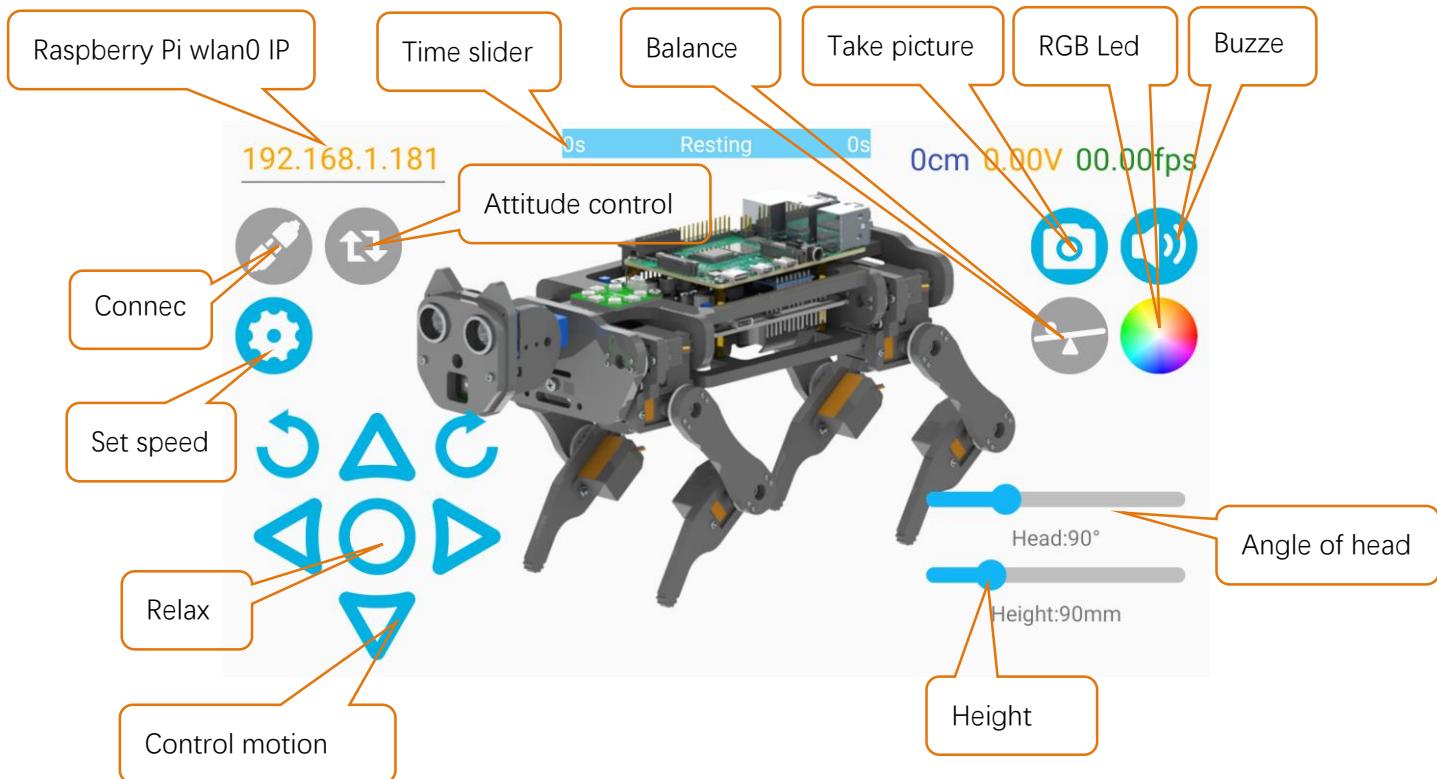
Relax mode.

- When the robot dog moves for 3 minutes in total, it will feel tired (the servo will get hot). In order to protect the servo, the robot will get into relax mode for 1 minute. **During this time, it won't respond to motion command.** You can still use the functions of LED, buzzer, real-time video and so on.
- When the robot dog moves for <3 minutes and then the robot rest for 1 minute. The timer will start from 0. Then the robot can move for 3 minutes again.
- If the robot isn't tired and is standing, when the robot does not receive motion command for 10s, it will get into relax mode. In this situation, it will respond to any commands.

The followings are the features of this app.

First, you need to turn on the Server. Then enter your raspberry pi IP address and click connect icon.

On the top of the interface, there is a timer slider to indicate the time for moving or resting.



What's Next?

THANK YOU for participating in this learning experience!

We have reached the end of this Tutorial. If you find errors, omissions or you have suggestions and/or questions about the Tutorial or component contents of this Kit, please feel free to contact us:
support@freenove.com

We will make every effort to make changes and correct errors as soon as feasibly possible and publish a revised version.

If you want to learn more about Arduino, Raspberry Pi, Smart Cars, Robotics and other interesting products in science and technology, please continue to visit our website. We will continue to launch fun, cost-effective, innovative and exciting products.

<http://www.freenove.com/>

Thank you again for choosing Freenove products.