Welcome

Thank you for choosing Freenove products!

About Battery

First, read the document **About_Battery.pdf** in the unzipped folder.
If you have not download the zip file, please download and unzip it via the link below.
https://github.com/Freenove/Freenove_Robot_Dog_Kit_for_ESP32/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.

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

Copyright

FREENOVE™

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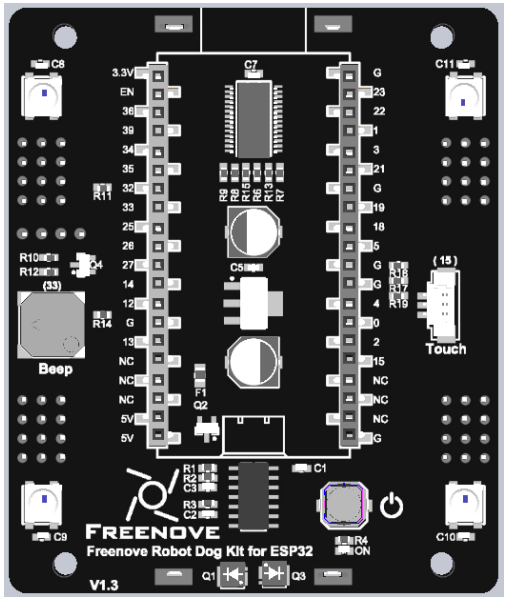
List

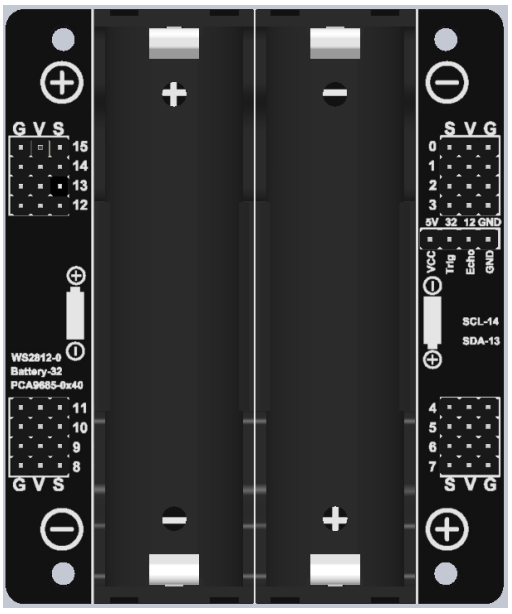
If you have any concerns, please feel free to contact us at support@freenove.com

Driver Board

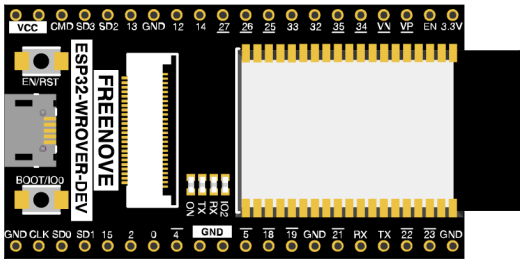
Top



Bottom



ESP32

ESP32	OV2640
	

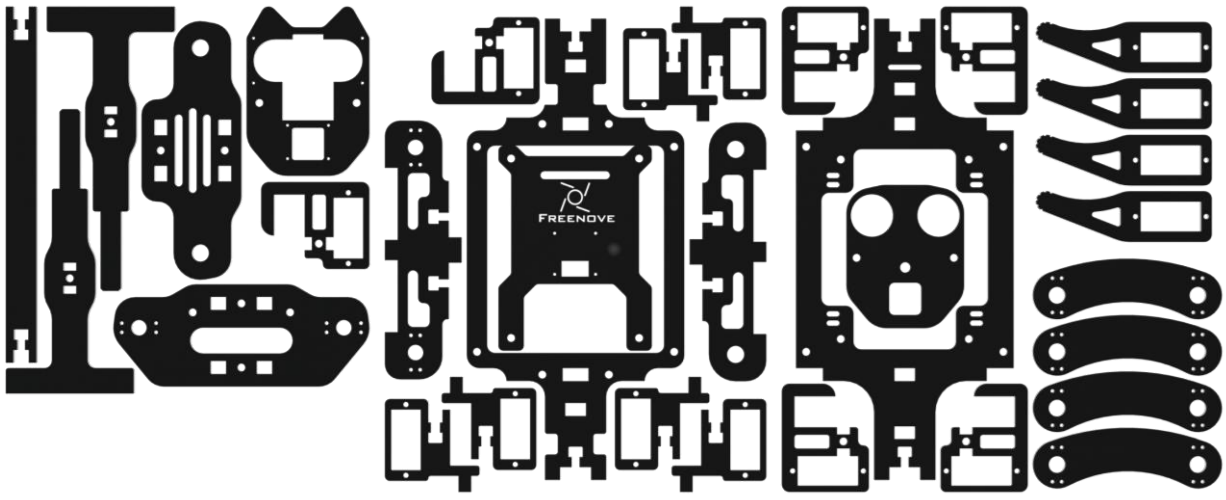
Machinery

Transmission

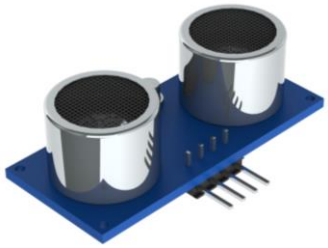
Servo package x12

Acrylic

Acrylic x1



Electronic

Extension board for camera 	HC-SR04 ultrasonic module 	Touch module 

Tools

Cross screwdriver (3mm) x1 Cross screwdriver (2mm) x1 	Cable tidy x80cm 
翘棒 	USB 线 
FPC 排线 	
3P 线 	4P 杜邦线 

Required but NOT Included Parts

Two 18650 lithium batteries without protection 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.

Preface

Welcome to use Freenove Robot Dog Kit for ESP32. Following this tutorial, you can make a very cool robot dog with many functions.

This kit is based on ESP32, a popular control panel, so you can exchange your experience and design ideas with many enthusiasts all over the world. The parts in this kit include all electronic components, modules, and mechanical components required for making the robot dog. And all of them are packaged individually. There are detailed assembly and commissioning instructions 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 aims to help **enthusiasts assemble the robot dog and download related codes. You can read and download the codes via the link below:**
https://github.com/Freenove/Freenove_ESP32_Dog_Firmware

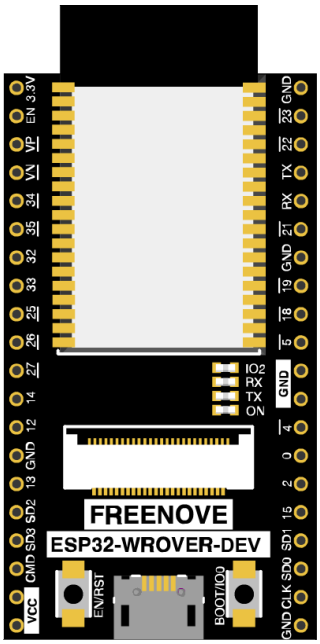
If you have any questions, please send an email to us: support@freenove.com, or you can refer to another esp32 kit designed for starters: Freenove_Ultimate_Starter_Kit_for_ESP32.

ESP32

ESP32-Wrover comes with two different antenna packages, PCB (on-board) antenna and IPEX™ antenna. The PCB on-board antenna is an integrated antenna in the chip module itself, so it is convenient to carry and design. The IPEX™ antenna is a metal antenna connector, derived from the integrated antenna of the chip module itself, which is used to enhance the signal of the ESP32 module.

PCB on-board antenna	IPEX antenna
	

In this tutorial, the ESP32-WROVER is designed based on PCB on-board antenna packaged ESP32-WROVER module.

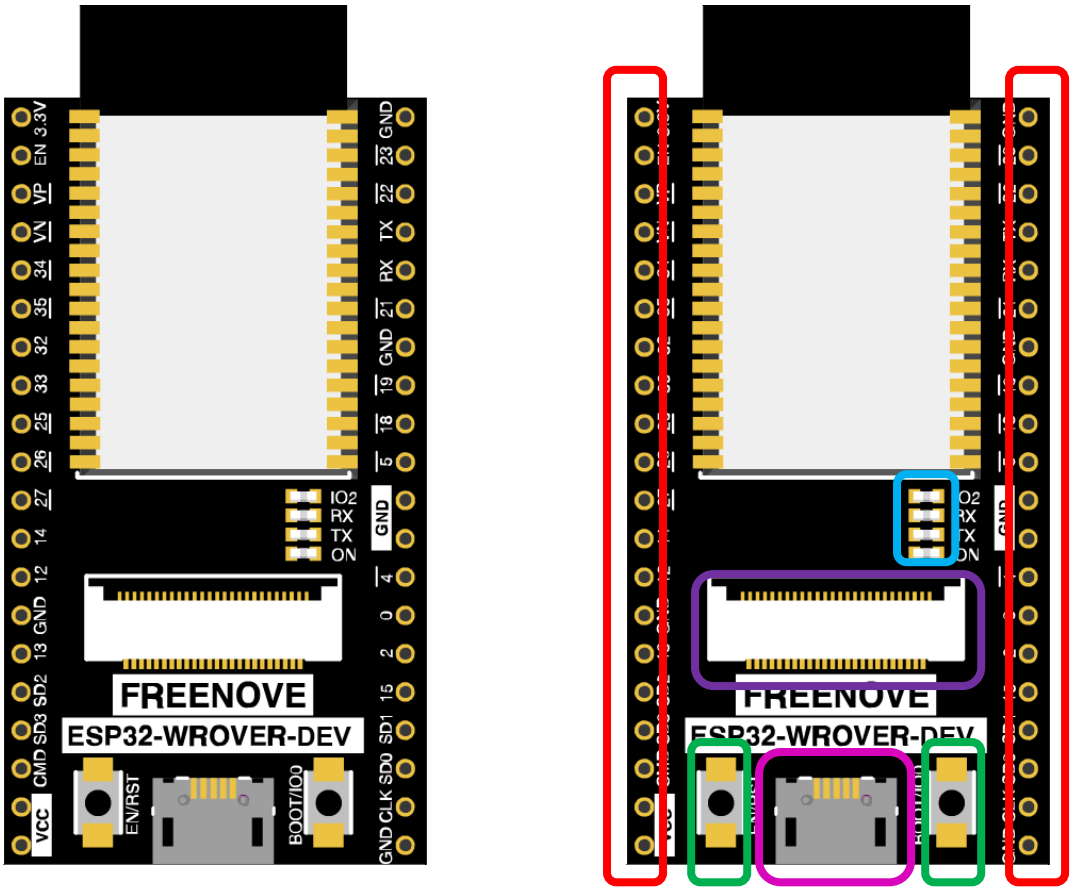


Pins of the Robot

To learn what each GPIO corresponds to, please refer to the following table.
The functions of the pins are allocated as follows:

Pins of ESP32	Functions	Description
GPIO36	Camera interface	CSI_Y6
GPIO39		CSI_Y7
GPIO34		CSI_Y8
GPIO35		CSI_Y9
GPIO25		CSI_VYSNC
GPIO26		SIOD
GPIO27		SIOC
GPIO4		CSI_Y2
GPIO5		CSI_Y3
GPIO18		CSI_Y4
GPIO19		CSI_Y5
GPIO21		XCLK
GPIO22		PCLK
GPIO23		HREF
GPIO13	I2C port	SDA
GPIO14		SCL
GPIO32	Battery detection / Ultrasonic-Trig port	A6 / Trig
GPIO12	Ultrasonic-Echo port	Echo
GPIO33	Buzzer port	Buzzer
GPIO15	Touch Sensor port	Touch
GPIO0	WS2812 port	WS2812
GPIO1	Serial port	TX
GPIO3		RX

The hardware interfaces of ESP32 are distributed as follows:

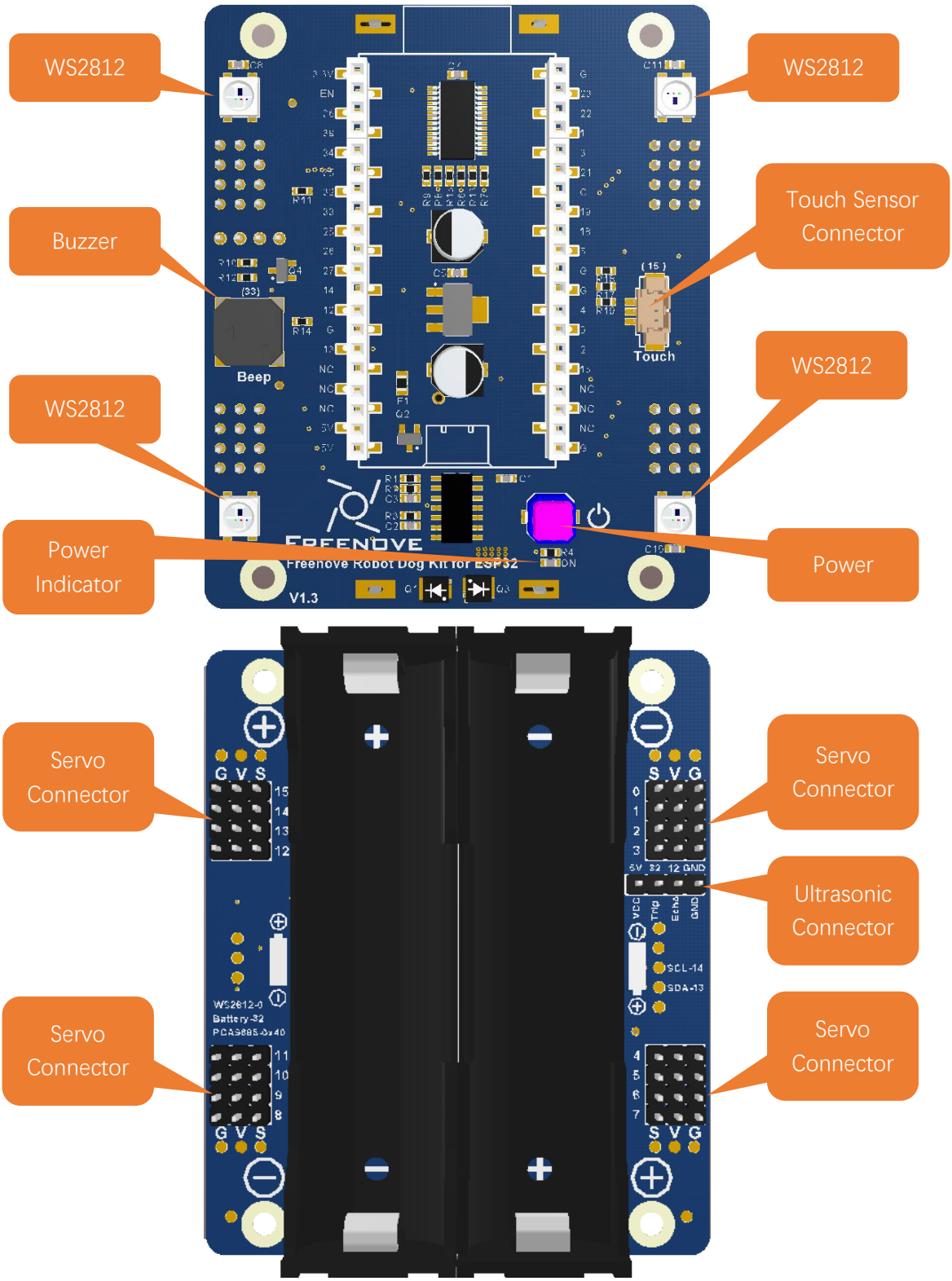


Compare the left and right images. We have boxed off the resources on the ESP32 in different colors to facilitate its understanding.

Box color	Corresponding resources introduction
	GPIO pin
	LED indicator
	Camera interface
	Reset button, Boot mode selection button
	USB port

Introduction to the Driver Board

The functions of the driver board are as follows:

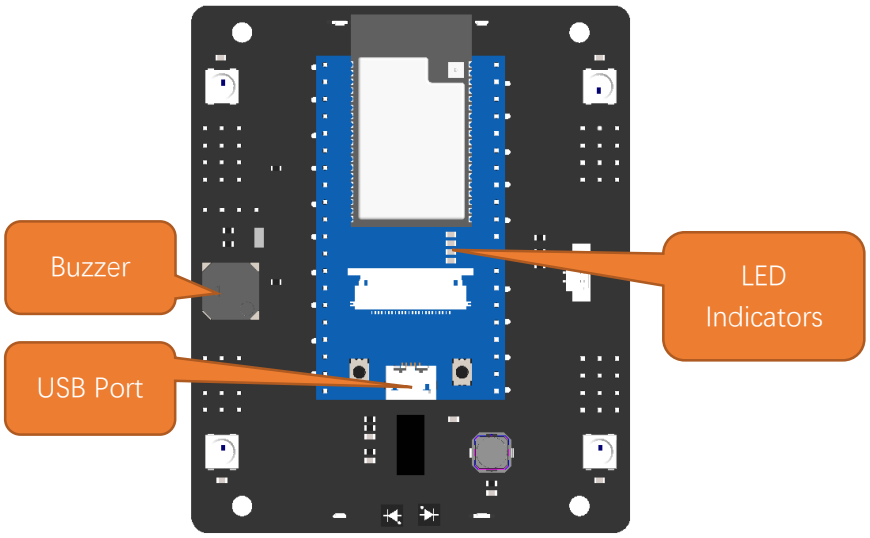


Note: Please refer to the marks on the battery holder to install batteries; otherwise, the circuit will not work.

Chapter 0 Install CH340 and Burn Firmware

Please note that the firmware has been burnt by default, so generally, you do not need to burn it again.
Please follow the steps below to check whether firmware has been burnt:

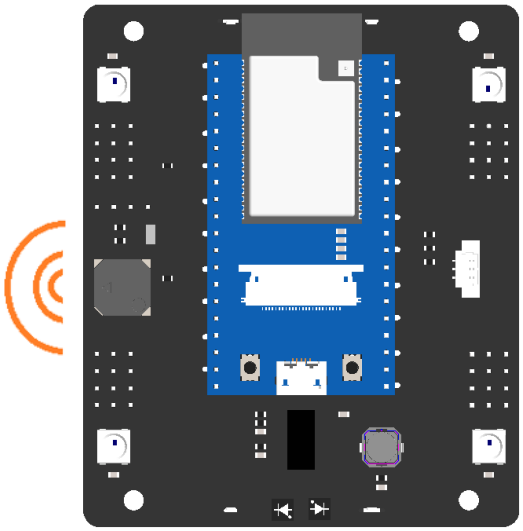
1. Plug the ESP32 to the driver board.



Pay attention to the orientation of the ESP32 and make sure it is plugged in correctly; otherwise, it may damage the robot.

2. Connect ESP32 to your computer with a USB cable.

After connecting, you can see the yellow LED on ESP32 stay ON and the blue LED blink twice every second. Meanwhile, the buzzer makes 4 warning sounds to tell you the camera has not yet been installed and then a pleasant sound to indicate the finish of initialization.



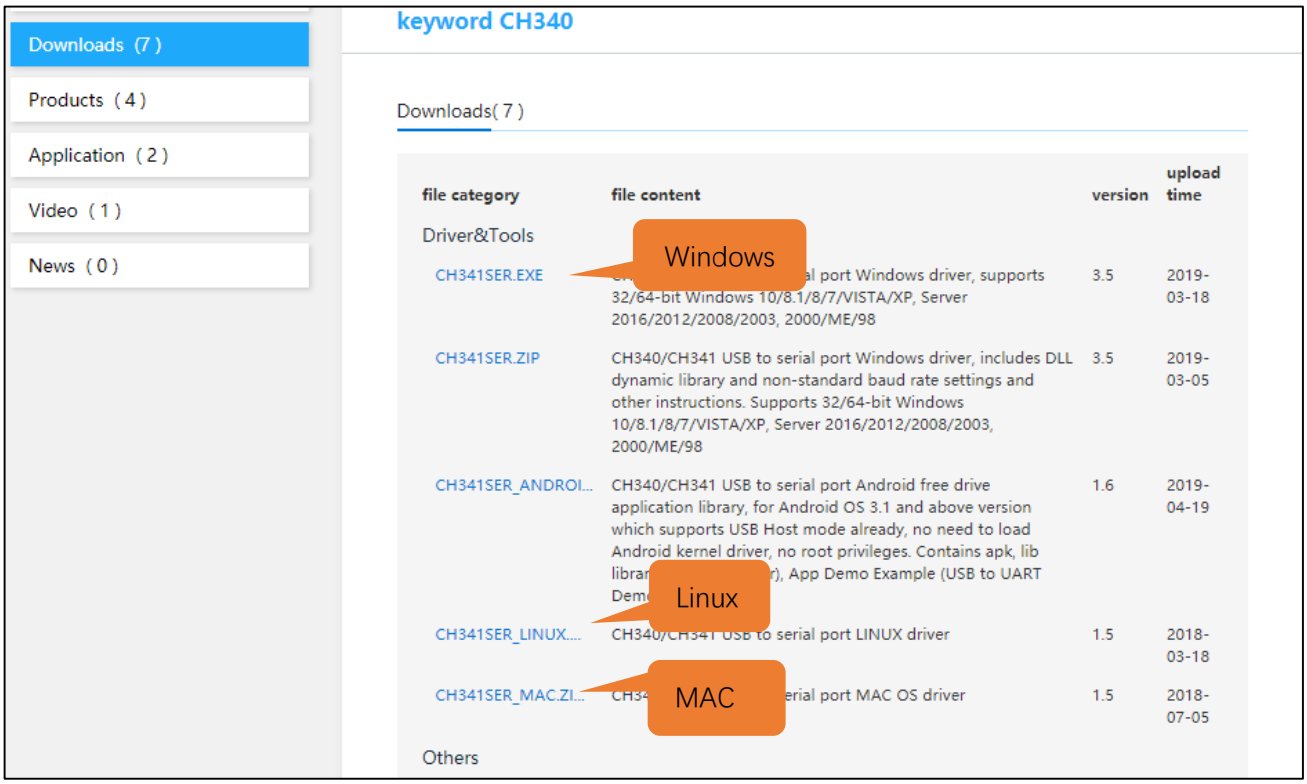
If the above phenomena happen, it means the firmware has been burnt.

If the firmware has been burnt on your robot, please skip to Chapter 1.
Otherwise, please continue with the following steps. We have provided ways to burn the firmware for three different operating systems.
Please send emails to us (support@freenove.com) if you have any questions regarding the robot.

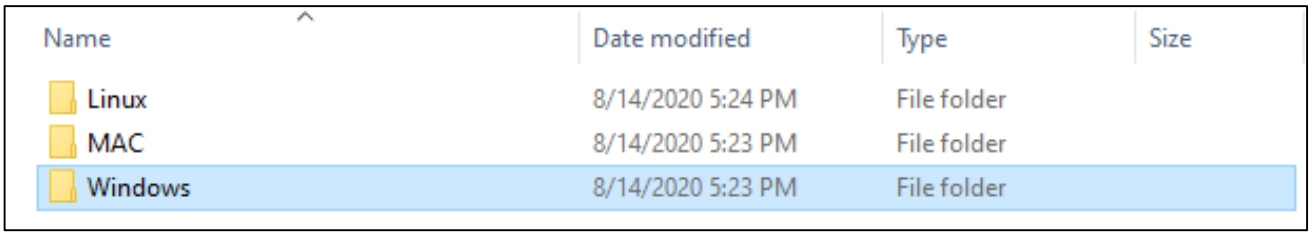
Install CH340 Driver

The computer uploads codes to ESP32 via CH340, so we need to install CH340 driver on our computer before using.

1. First, download the CH340 driver. Click http://www.wch-ic.com/search?q=CH340&t=downloads to download the appropriate one based on your operating system.



If you would not like to download the installation package, you can open **"Freenove_Robot_Dog_Kit_for_ESP32/CH340"**. We have prepared the installation package.

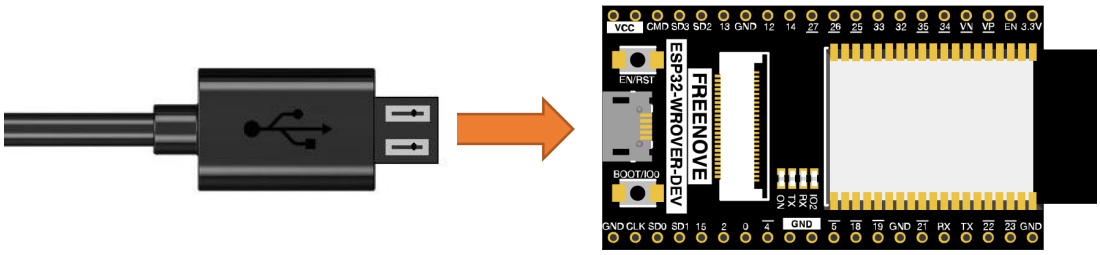


Next, we will explain how to install CH340 on different operating systems including Windows, Mac OS and Linux.

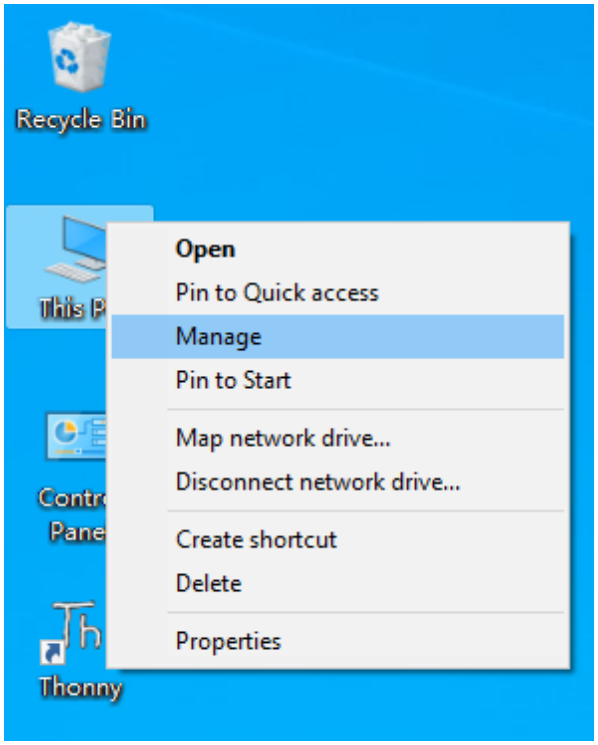
Windows

Check the Installation of CH340

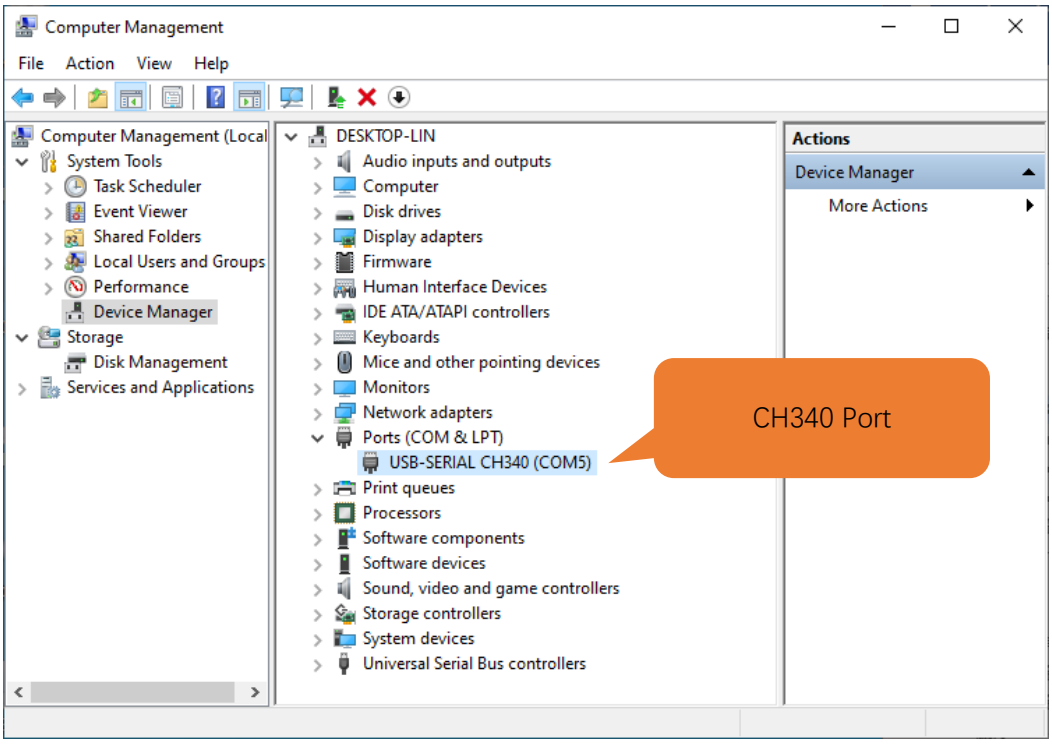
1. Connect esp32 to your computer with a USB cable.



2. Right-click on “This PC” on your computer desktop and select “Manage”.



3. Click on "Device Manager" on the left of the pop-up window, and then click on "Ports" on the right. If your computer has installed CH340 driver, you can see the port: USB-SERIAL CH340 (COMx).

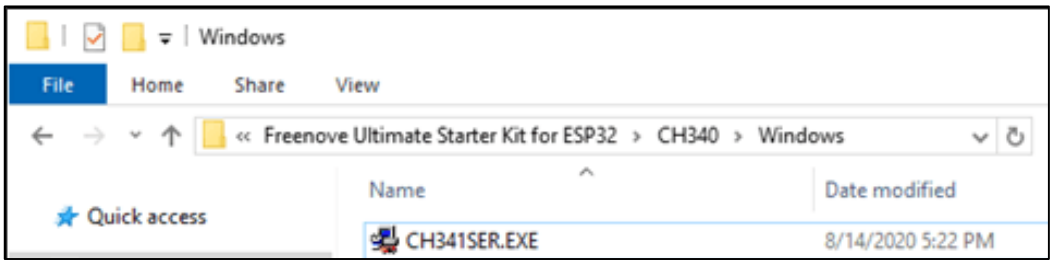


If so, you can click here to move to the next step.

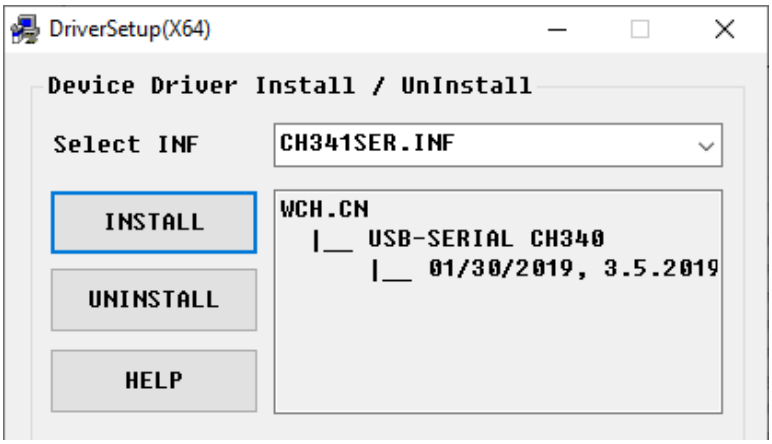
If CH340 (COMx) does not show on your computer, you need to install CH340 driver.

Install CH340 Driver

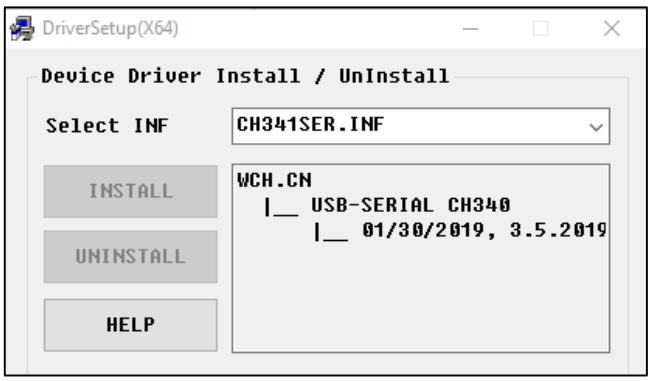
4. Open "**Freenove_Robot_Dog_Kit_for_ESP32/CH340/Windows/**".



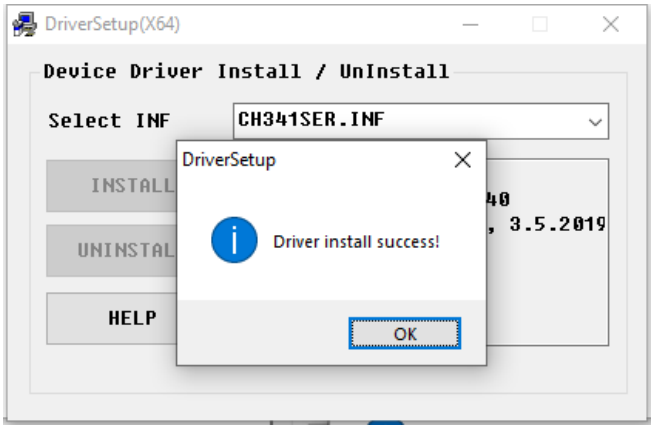
5. Double click to run the file "**CH341SER.EXE**", whose interface is as below:



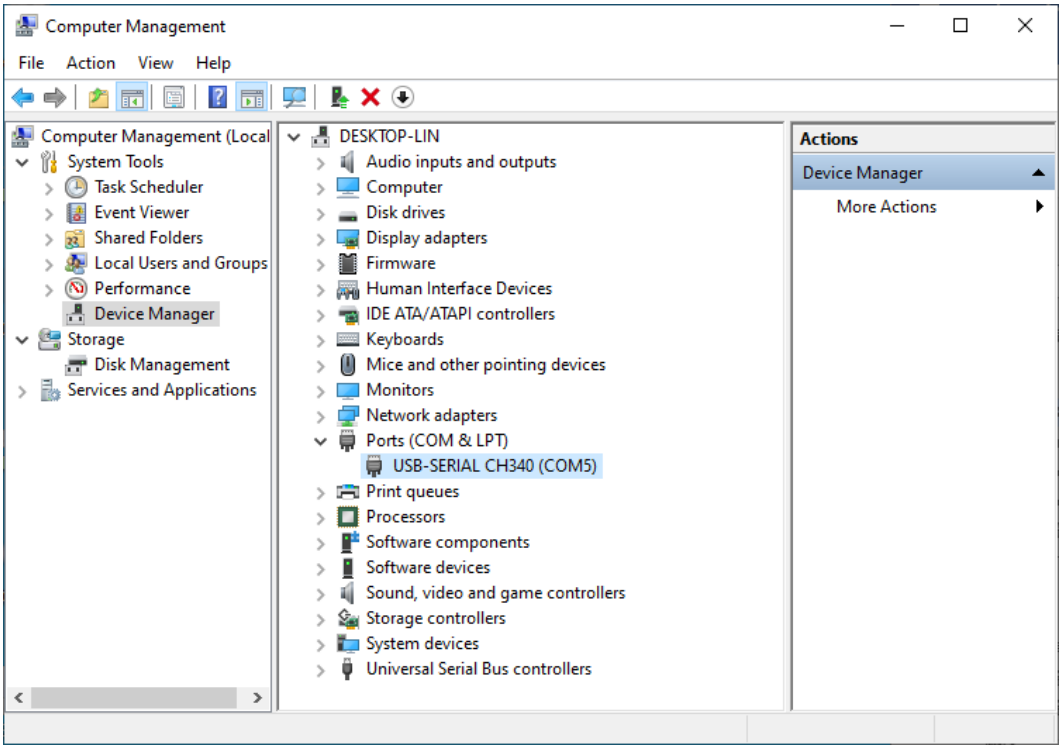
6. Make sure ESP32 has connected to your computer and then click "INSTALL". Wait for the installation to finish.



The following window indicates that the installation finishes.



7. After installation, open device manager again and you can see the port USB-SERIAL CH340 (COMx).

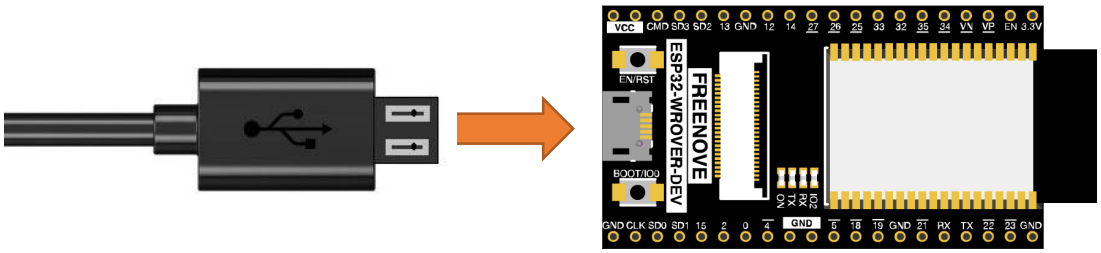


So far, CH340 has been installed. Close all dialog boxes.

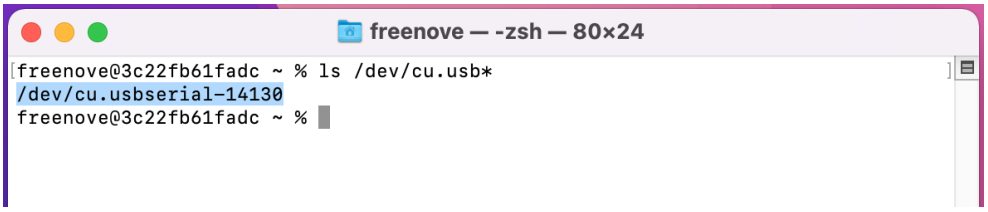
Mac OS

Check the Installation of CH340

Connect esp32 to your computer with a USB cable.



Open Terminal of Mac OS, and type in the command **ls /dev/cu.usb***



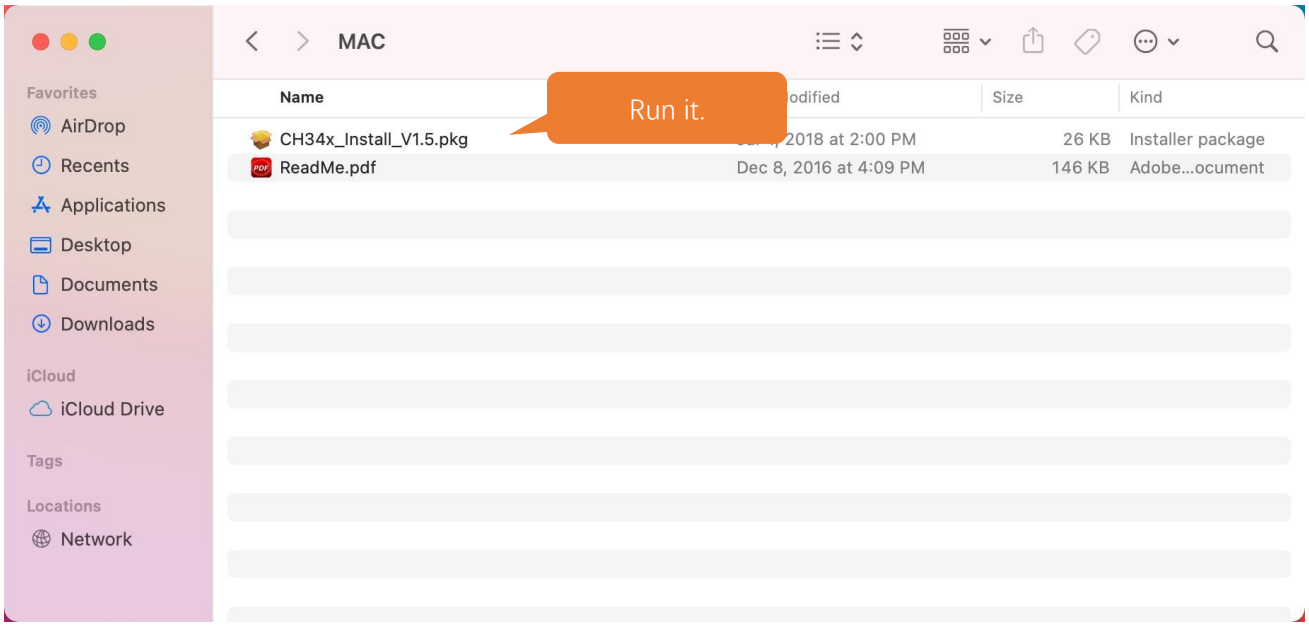
If your Terminal prints the message similar to the above, then your computer has installed the CH340. You can click here to move to the next step.

Otherwise, please continue with the following the steps.

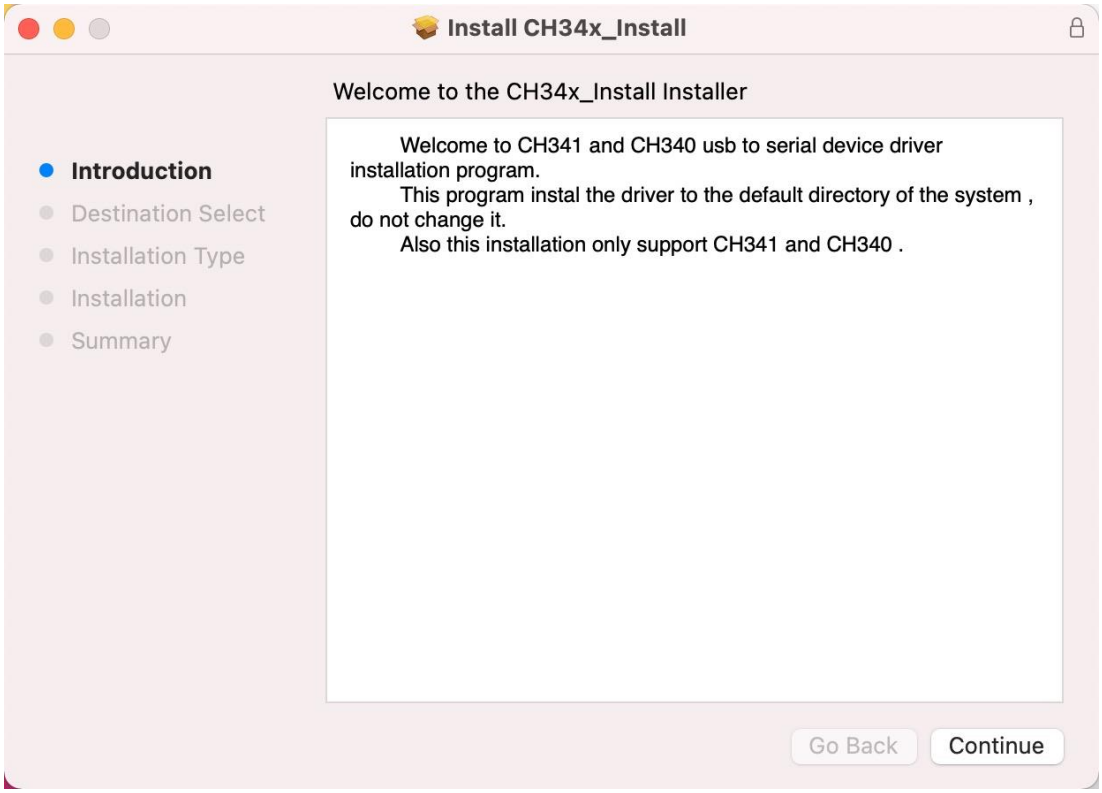
Install CH340

If you would not like to download the installation package, you can open **"Freenove_Robot_Dog_Kit_for_ESP32/CH340"**. We have prepared the installation package.

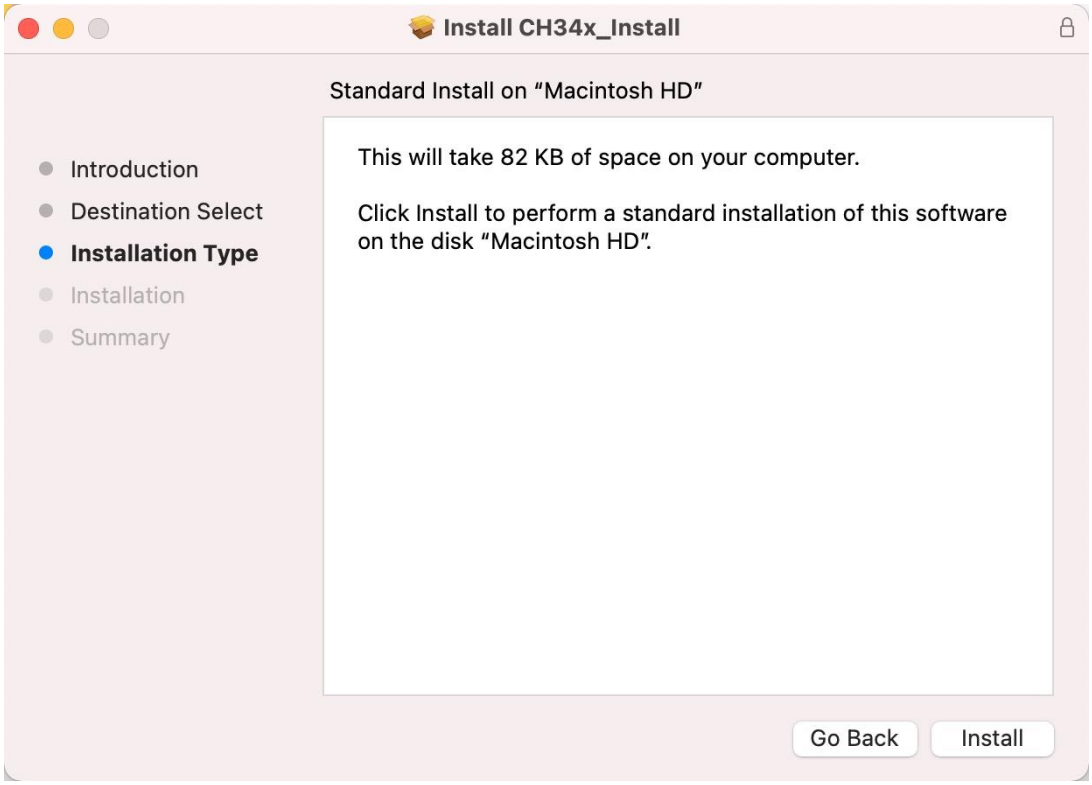
Open the folder "**Freenove_Robot_Dog_Kit_for_ESP32/CH340/MAC/**"

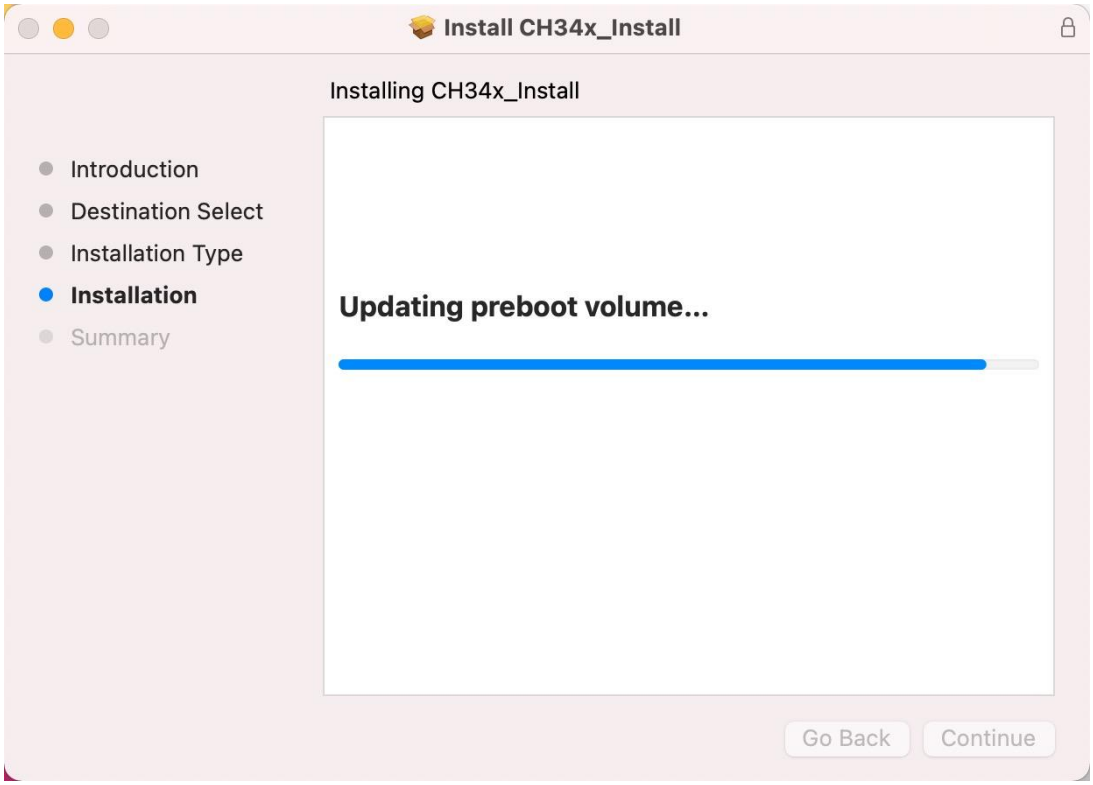


Click Continue.

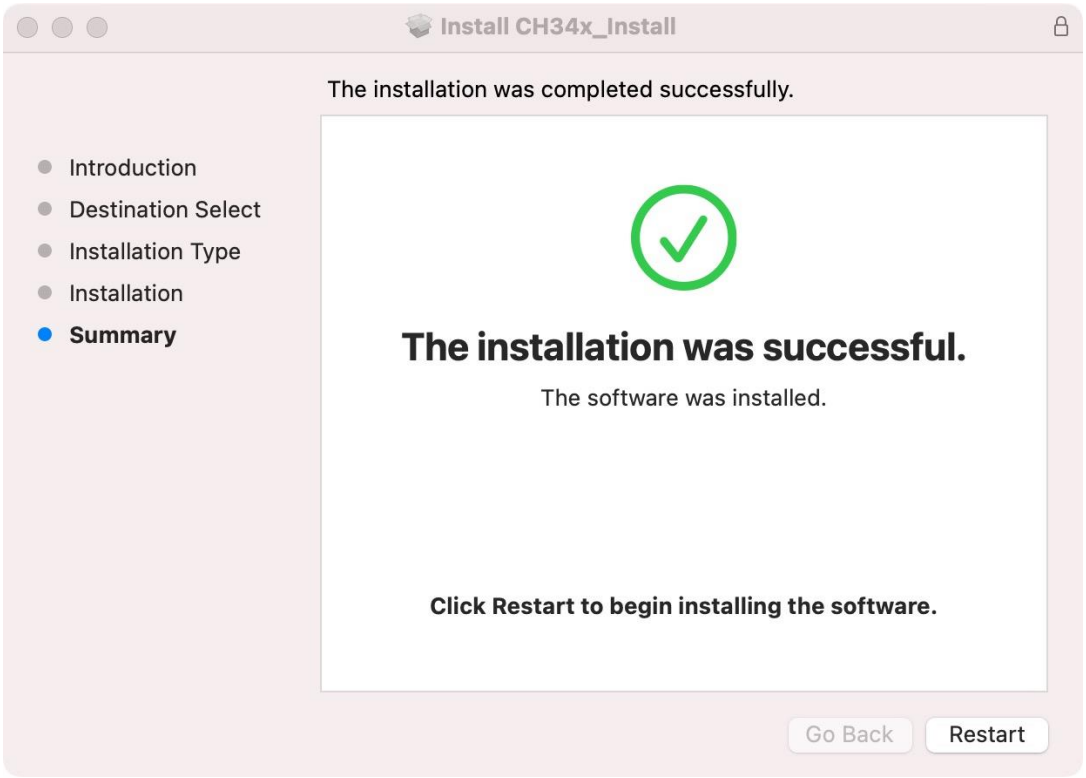


Click Install and wait for it to finish.

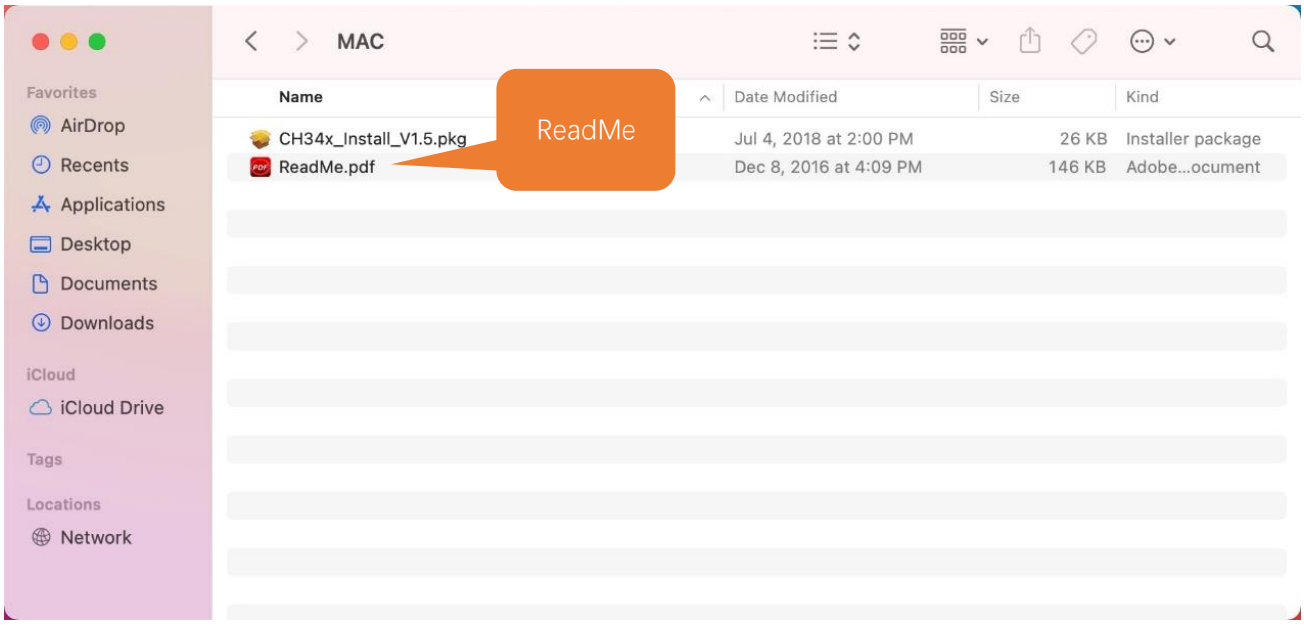




Restart your PC.



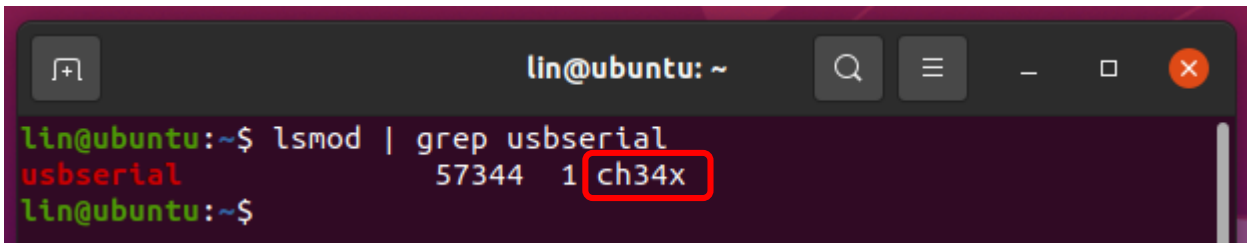
If CH340 is still not installed after the above steps, please refer to the ReadMe.pdf to install.



Linux

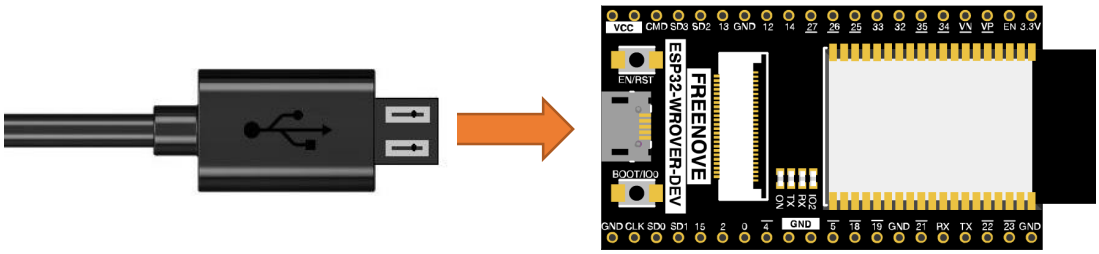
Check the Installation of CH340

Open the system terminal and type in the command: **lsmod | grep usbserial**. If your computer has installed the driver, you should see the following information:

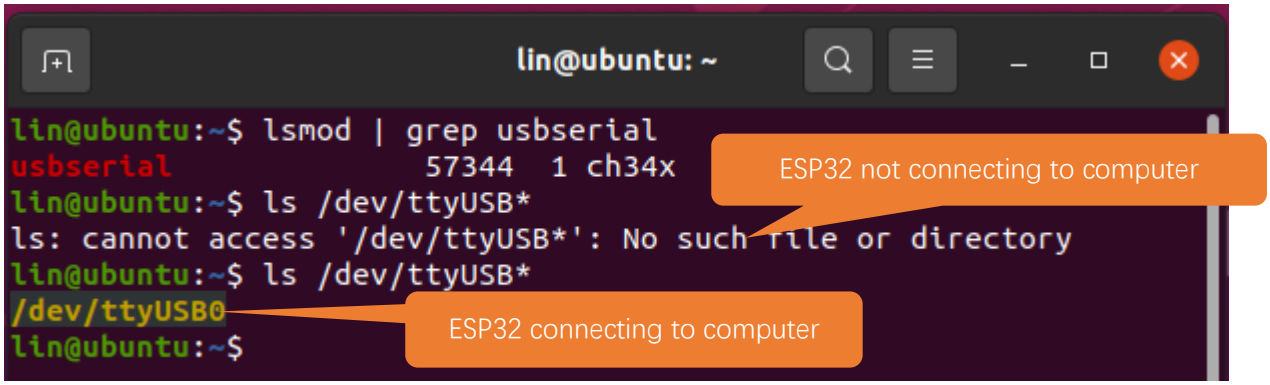


If the driver has been installed, you can determine the port used by ESP32 to communicate with your computer in this way:

1. When ESP32 is not connected to your computer, open system terminal and type in the command **ls /dev/tty***
2. Connect ESP32 to your computer with a USB cable and type in the command **ls /dev/tty*** again.



Compare the results. As shown below, **/dev/ttyUSB0** is the port that ESP32 communicates with your computer.



If your computer has installed CH340, you can click here to skip to the next step.

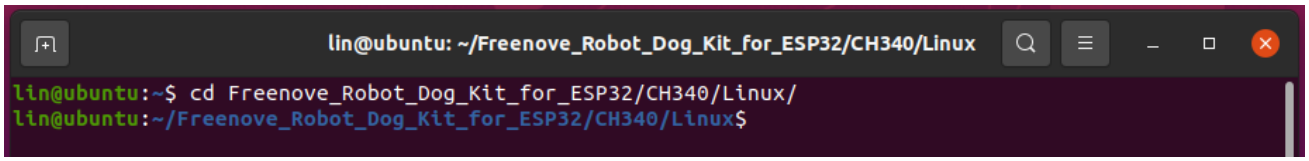
Install CH340

If you connect the ESP32 to your computer but it does not detect **/dev/ttyUSB0**, then it has not installed CH340 yet.

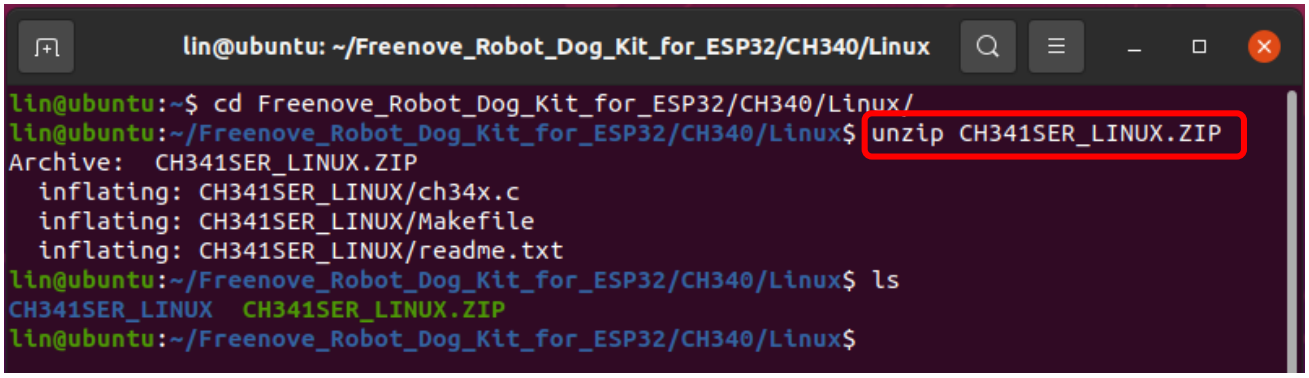
Please follow the steps below to install CH340 driver.

We have prepared the installation package for you: "**Freenove_Robot_Dog_Kit_for_ESP32/CH340/LINUX/**".

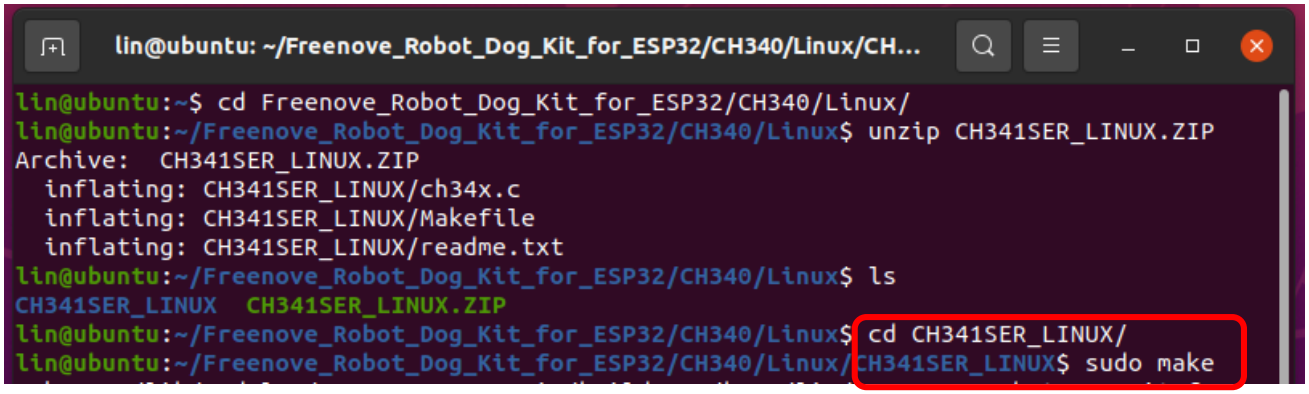
1. Enter the folder on terminal: **cd Freenove_Robot_Dog_Kit_for_ESP32/CH340/Linux/**



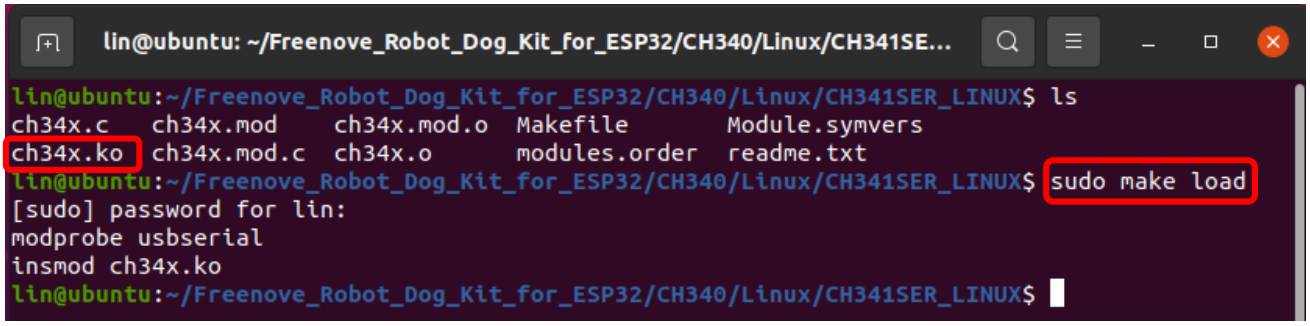
2. Unzip the installation package: **unzip CH341SER_LINUX.ZIP**



3. Enter the unzipped folder and type in the command **sudo make** to compile and generate the file ch34x.ko.



4. Use the ls command to check the file. As you can see below, the ch34.ko has been generated under the current directory.
5. Type in the command to upload the file to the system: **sudo make load**



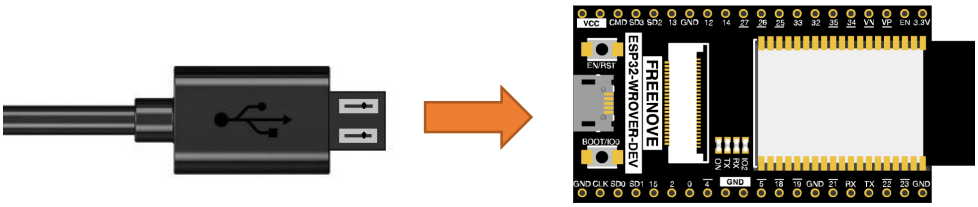
So far, the ch340 driver has been installed.

Burn the Firmware

For this product, ESP32 has burned the required firmware by default. If your ESP32 does not have the firmware or the firmware does not work, please re-burn the firmware with the following steps.
We will explain respectively for Windows, Mac OS and Linux systems.

Windows

First, connect ESP32 to your computer with a USB cable.

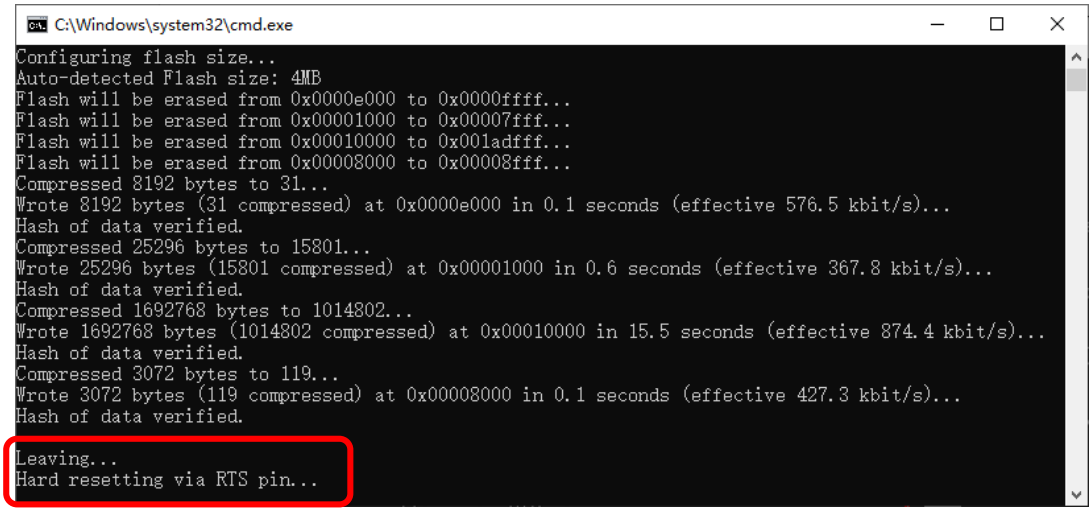


Second, open "windows.bat" under the directory of Freenove_Robot_Dog_Kit_for_ESP32/Code/Windows with txt editor, and modify the COMx in the file according to the port USB-SERIAL CH340 (COMx) on your computer.

```
@echo off

:start

echo.

esptool.exe --port COM4 erase_flash

echo.

esptool.exe --chip esp32 --port COM4 --baud 2000000 --before default_reset --after hard_reset write_flash -z --flash_mode

echo.

pause

echo.
```

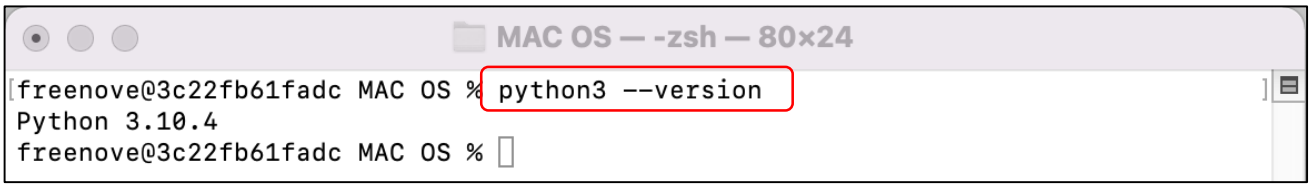
Note: Do NOT modify other contents.

Third, save and close the file. Double-click it to run and wait for it to finish downloading.



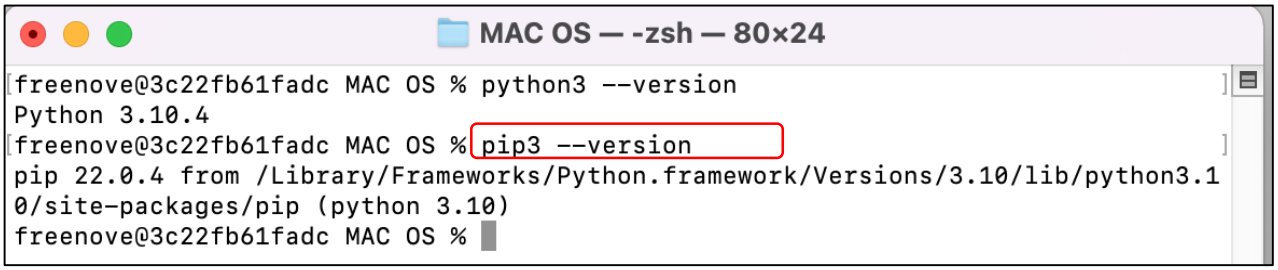
Mac OS

1. Open Terminal on your computer and type in the command **python3 --version** to check whether python3 has been installed on your computer.

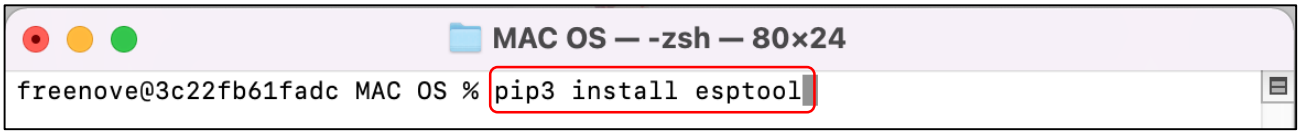


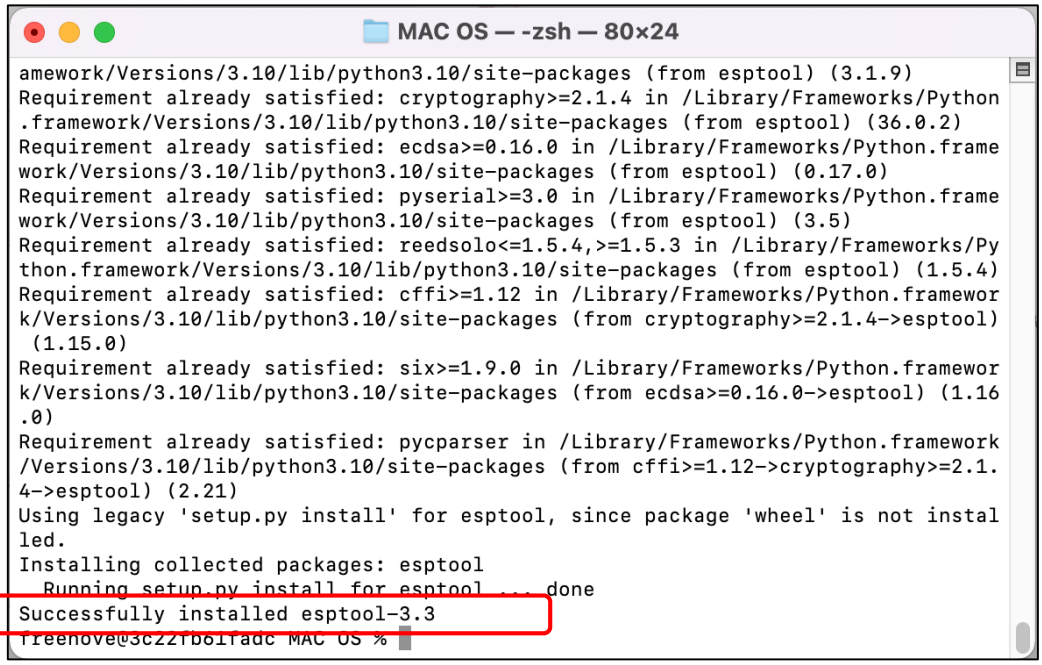
If your computer has not yet installed python3, please type in the command to install: **brew install python3**
If you do not want to download, you can open the installation package we prepared under the directory of Freenove_Robot_Dog_Kit_for_ESP32/Code/MAC OS/Python to install.

2. Type in the command **pip3 --version** to check whether python3 has integrated with pip3. If it has not, please type in the command **curl https://bootstrap.pypa.io/get-pip.py | python3** to install.



3. Enter the command to install firmware-downloading tool: **pip3 install esptool**

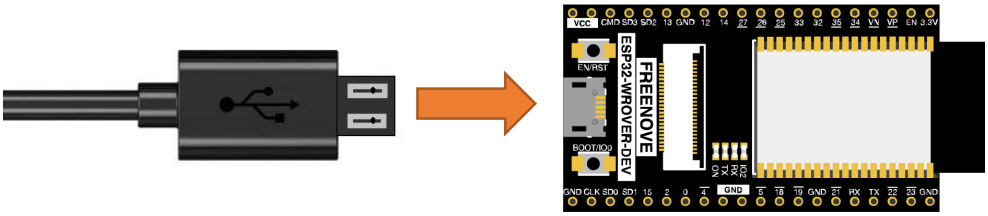




4. Check whether esptool has been installed: **pip3 list**

```
MAC OS — -zsh — 80×24
.0)
Requirement already satisfied: pycparser in /Library/Frameworks/Python.framework
/Versions/3.10/lib/python3.10/site-packages (from cffi>=1.12->cryptography>=2.1.
4->esptool) (2.21)
Using legacy 'setup.py install' for esptool, since package 'wheel' is not instal
led.
Installing collected packages: esptool
  Running setup.py install for esptool ... done
Successfully installed esptool-3.3
freenove@3c22fb61fadc MAC OS % pip3 list
Package      Version
------------ -------
bitstring    3.1.9
cffi         1.15.0
cryptography 36.0.2
ecdsa        0.17.0
esptool      3.3
pip          22.0.4
pycparser    2.21
pyserial     3.5
reedsolo     1.5.4
setuptools   58.1.0
six          1.16.0
freenove@3c22fb61fadc MAC OS %
```

5. Connect ESP32 to your computer with the USB cable.



6. Open Mac OS Terminal and type in the command to check whether ESP32 can be detected:
   ls /dev/cu.usb*

```
freenove — -zsh — 80×24
freenove@3c22fb61fadc ~ % ls /dev/cu.usb*
/dev/cu.usbserial-14130
freenove@3c22fb61fadc ~ %
```

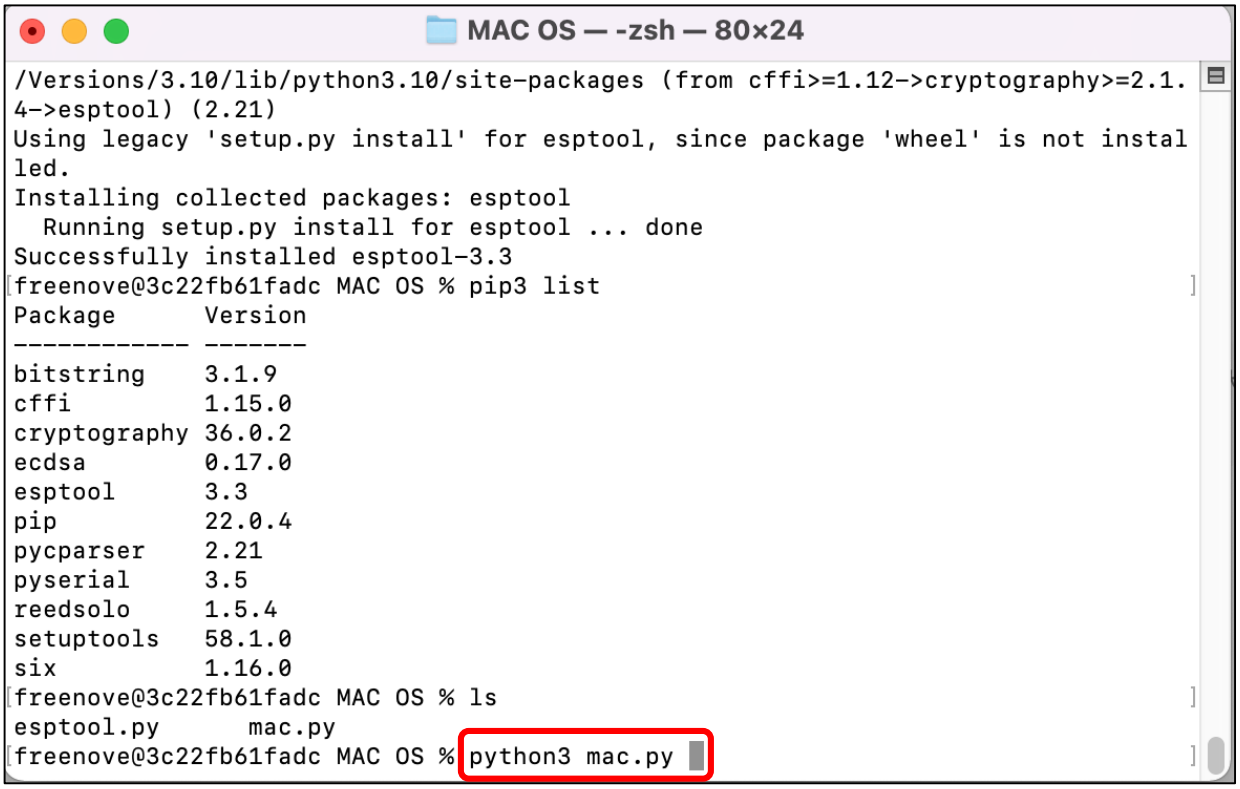
The port number may vary among different computers. Here we take "/dev/cu.usbserial-14130" as an example. Copy the serial number.

7. Open mac.py under the directory of Freenove_Robot_Dog_Kit_for_ESP32/Code/MAC OS/ with txt editor, and modify the port number to that of your computer. Save it and exit.

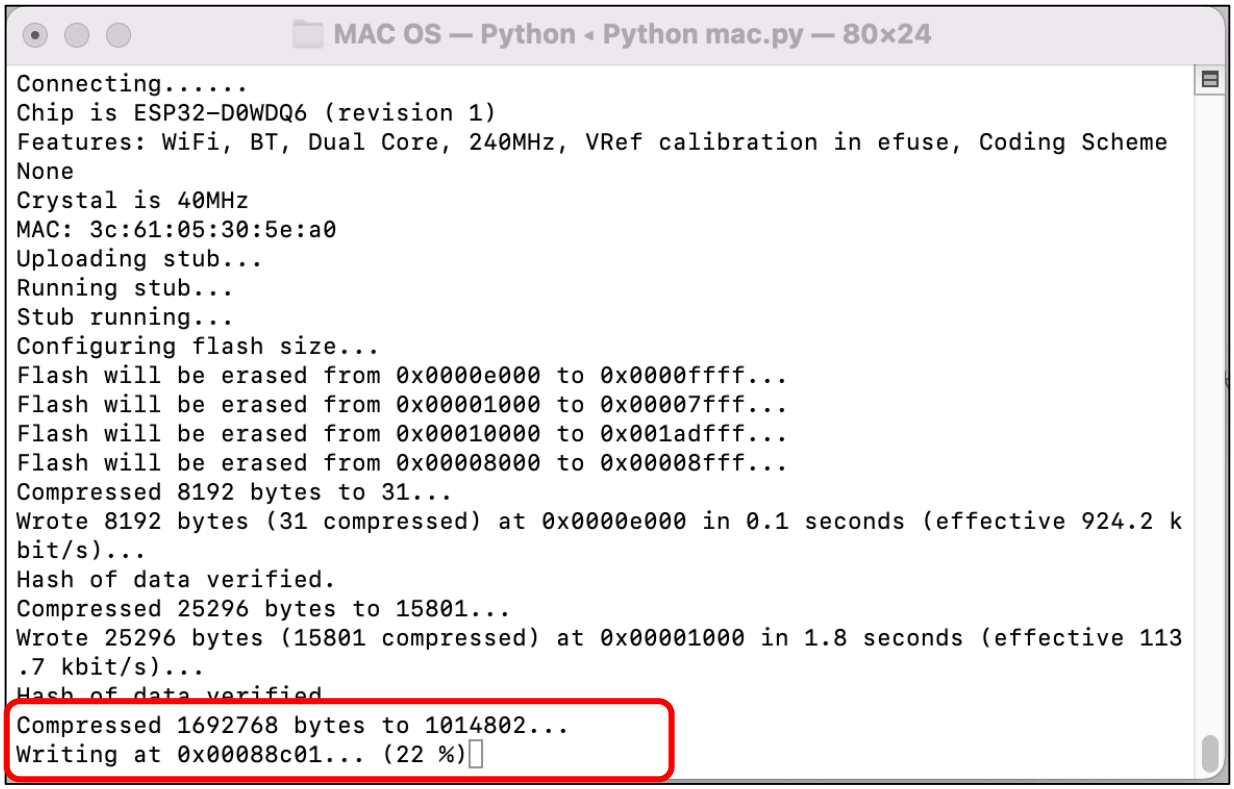
```
import os
import sys
os.system("esptool.py -p /dev/cu.usbserial-14130 erase_flash")
os.system("esptool.py --chip esp32 -p /dev/cu.usbserial-14130 --baud 115200 --before default_reset --after hard_reset write_f
```

Note: Please make sure only the port number is changed and other information, including space is not changed; otherwise, the firmware may fail to burn.

8. Enter the command: **cd Freenove_Robot_Dog_Kit_for_ESP32/Code/MAC OS/** and **python3 mac.py** one by one to install the firmware to esp32.

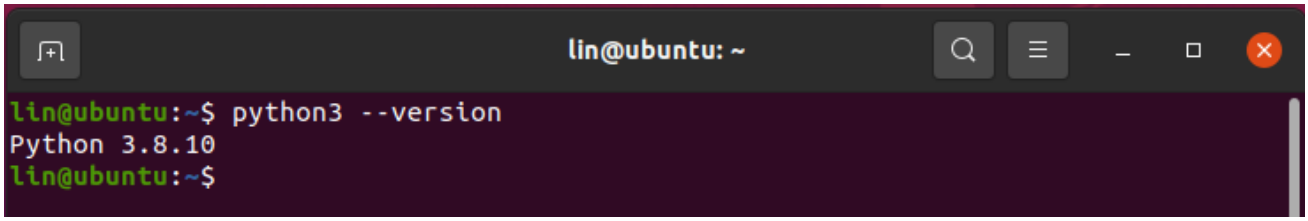


9. Wait for it to finish.

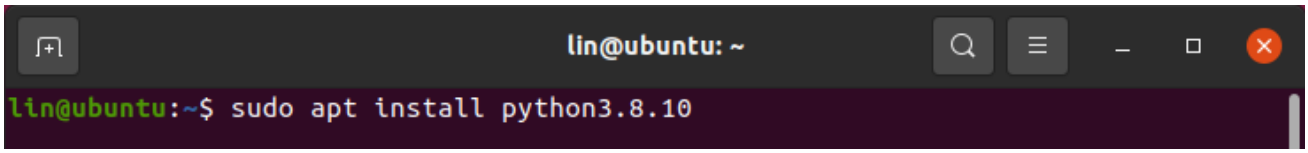


Linux

1. Check whether your computer has installed python3. If it has, please skip to the next step.

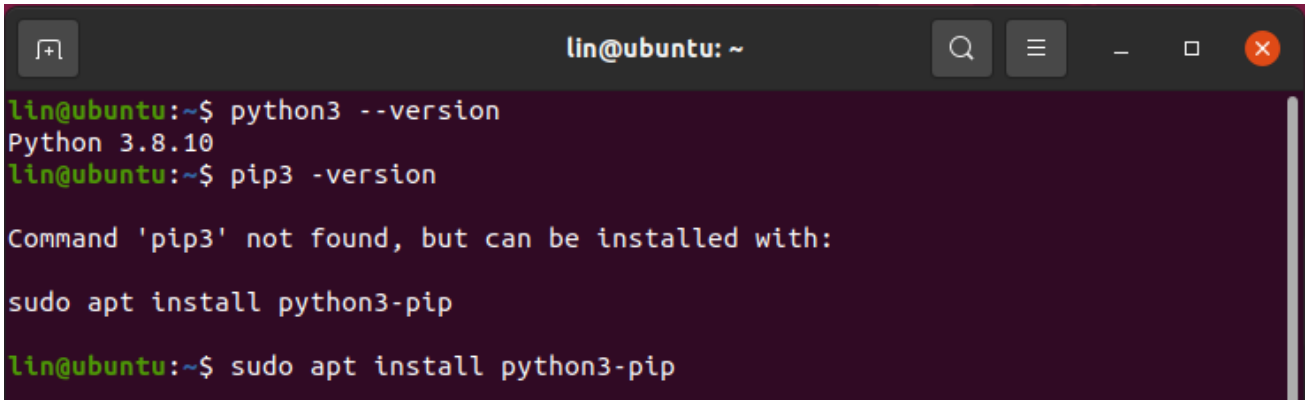


If it has not, please run the command to install.

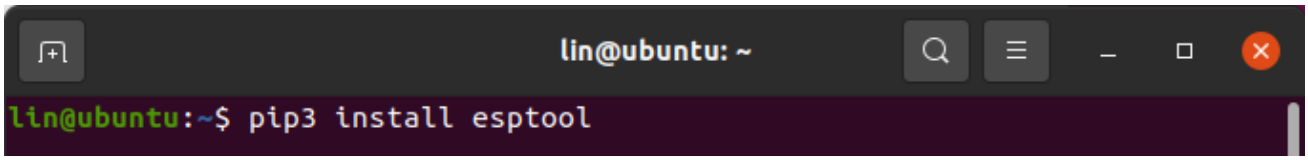


2. Check whether pip3 has been installed on your computer. If it has, please move on to the next step. Otherwise, please run the following commands to install:

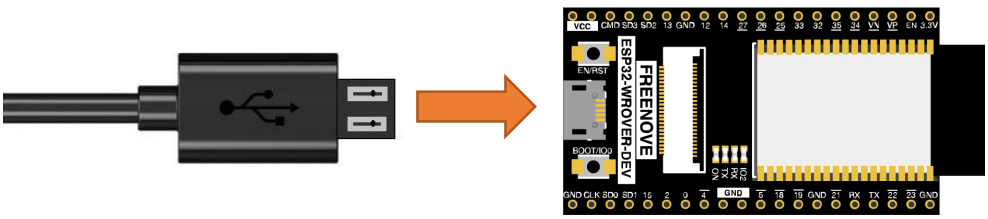
```
sudo apt update&
sudo apt install python3-pip
```



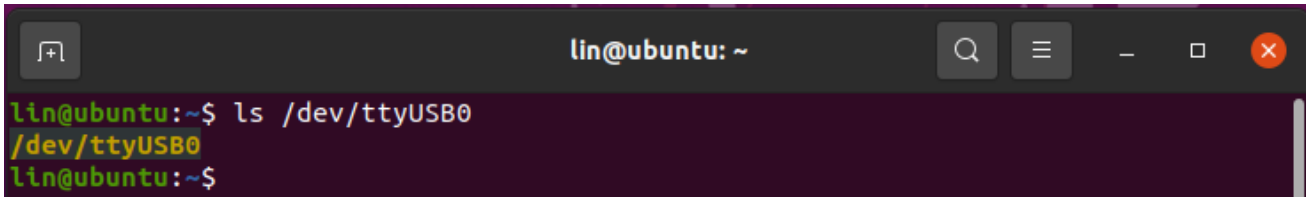
3. Type in the command: pip3 install esptool



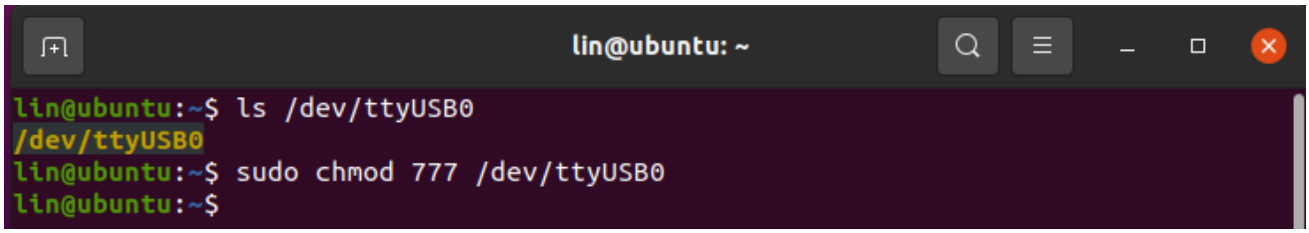
4. Connect ESP32 to your computer with the USB cable.



5. Enter the command **ls /dev/ttyUSB** to check the port number.

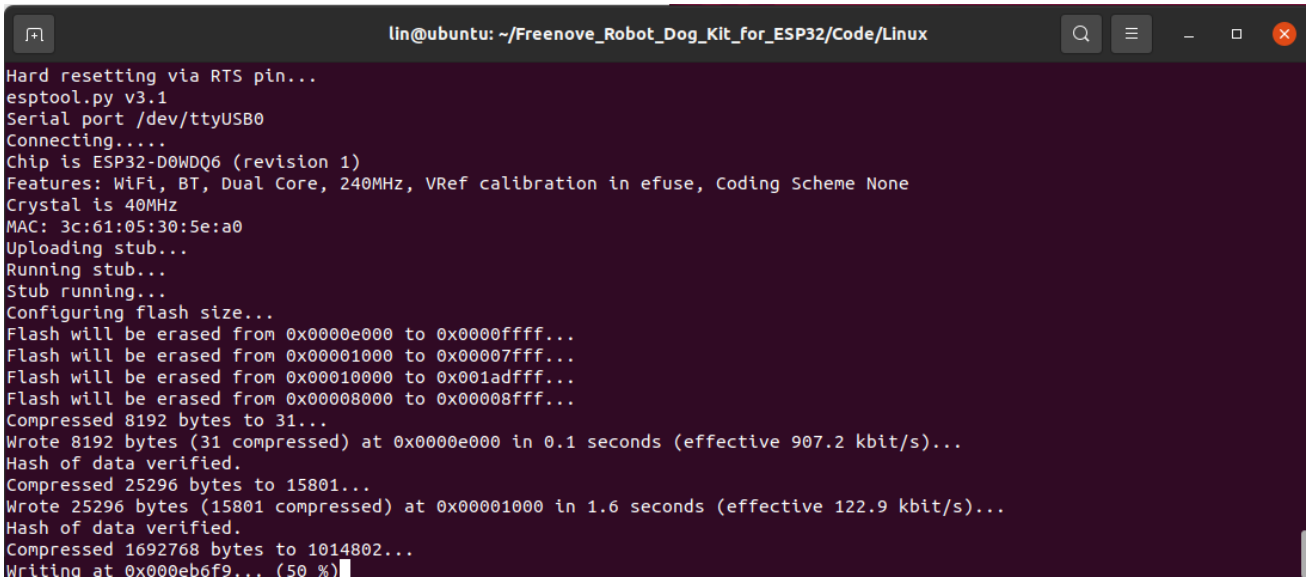


6. Enter the command **sudo chmod 777 /dev/ttyUSB0**



Note: The above command is to give permission to/dev/ttyUSB0. Without this, the code may fail to download.

7. Enter the directory of Freenove_Robot_Dog_Kit_for_ESP32/Code/Linux and enter the command **python3 linux.py**



8. Wait for it to finish download.

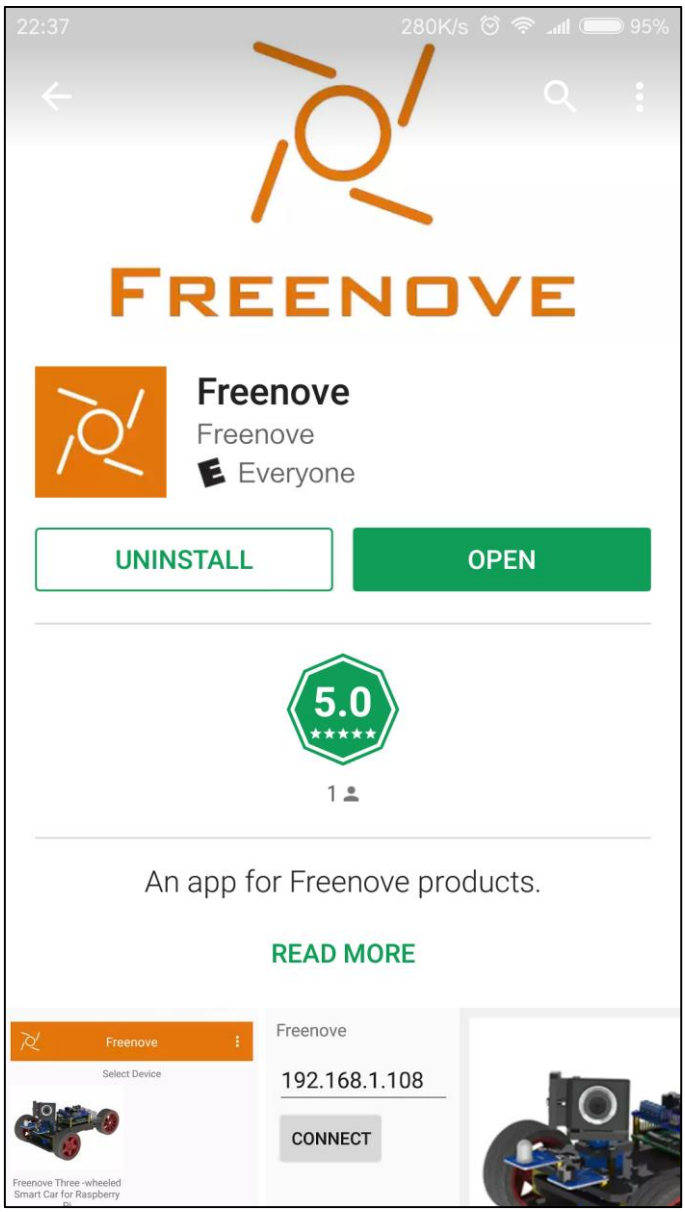
Chapter 1 Install Freenove App

Here are three installation methods. You can choose any one of them.

Install Freenove App

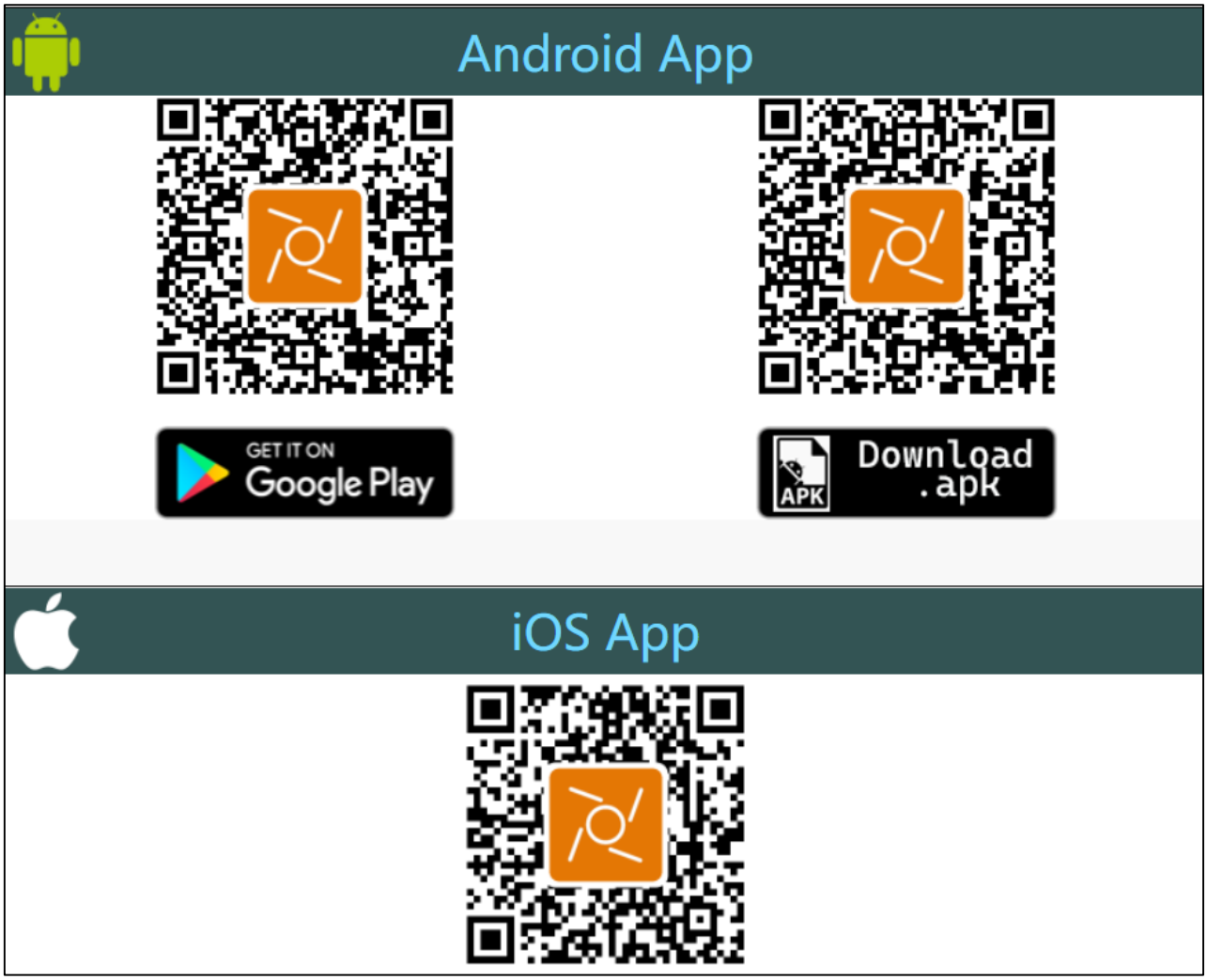
Method 1

Open Google Play on your phone and search “Freenove” to download.



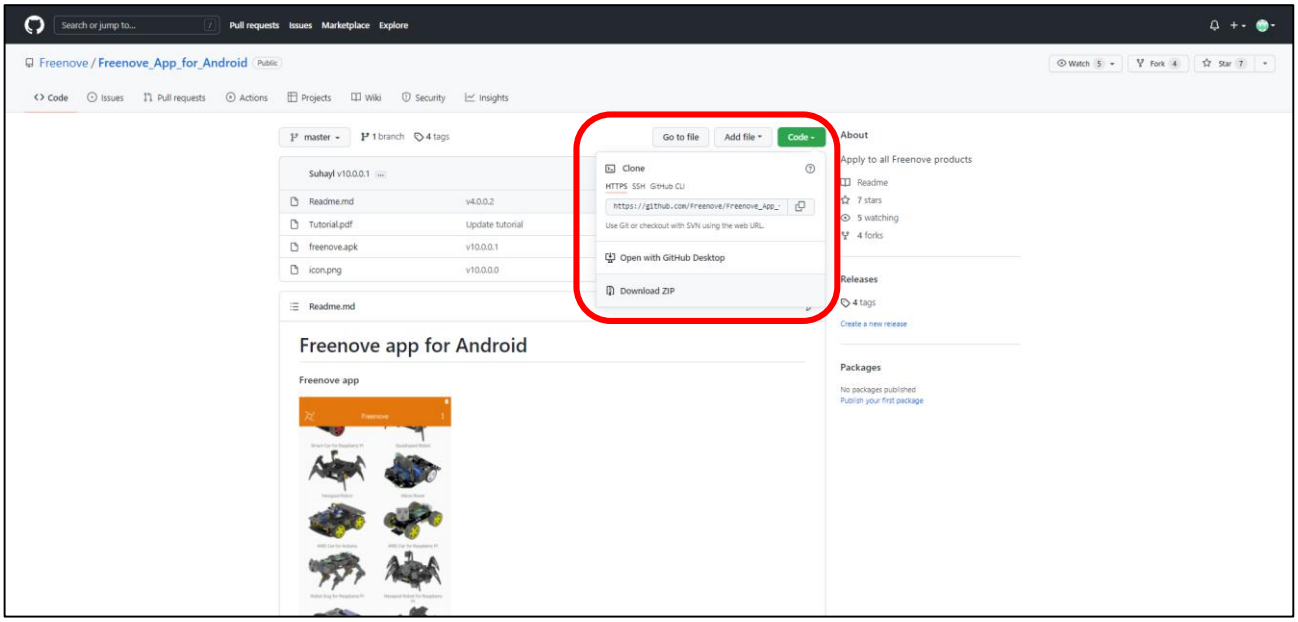
Method 2

Visit the website https://www.freenove.com/app.html with your computer and choose the one corresponding to your phone system to download, and then transfer it to your phone to install.



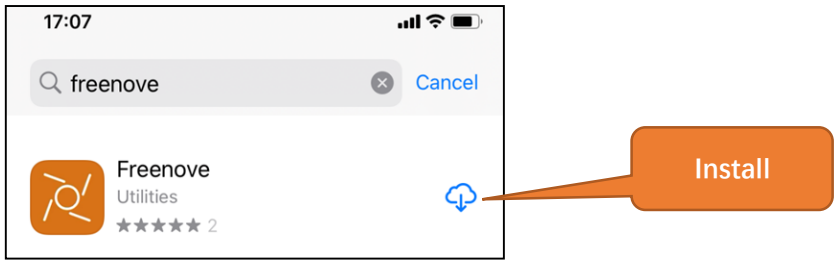
Method 3

Use your phone or computer to visit the website: https://github.com/Freenove/Freenove_app_for_Android, click Download ZIP under Code.



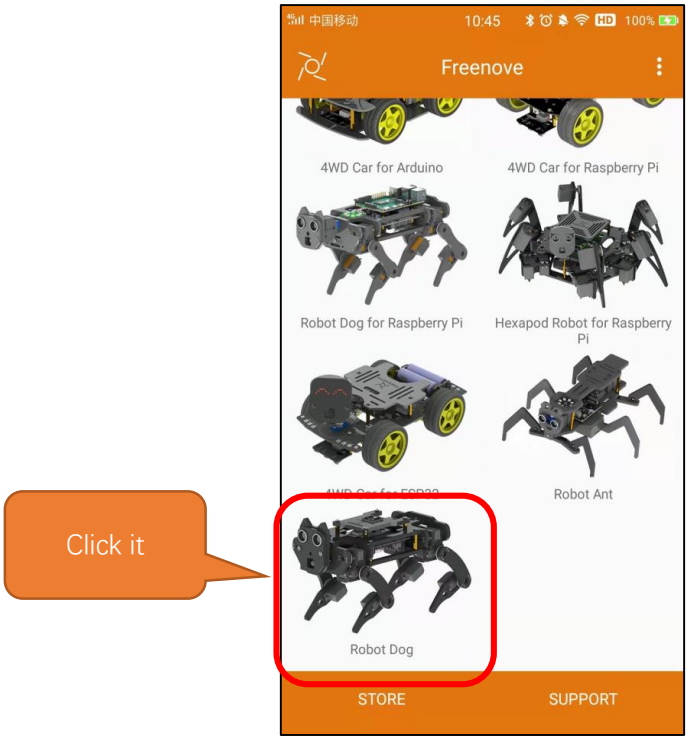
IOS

Open the iPhone's APP Store, search Freenove and install it.

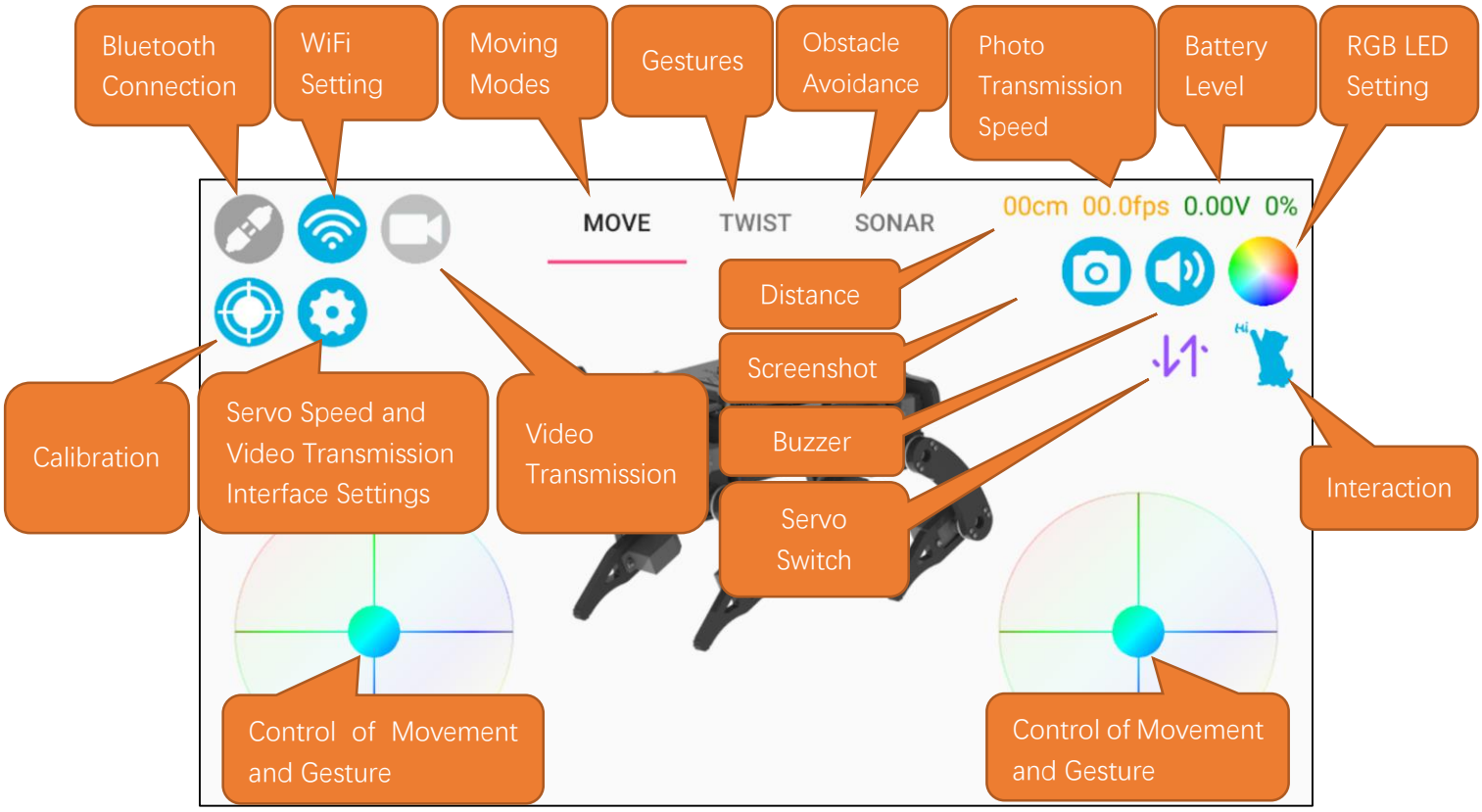


Introduction to Freenove App

Open the app and select the ESP32 robot Dog.



Before using the phone App to control the robot dog, we need to understand the interface first.



Chapter 2 Robot Assembly

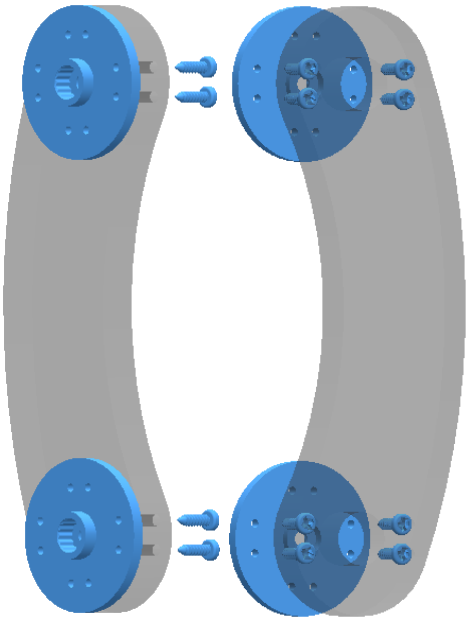
Please follow the tutorial to assemble the robot; otherwise, it may not function well.

Step 1 Assembly of Disc Servo Arms

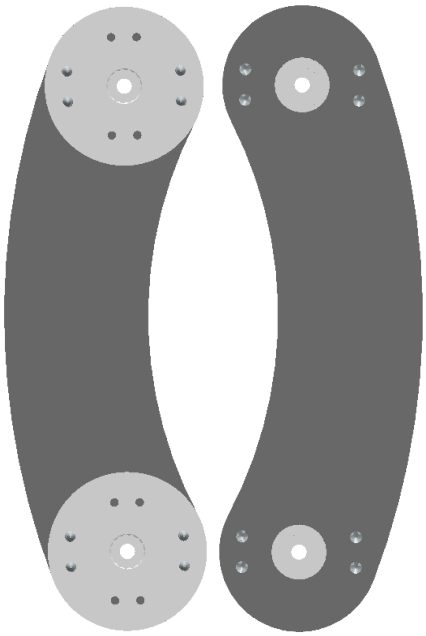
1. Take out 8 disc servo arms and 32 M1.4*8 screws from servo packages.

2. Mount two disc servo arms to the acrylic part with eight M1.4*8 screws.

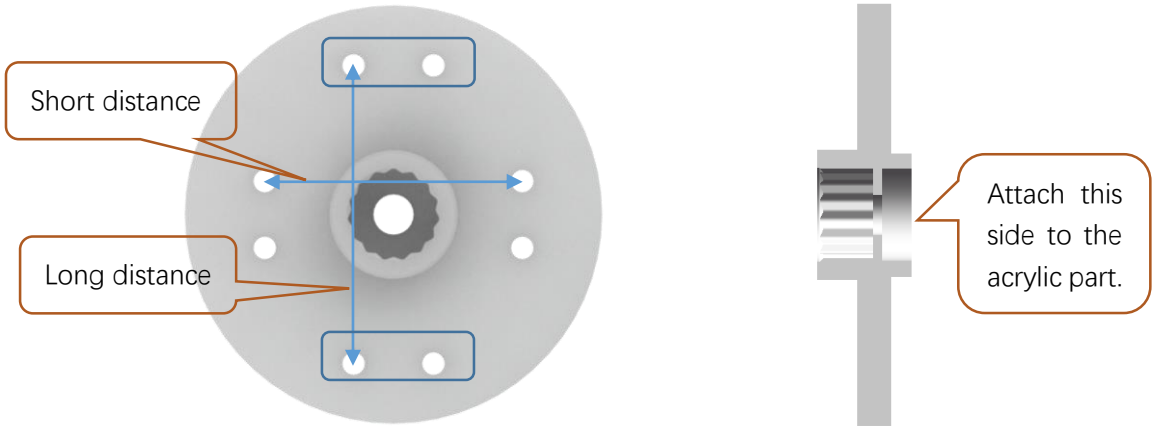
Below is a perspective view of the front and back.



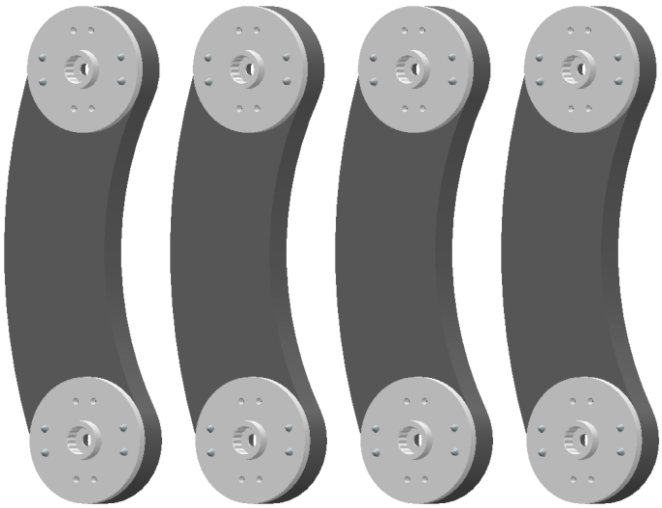
The front and back after assembly are as shown below.



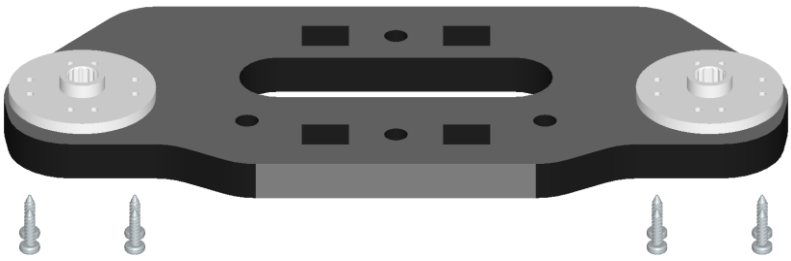
Note: The distance between the two sets of holes is different. Please use the ones with longer distance.



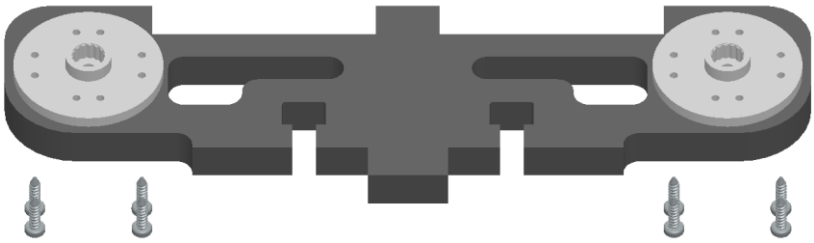
3. After assembly, you will get the following four parts.



4. Mount two disc servo arms with eight M1.4*8 screws to the head board.

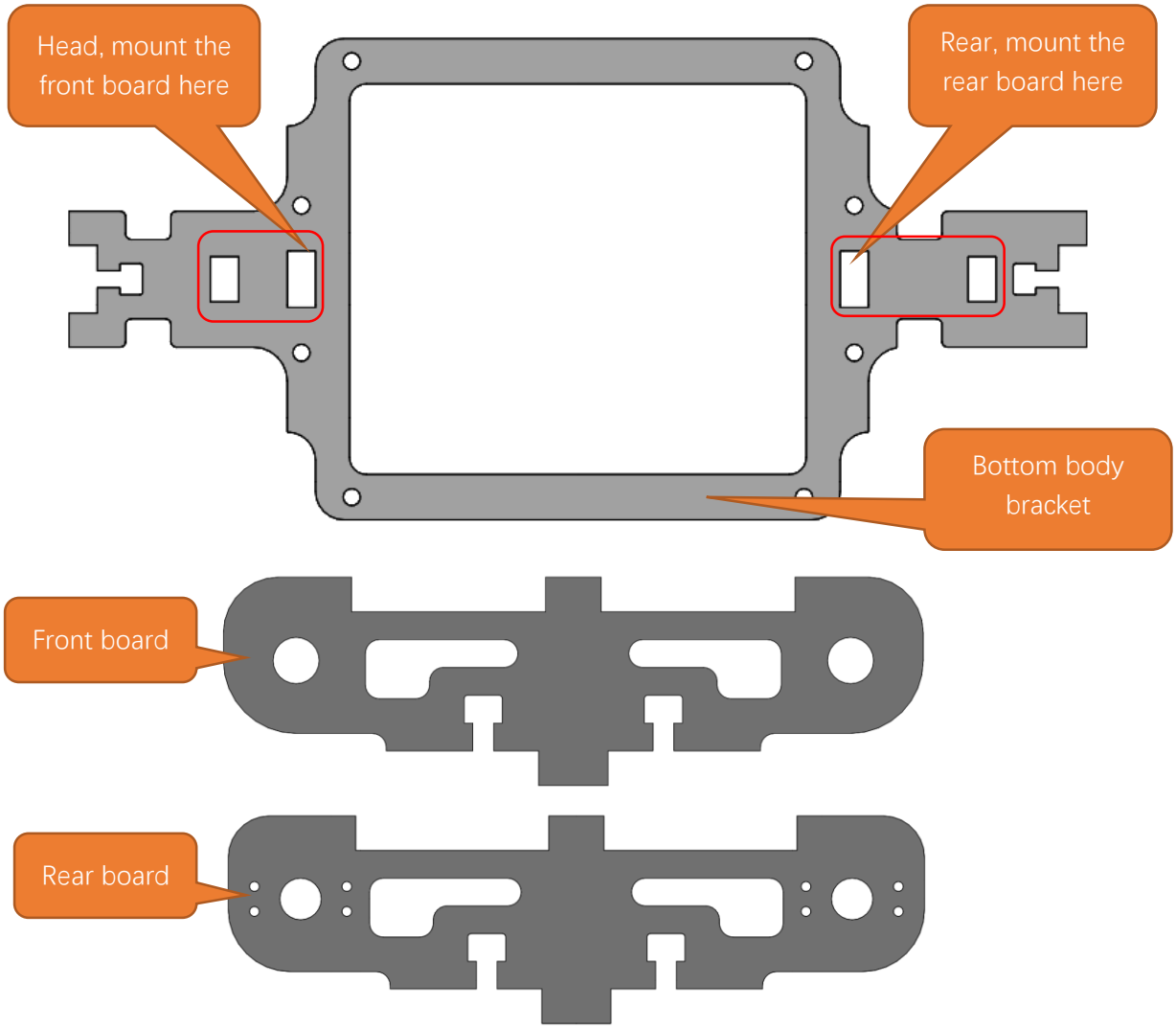


5. Mount two disc servo arms with eight M1.4*8 screws to the rear board.

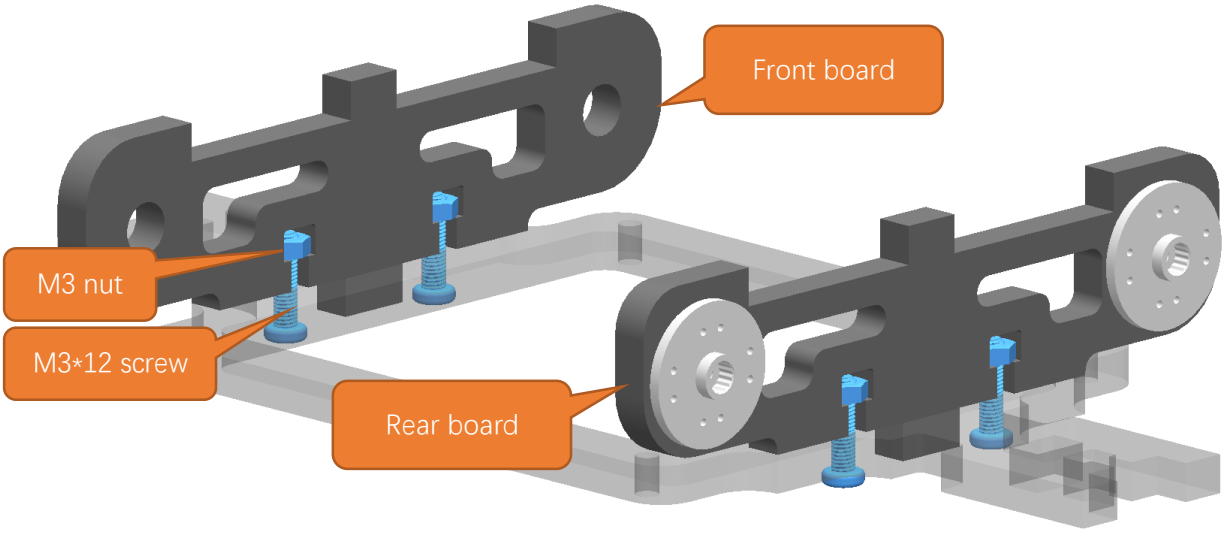


Step 2 Assembly of Body Bracket

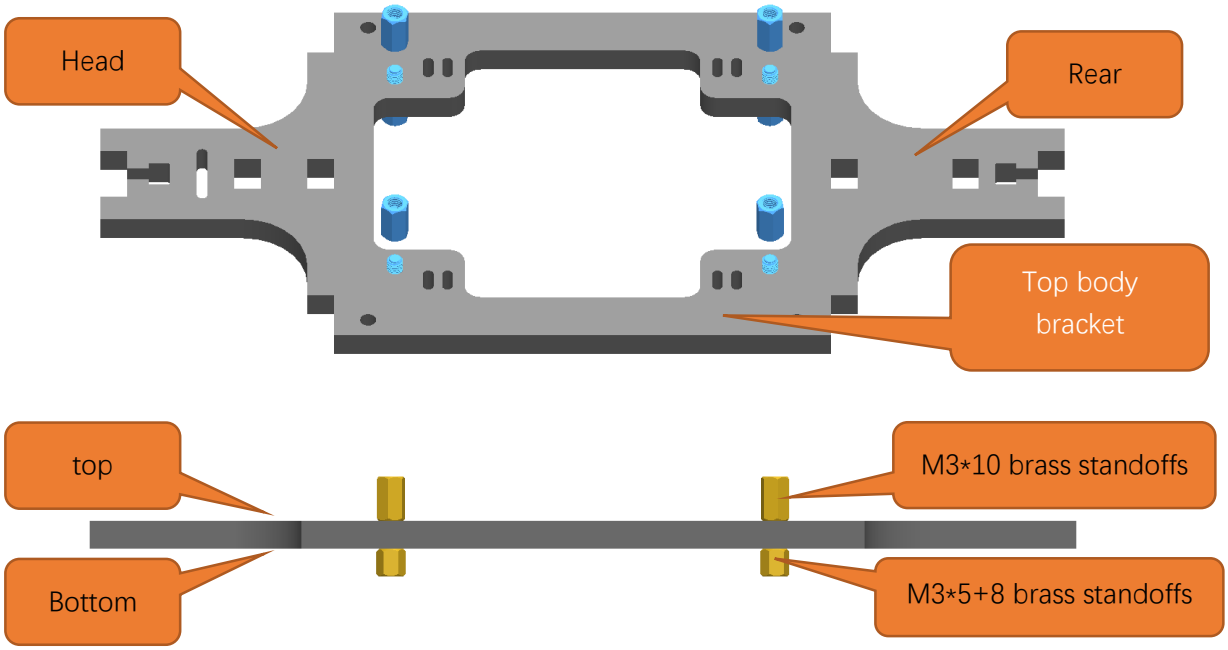
1. Mount the below two acrylic parts to the bottom body bracket with M3*12 screws and M3 nuts.



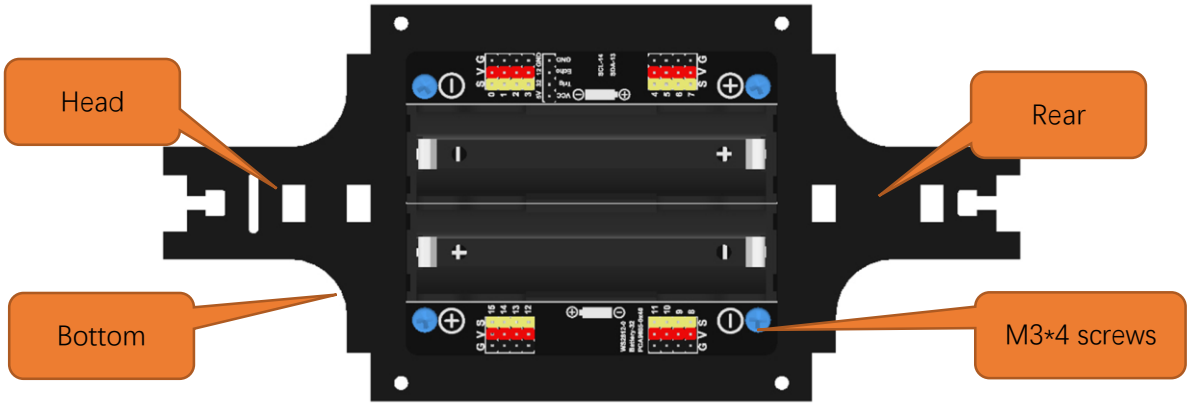
It should look as below after assembly. Pay attention to the direction of the rear board.



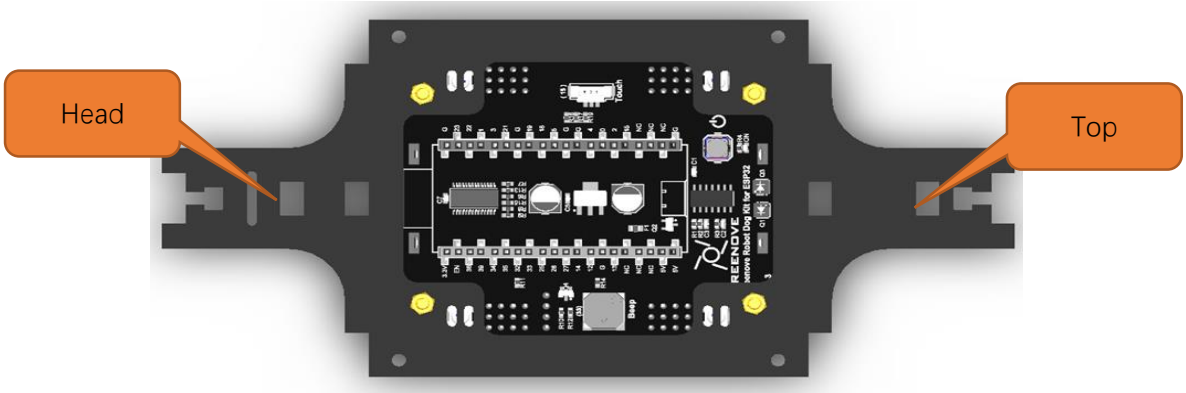
2. Mount four M3*5+8 and four M3*10 brass standoffs to the top body bracket.



3. Mount the driver board to the top body bracket with four M3*4 screws.

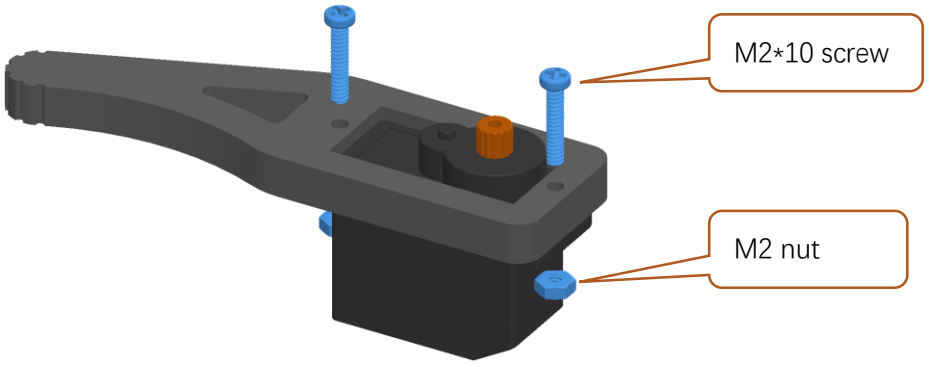


After assembly:

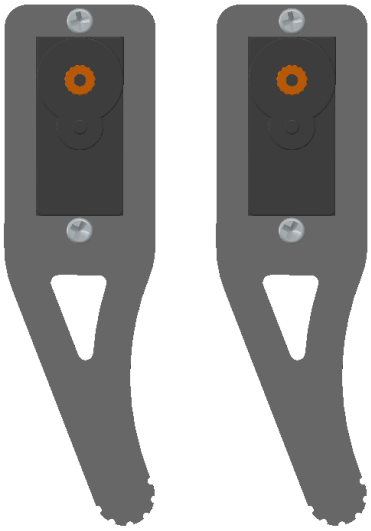


Step 3 Assembly of Legs

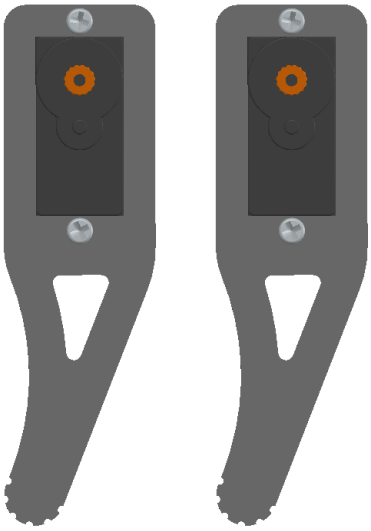
1. Mount four servos to four shanks with M2*10 screws and M2 nuts.



Left shank

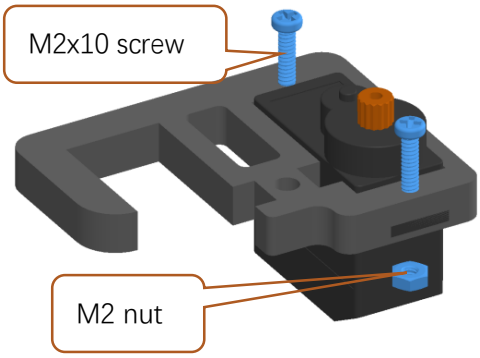


Left shank

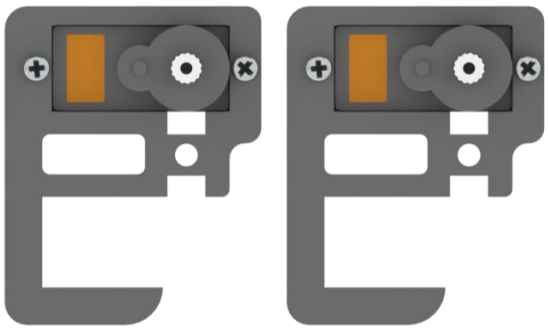


2. Mount two servos to the below acrylic parts with M2*10 screws and M2 nuts.

Assembly diagram

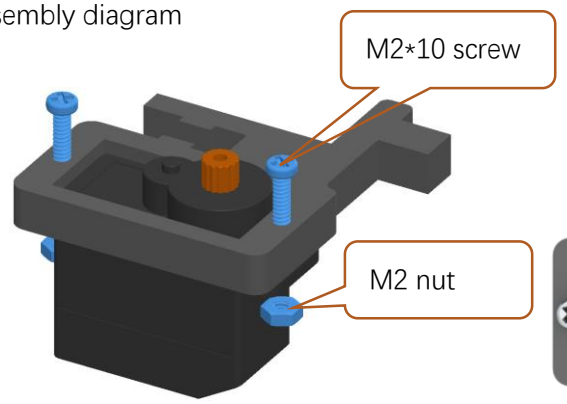


After assembly

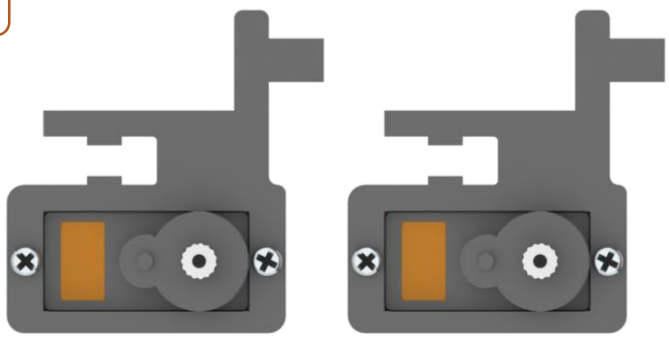


3. Mount two servos to the below acrylic parts with M2*10 screws and M2 nuts.

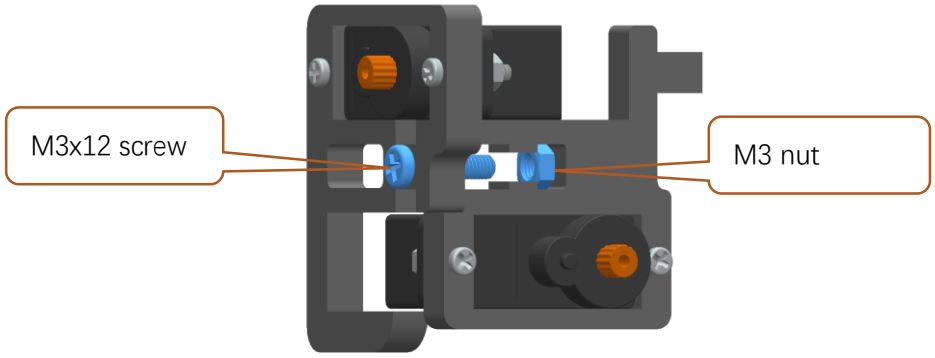
Assembly diagram



After assembly



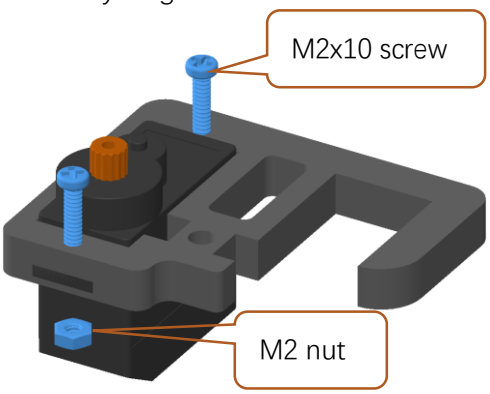
4. Mount the two set of acrylic parts above with M3*12 screws and M3 nuts.



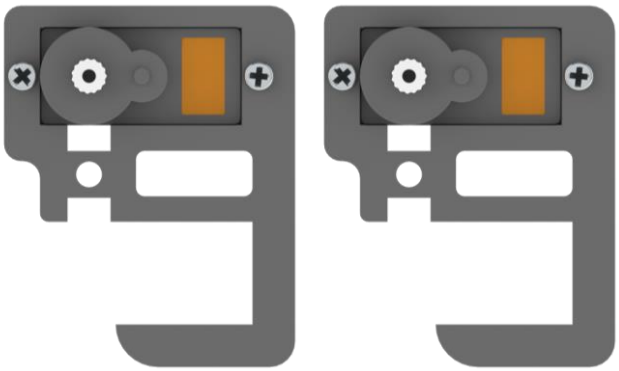
5. Mount two servos to the below acrylic parts with M2*10 screws and M2 nuts.

Note: The direction is different from that in No.2!

Assembly diagram



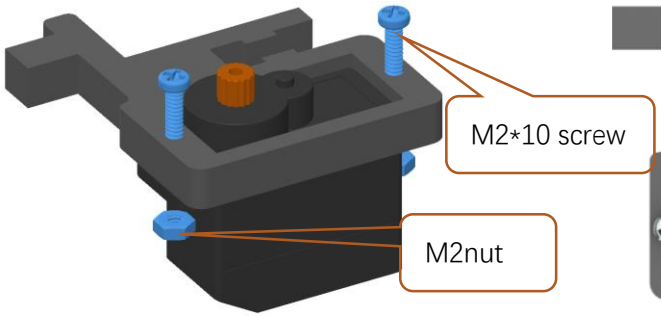
After assembly



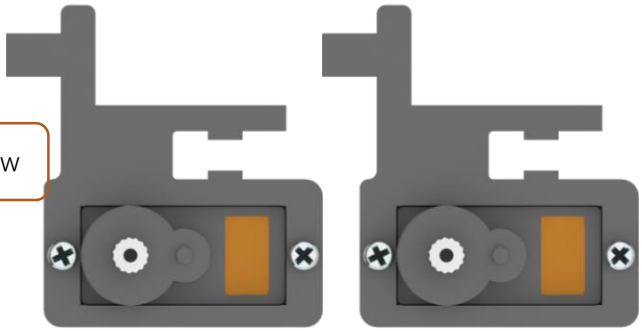
6. Mount two servos to the below acrylic parts with M2*10 screws and M2 nuts.

Note: The direction is different from that in No.3!

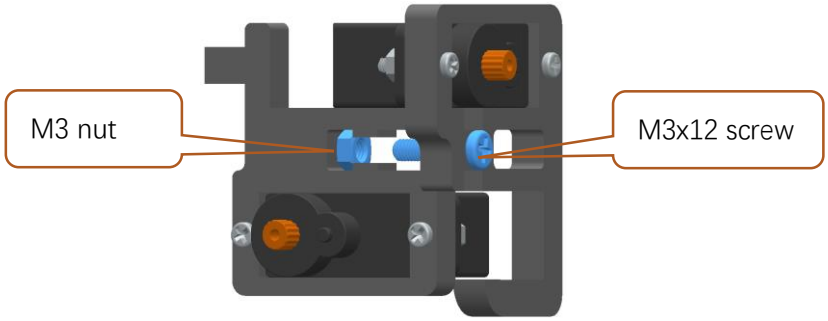
Assembly diagram



After assembly

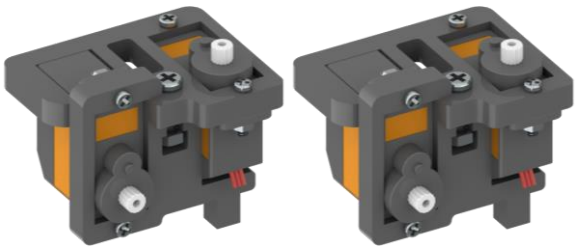


7. Mount the two set of acrylic parts abovw with M3*12 screws and M3 nuts.。

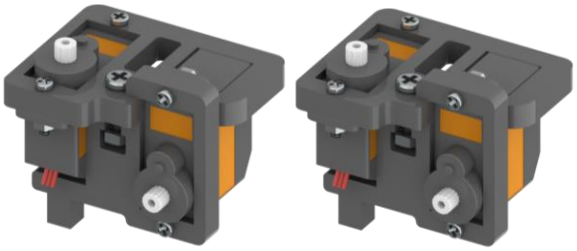


Note: The direction is different from that in No.4!

Left

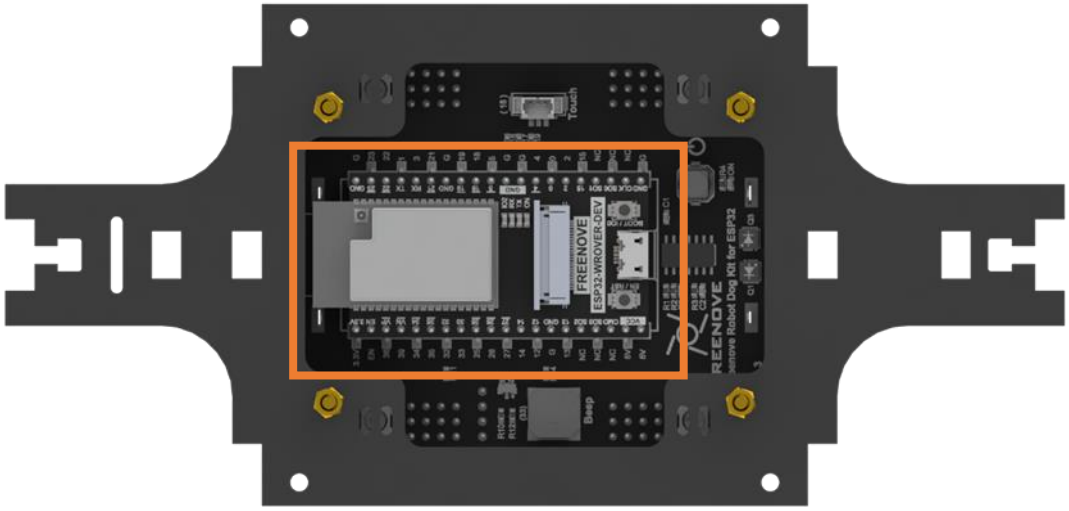


Right



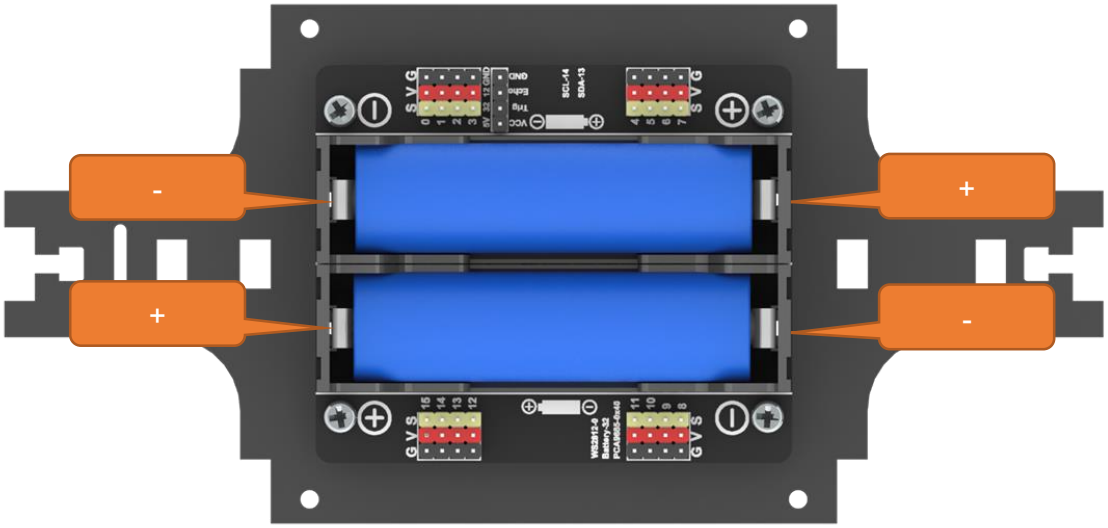
Step 4 Adjustment of Servo Angles

1. Plug ESP32 into the driver board.



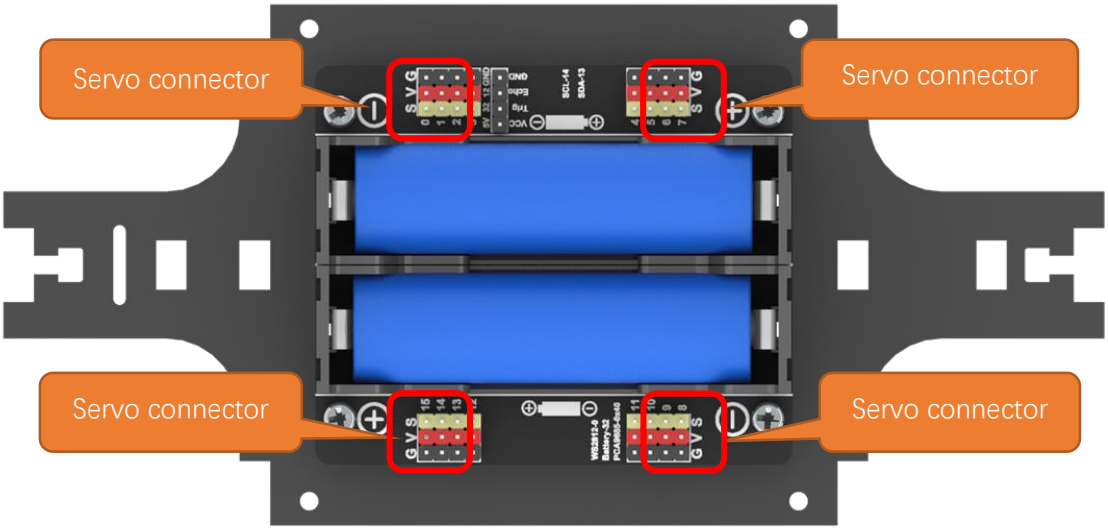
Pay attention to the orientation of the ESP32. Wrong installation may lead to damage.

2. Install the batteries.

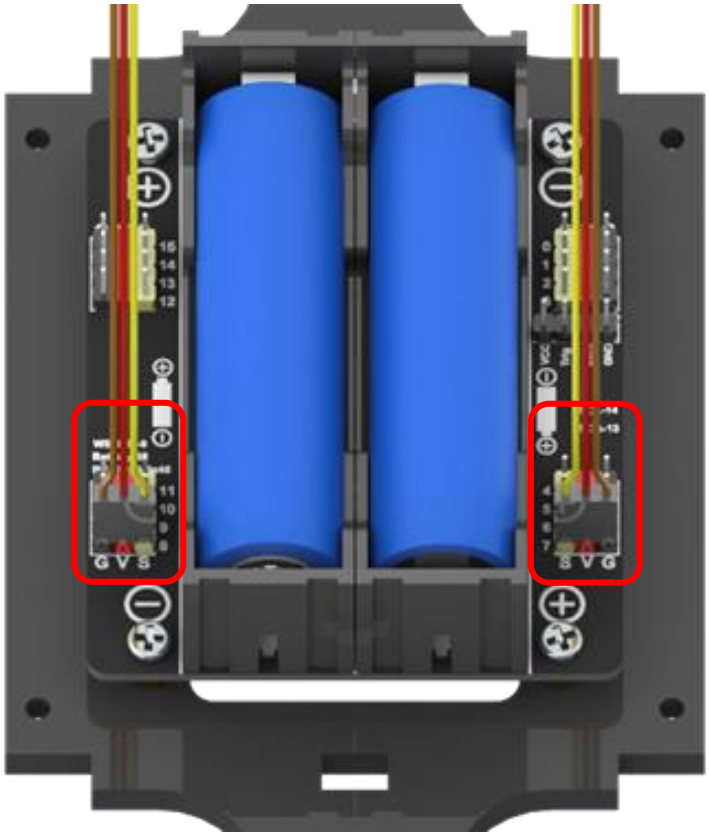


Put in the batteries according to the silkscreen. Wrong installation may result in malfunction.

3. Plug in the servo cables to the servo connector pins randomly.

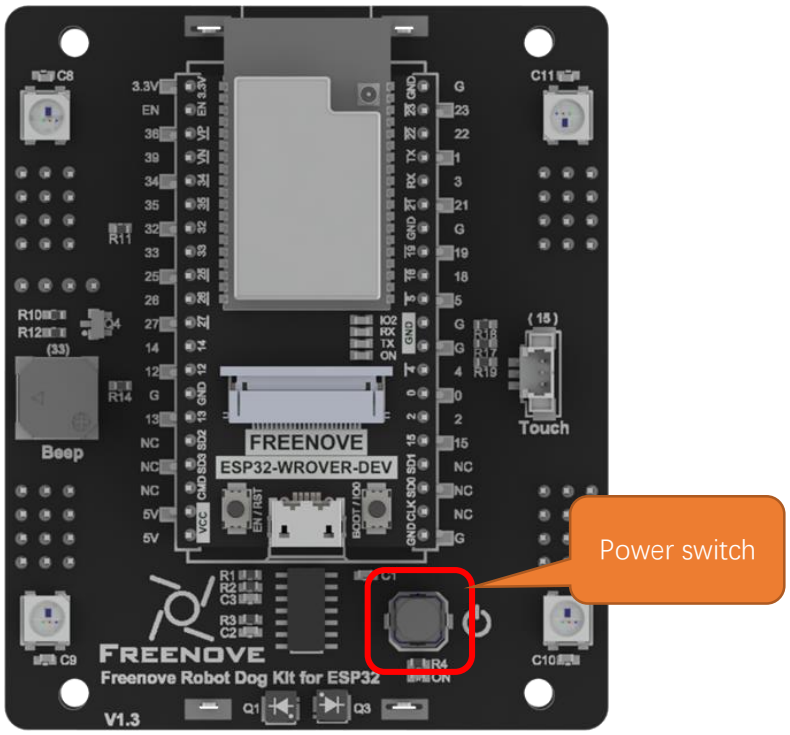


Pay attention to the color of the cable on each side.



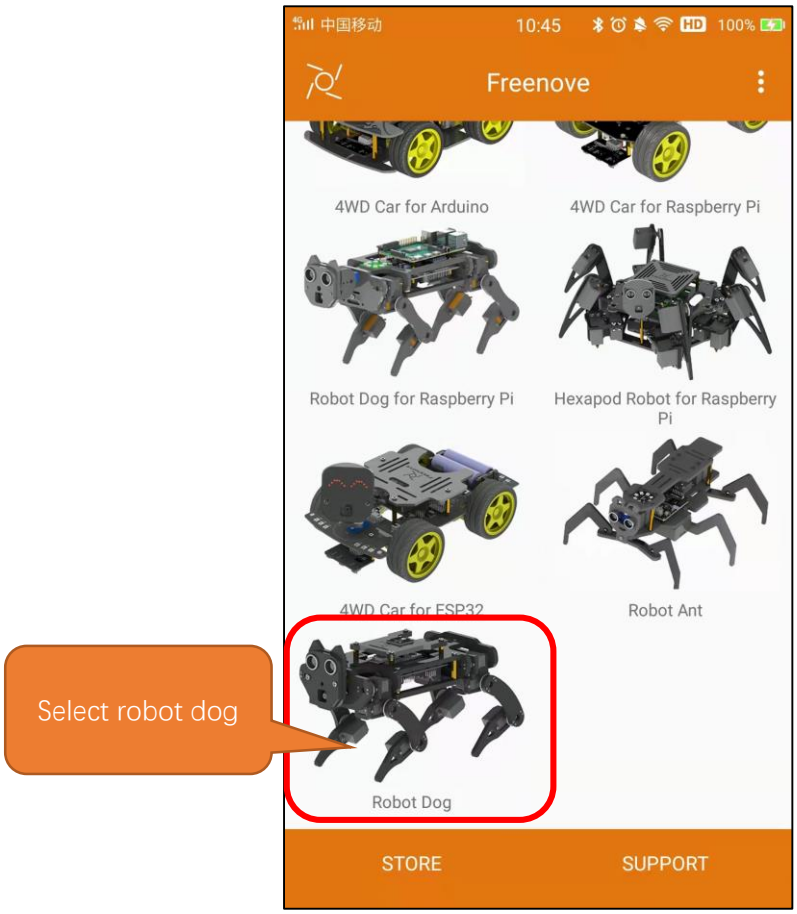
G-GND (brown cable)
V-VCC (red cable)
S-Signal (orange cable)
Note: Do NOT connect the cables in reverse. Otherwise, the servos will not work and may be damaged.

4. Turn ON power switch.

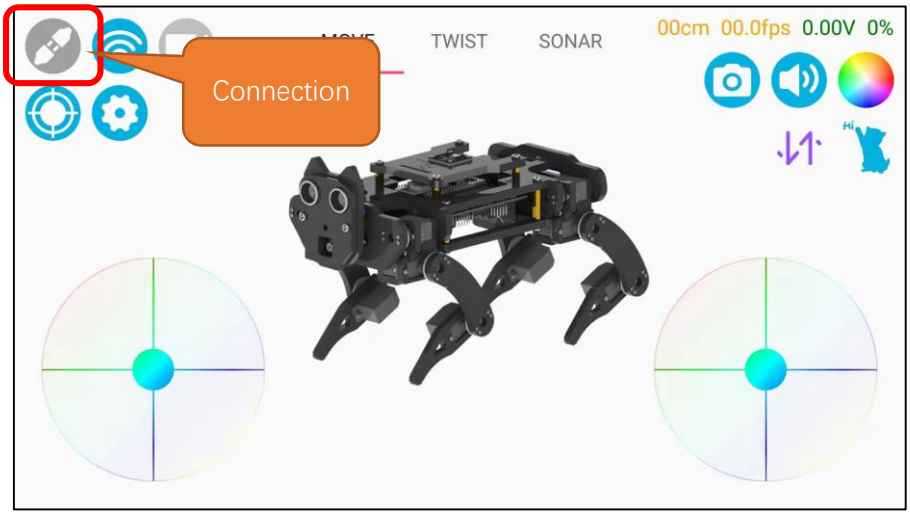


5. Open Freenove App and select robot dog

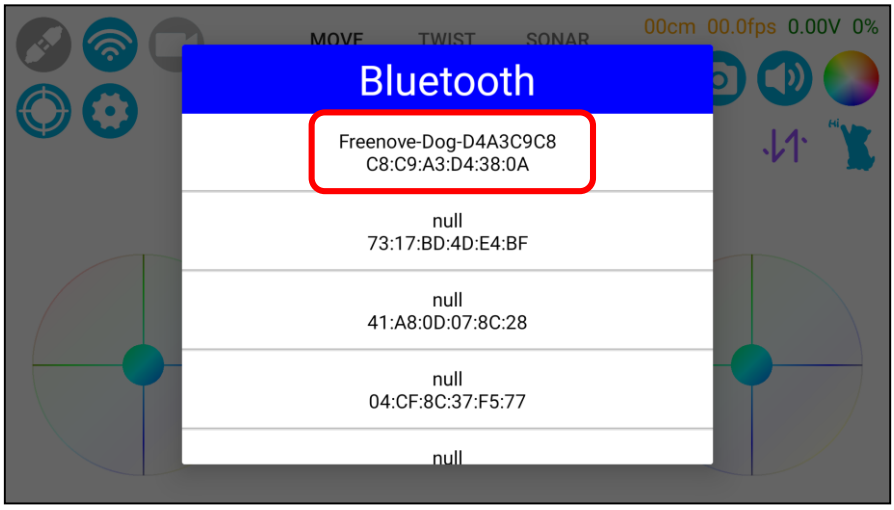
.For more details, please refer to the next chapter.



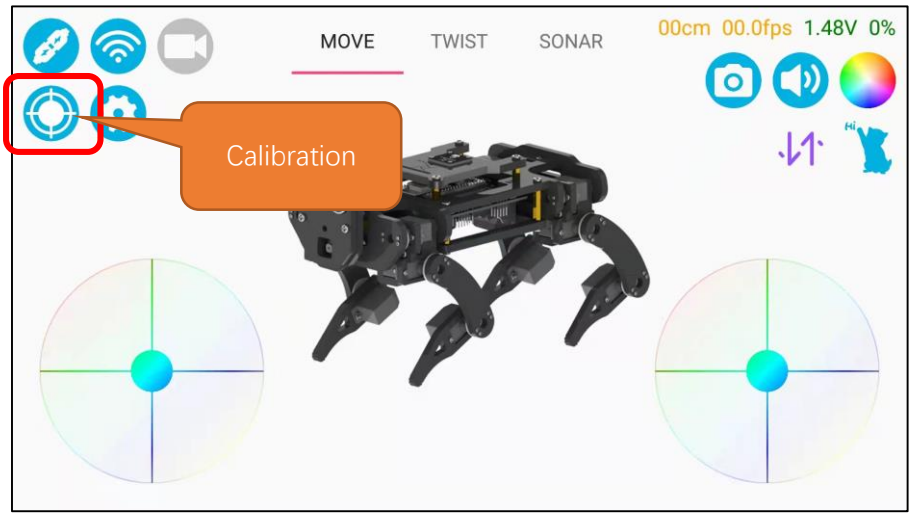
6. Turn ON Bluetooth of your phone and tap the Connect button on the app.



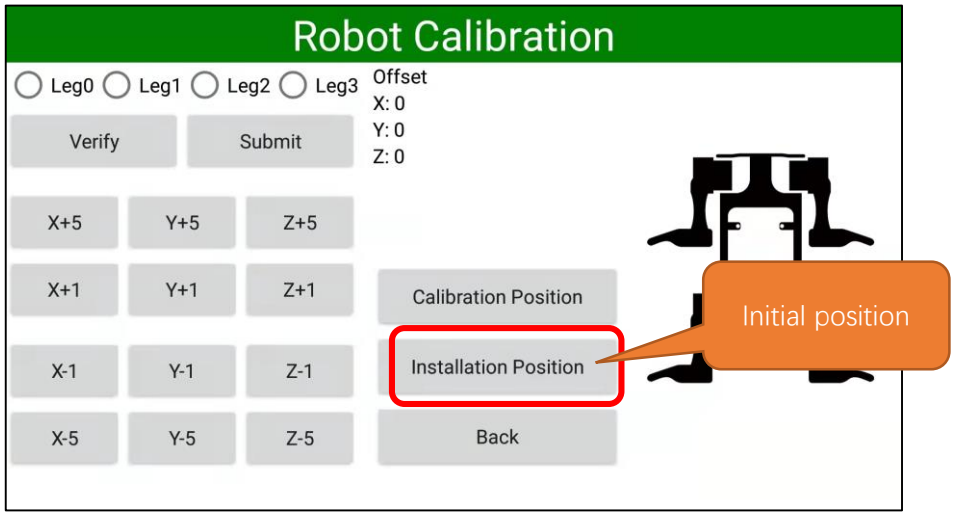
7. Select “Freenove-Dog-XXXXXXXX”.



8. Tap the calibration button.



9. Tap Installation Position and all the servos will rotate to 90 degrees.



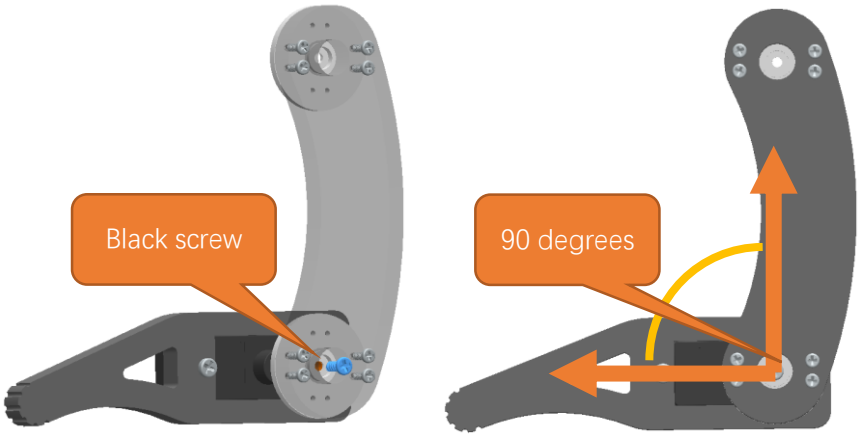
Note: The purpose of adjusting the angle of the servos is to ensure that there will not be too much deviation after assembly to avoid malfunction. Therefore, this step is very important.

Step 5 Assembly of Legs to Body

Please keep power ON and all the servo cables connecting to the driver board during assembly. We need to ensure servos remain at 90 degrees when assembling. (Servo cables are not shown in the following instructions.)

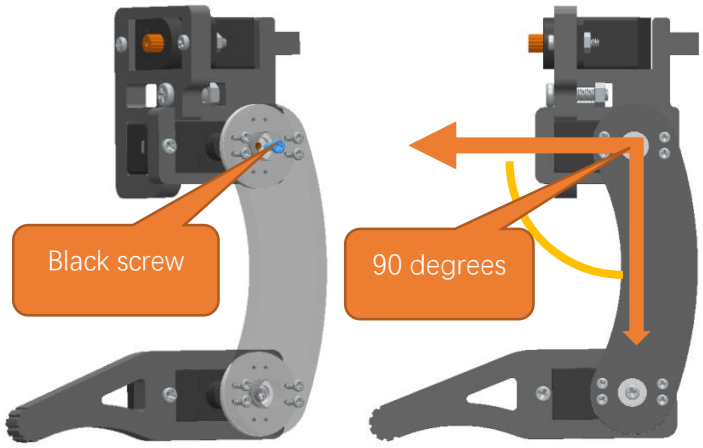
1. Assemble the servos to the acrylic parts with black screws in servo packages.

Assemble them as close to 90 degrees as possible. Angles at 70 – 110 degrees are acceptable.

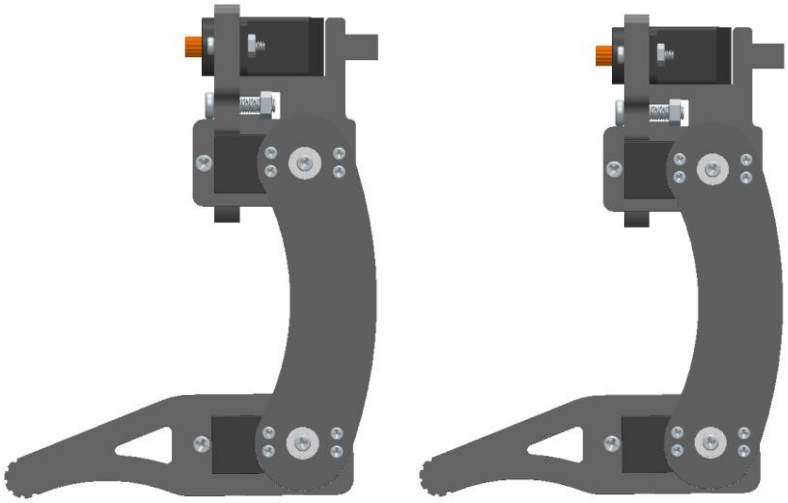


2. Assemble the servos to the acrylic parts with black screws in servo packages.

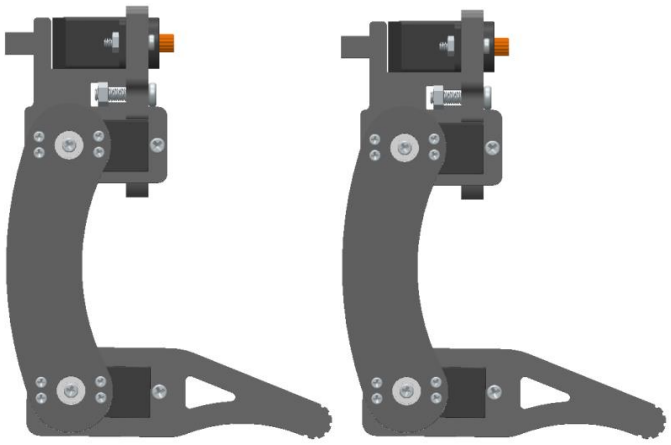
Assemble them as close to 90 degrees as possible. Angles at 70 – 110 degrees are acceptable.



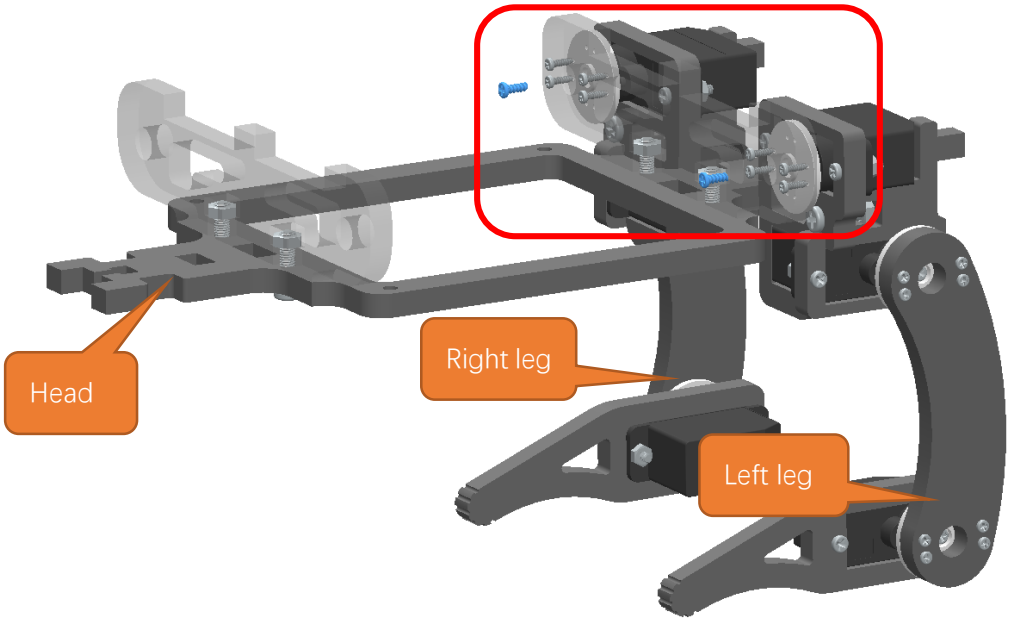
Repeat the above step to make two same left legs.



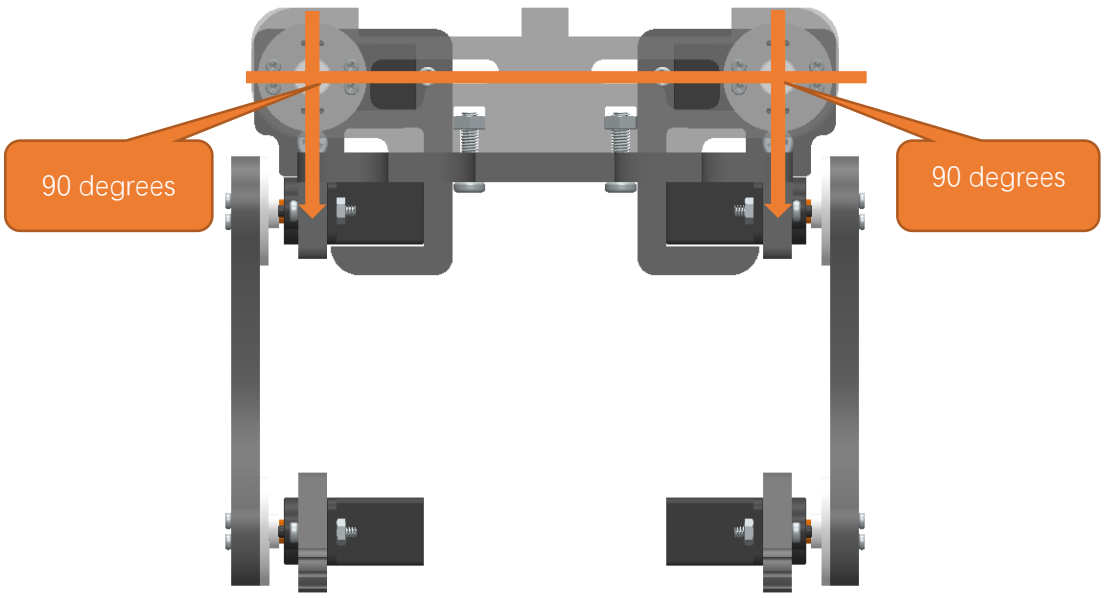
3. Similar to the above steps, assemble two right legs.



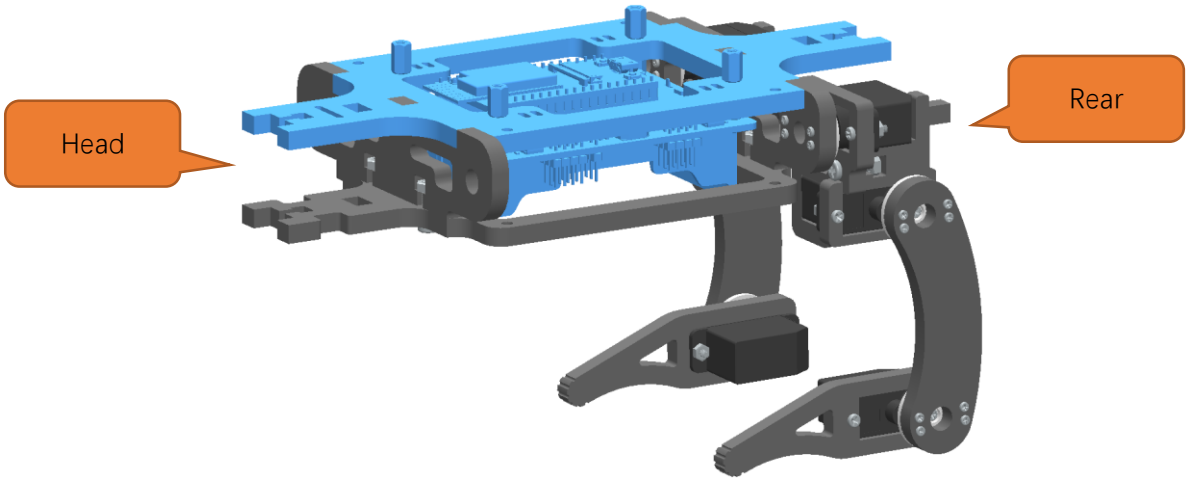
4. Mount one left and one right legs to the rear board with black screws in the servo package.



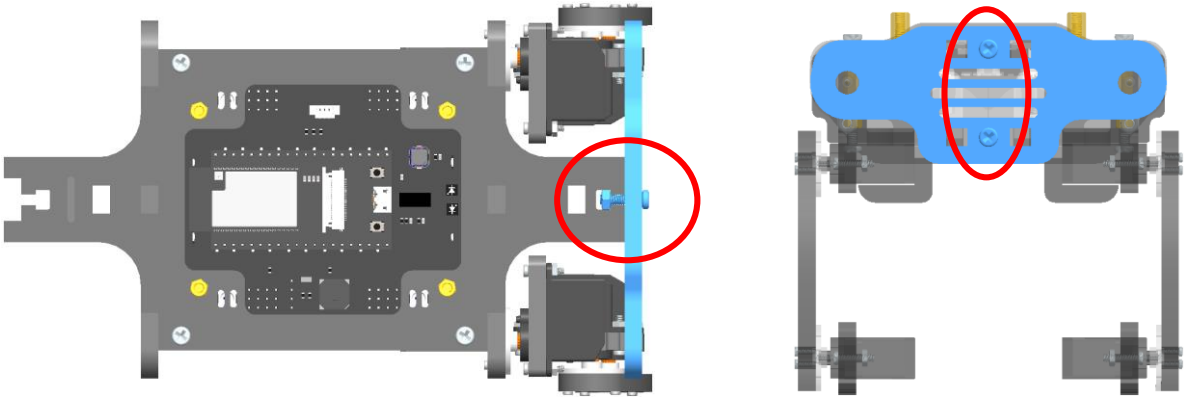
Assemble them as close to 90 degrees as possible. Angles at 70 – 110 degrees are acceptable.



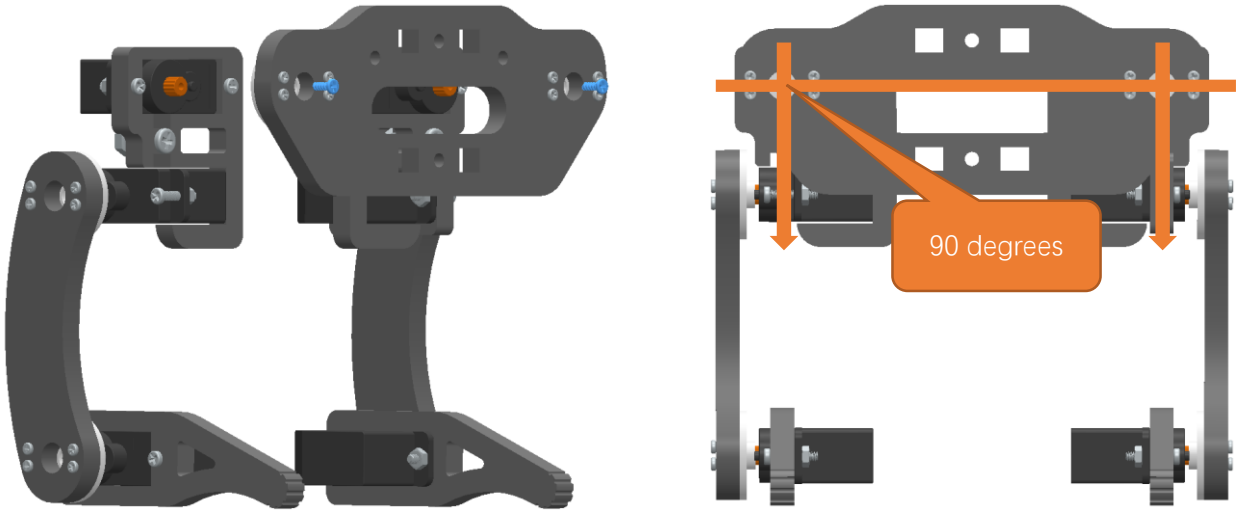
5. Mount the top body bracket to the bottom one.



6. Mount the rear board to the rear of the brackets with two M3*12 screws and two M2 nuts.

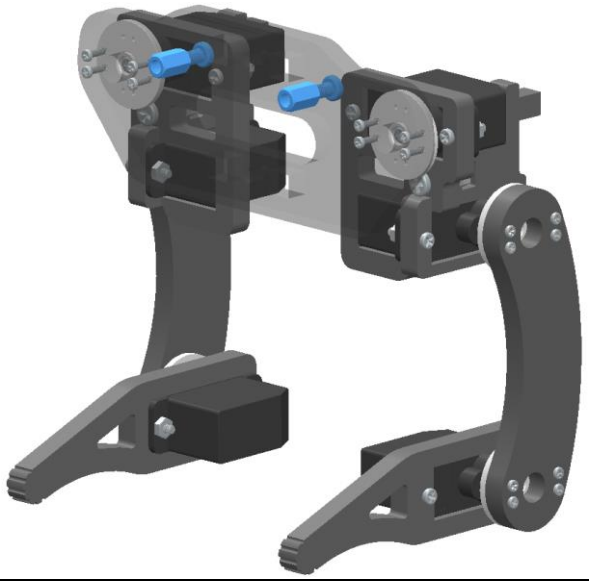


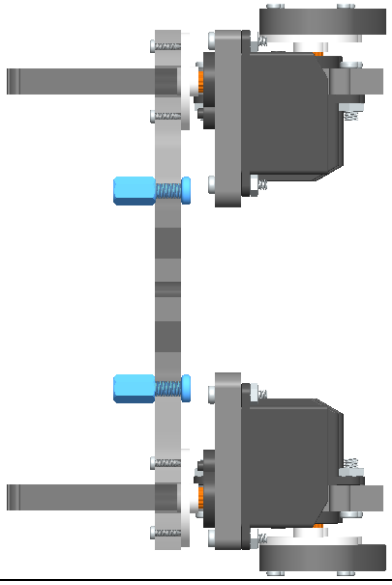
7. Mount one left and one right leg to the front board with black servo screws in the servo package. Assemble them as close to 90 degrees as possible. Angles at 70 – 110 degrees are acceptable.



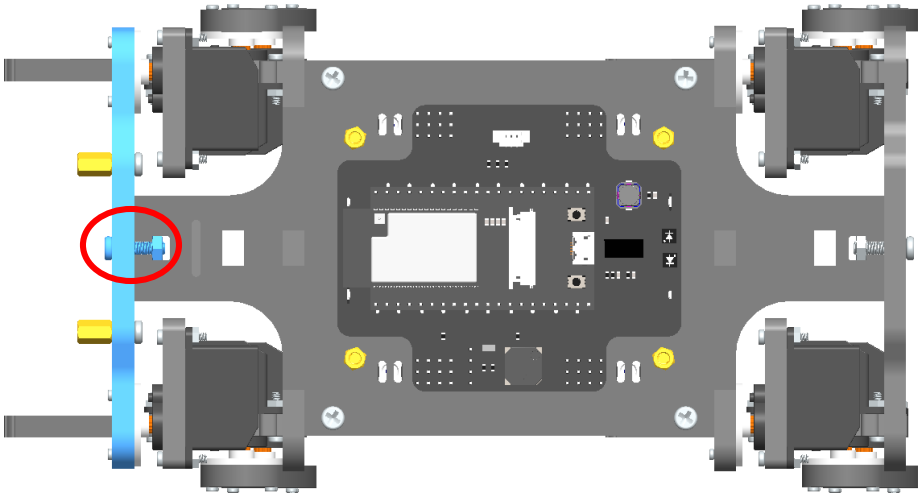
Note: After installing all Servo at 90 degrees, power can be turned off.

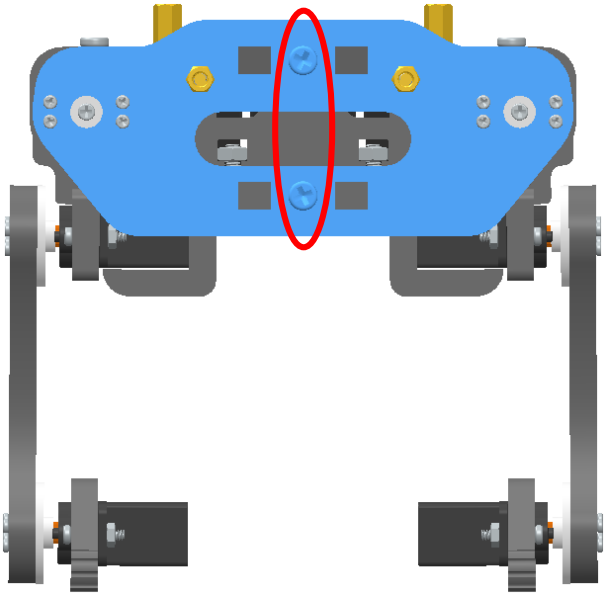
8. Mount two M3*10 standoffs to the front board with two M3*8 screws.



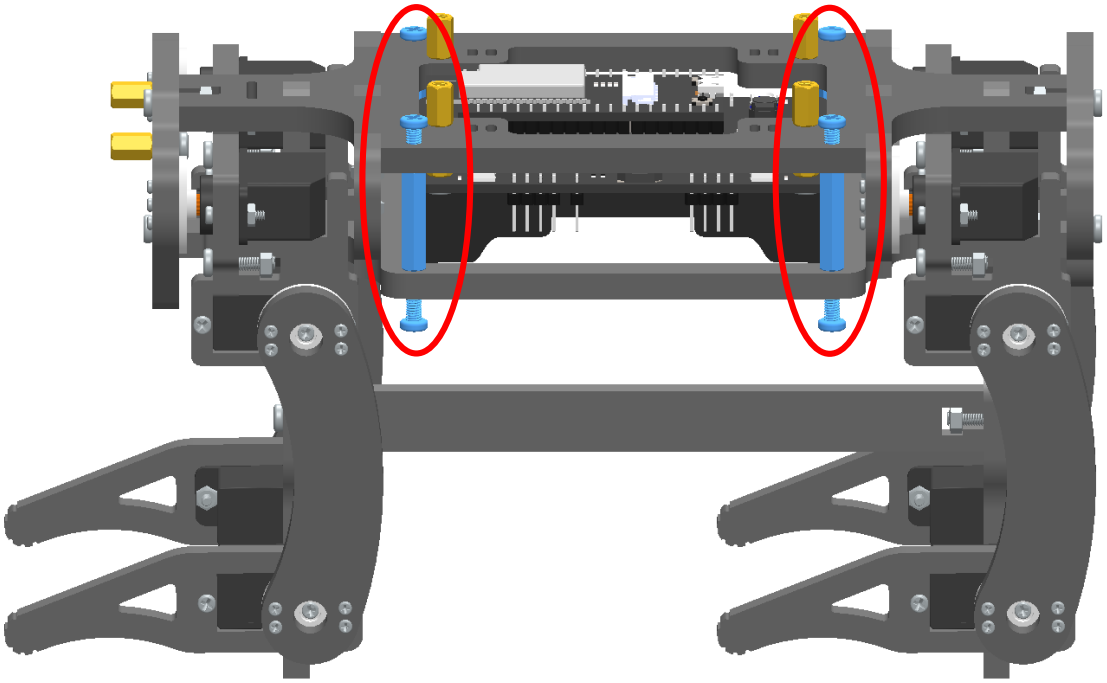


9. Mount the front board to the head of body bracket with a M3*12 screw and a M3 nut.



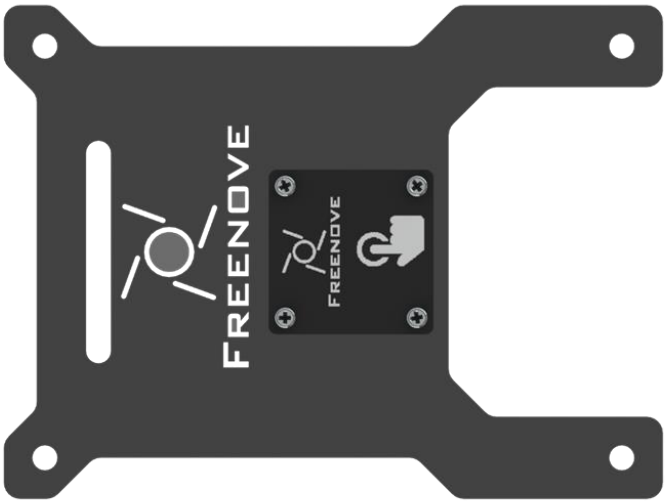


10. Fix the body brackets with eight M3*8 screws and four M3*20 brass standoffs.

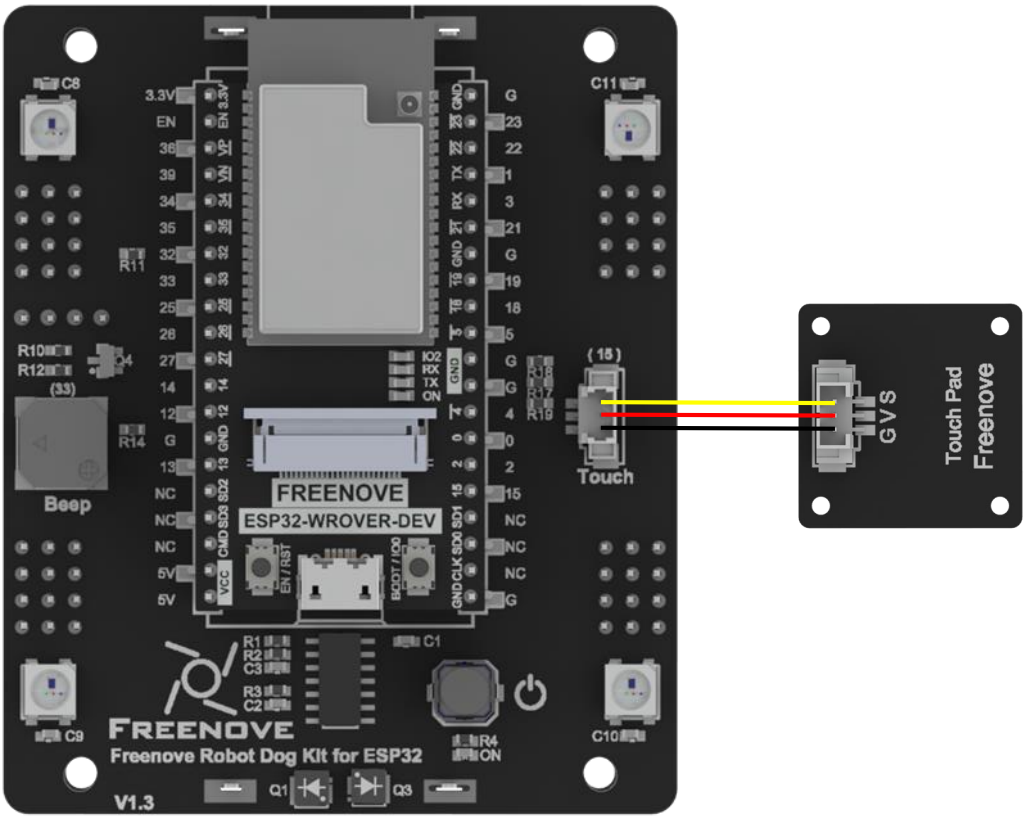


Step 6 Assembly of the Cover

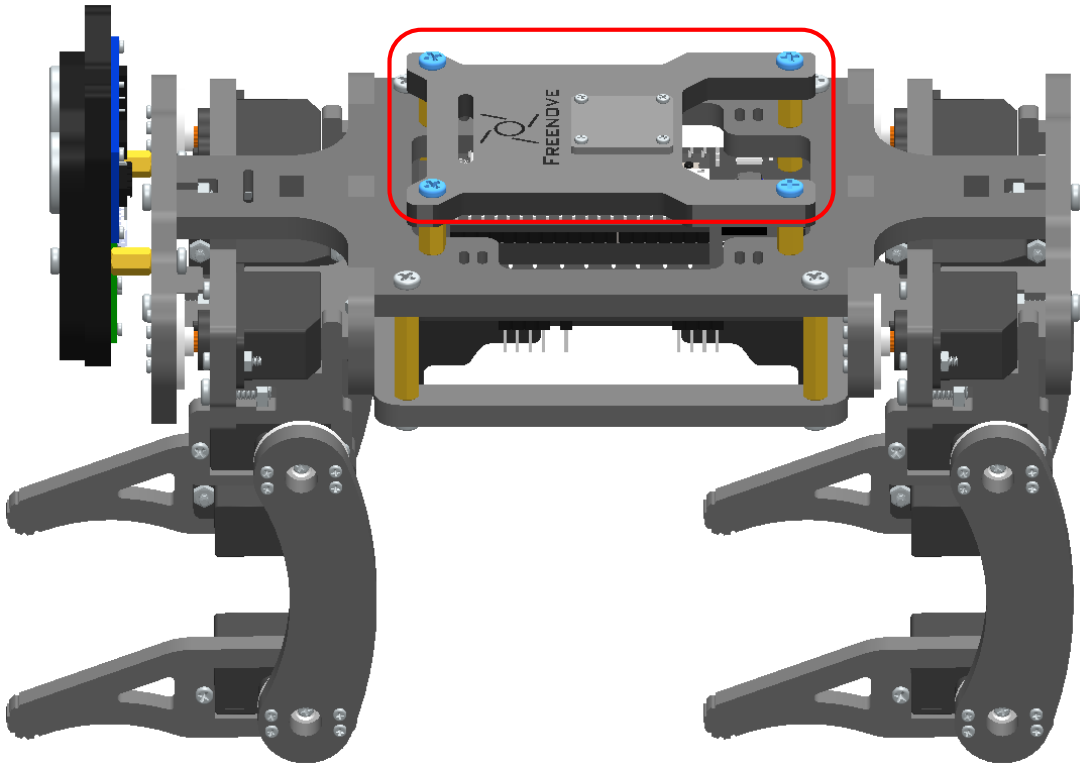
1. Mount the touch sensor to the cover with four M1.4*5 screws.



2. Use a 3P wire to connect the touch module to the robot dog drive board. The figure below does not show the acrylic part.

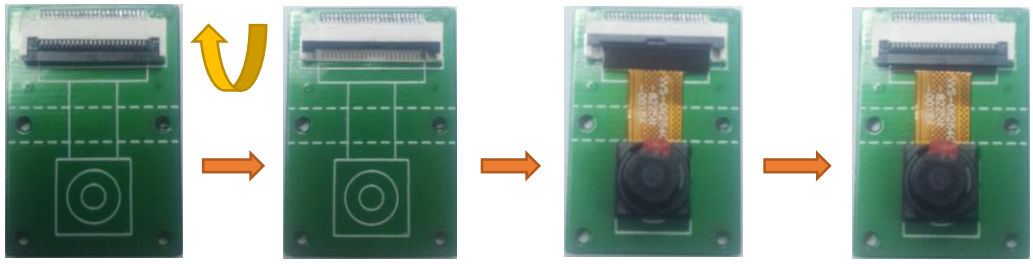


3. Mount the cover to the robot with four M3*8 screws.



Step 7 Assembly of Head

1. Connect the camera to its extension board.

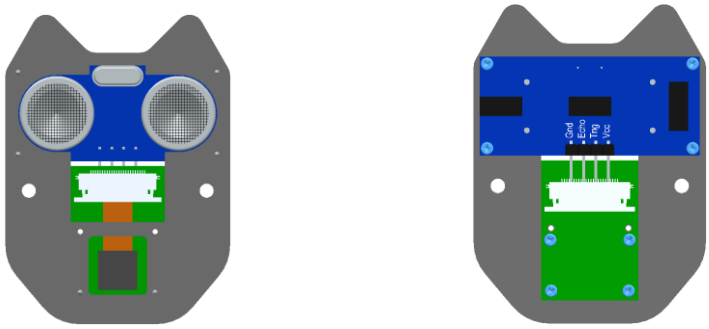


Gently pull up the lock with your fingernail or a plastic stick.

Note: Please do not use violence to avoid damage to the FPC seat.

Remember to keep power OFF when assembling the head to avoid damaging the camera.

2. Mount the camera and ultrasonic modules to the head acrylic part.



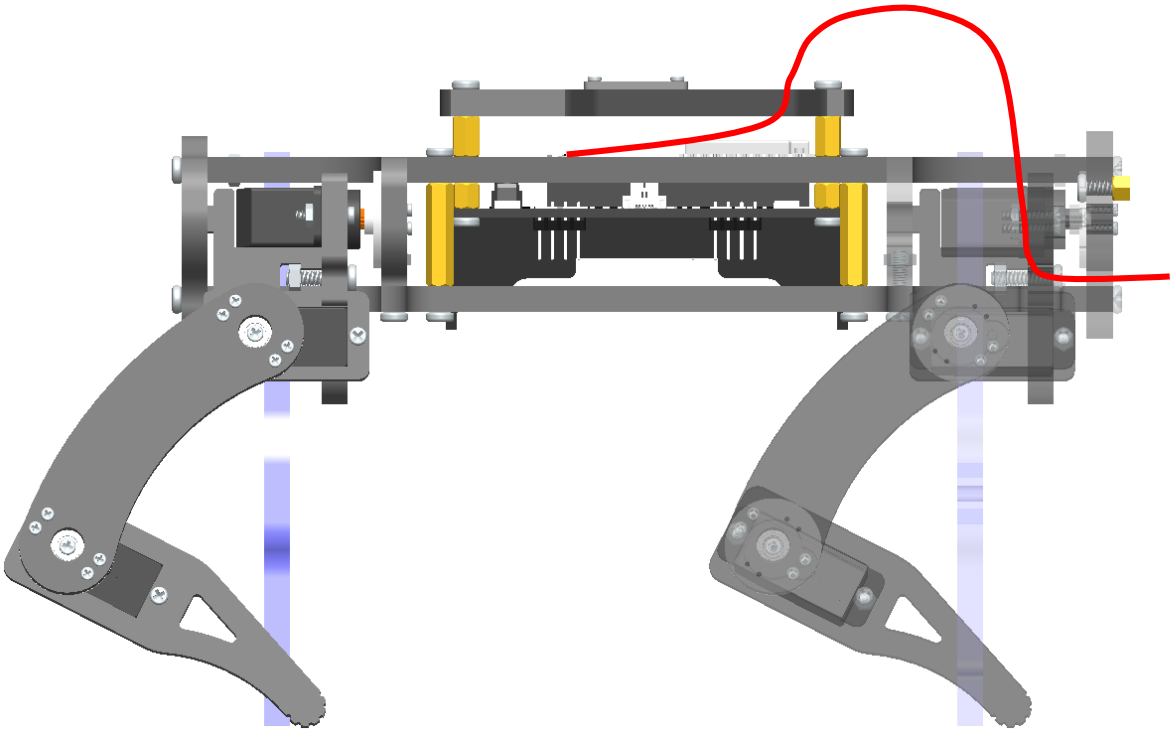
3. Plug one end of the camera cable into the camera extension board as shown below.

√ ×

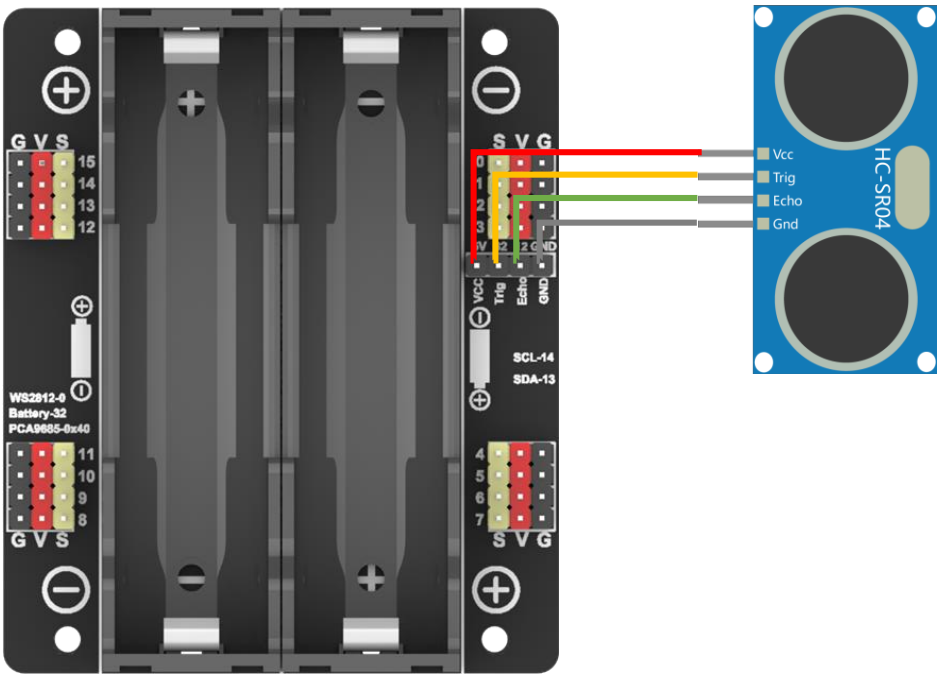
Plug the other end into the ESP32.

√ ×

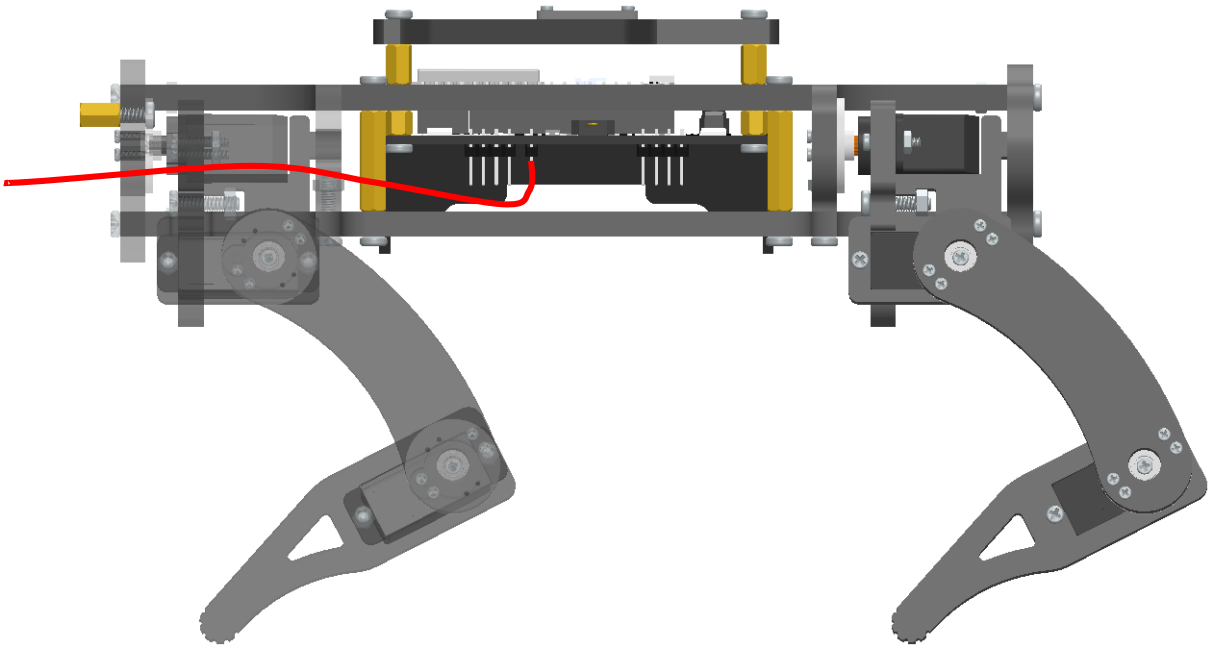
Cable connections to the camera are as follows:



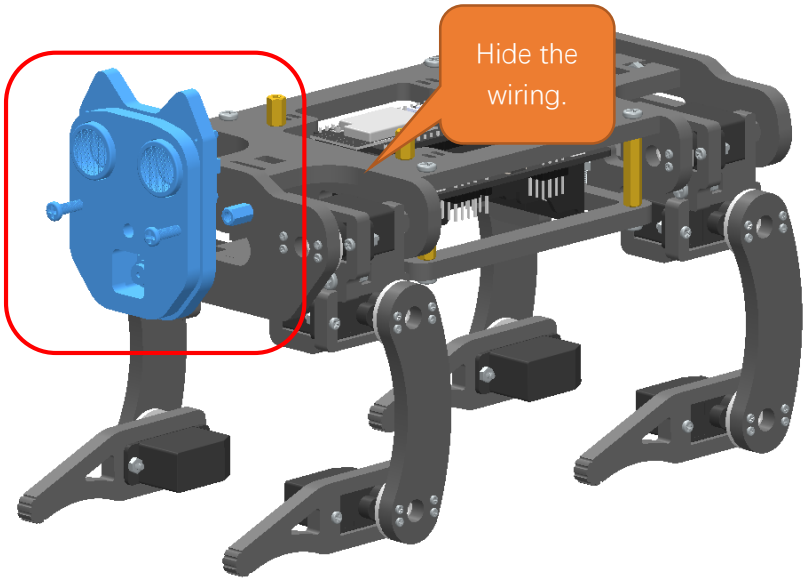
4. Connect the ultrasonic module to driver board with the 4P DuPont cable.



Ultrasonic wiring is as follows:

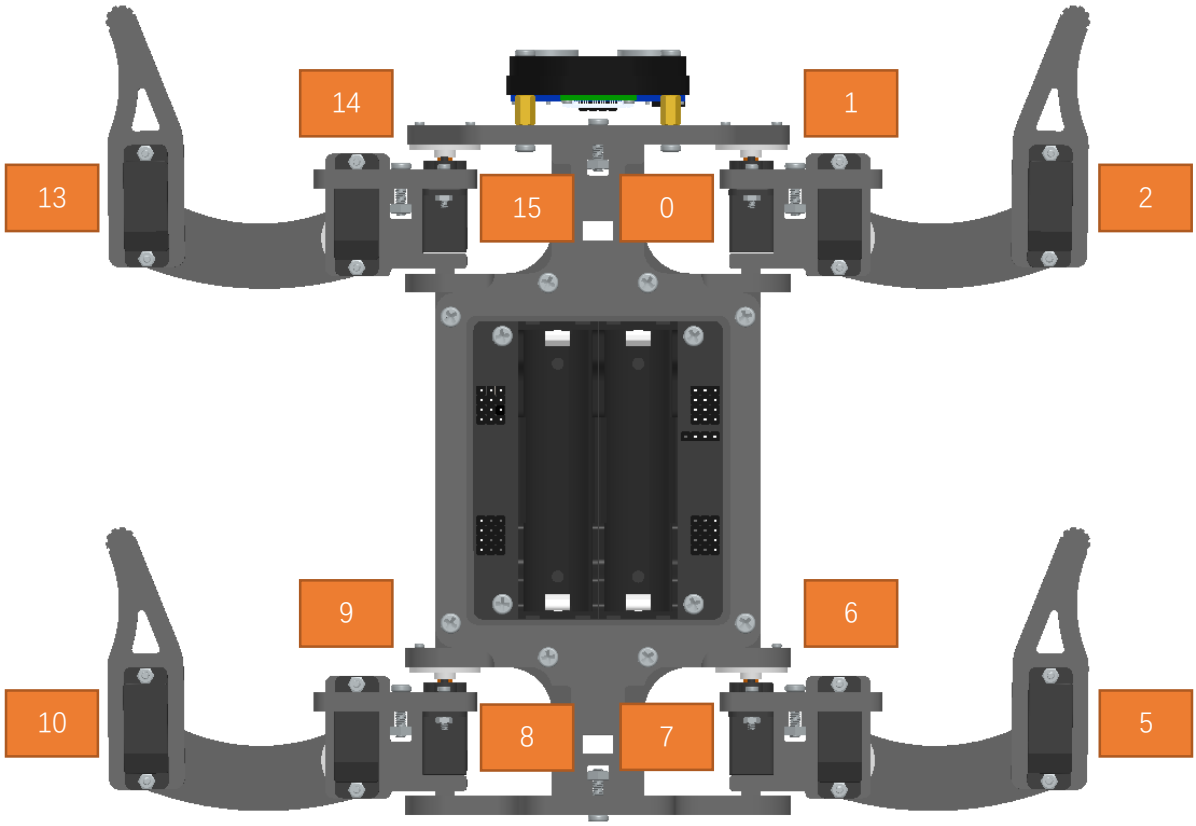


5. Mount the two acrylic parts for head to the body with two M3*12 screws.
It is recommended to hide the wiring of the head inside the body.



Step 8 Wiring

Reconnect the servo cables in accordance with the sequence below.

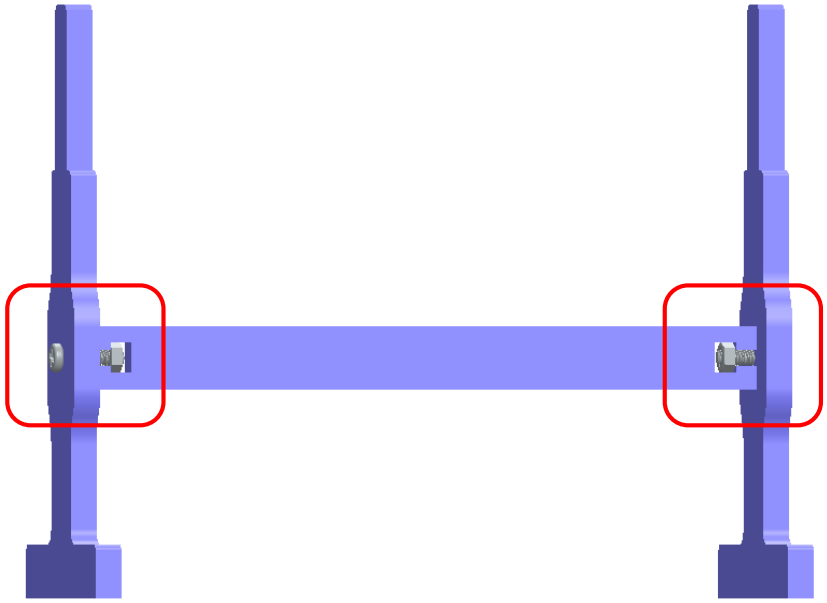


G-GND (brown cable)
V-VCC (red cable)
S-Signal (orange cable)
Note: Servo ports 3, 4, 11 and 12 are not connected by default.

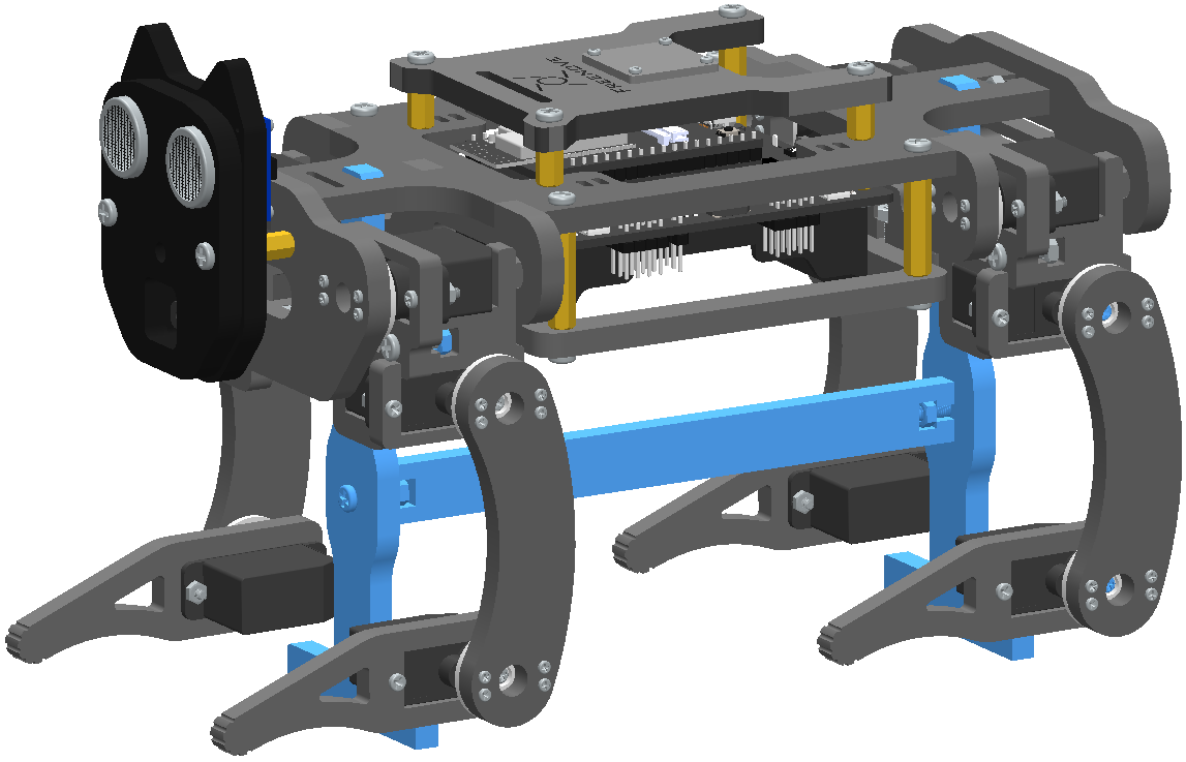
At this point, the robot dog has been assembled and can walk, but because it has not been calibrated, it cannot walk properly. Calibration is a very important task that determines whether your robot dog can walk perfectly. Please be patient with the next steps.

Step 9 Assembly of Calibration Bracket

1. Assemble the calibration bracket with two M3*12 screws and two M3 nuts.

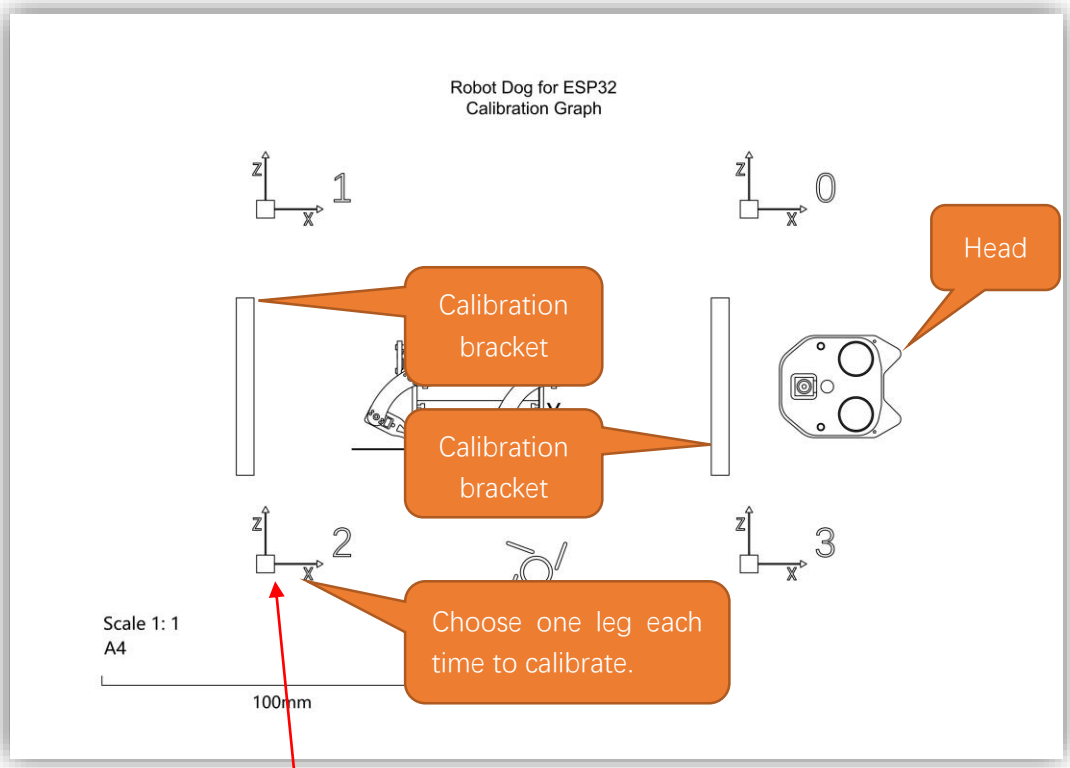


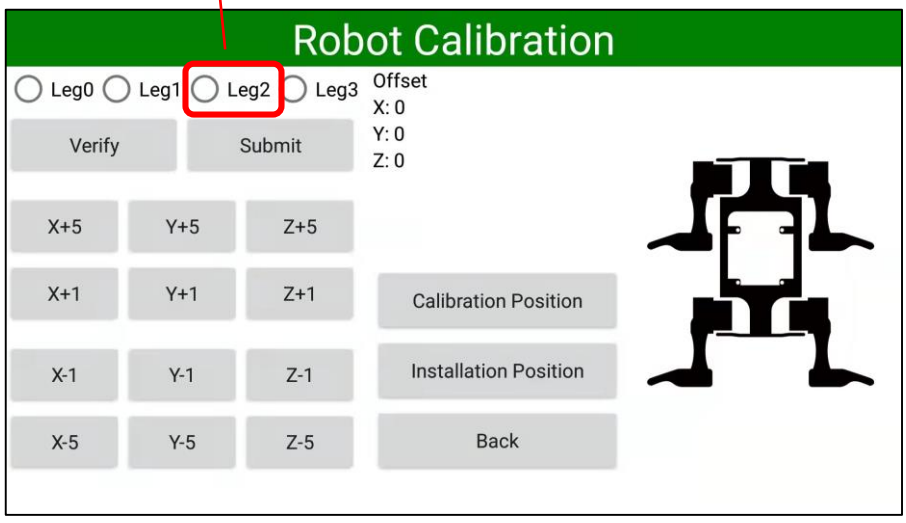
2. Insert the calibration bracket into the robot dog to suspend the four legs.



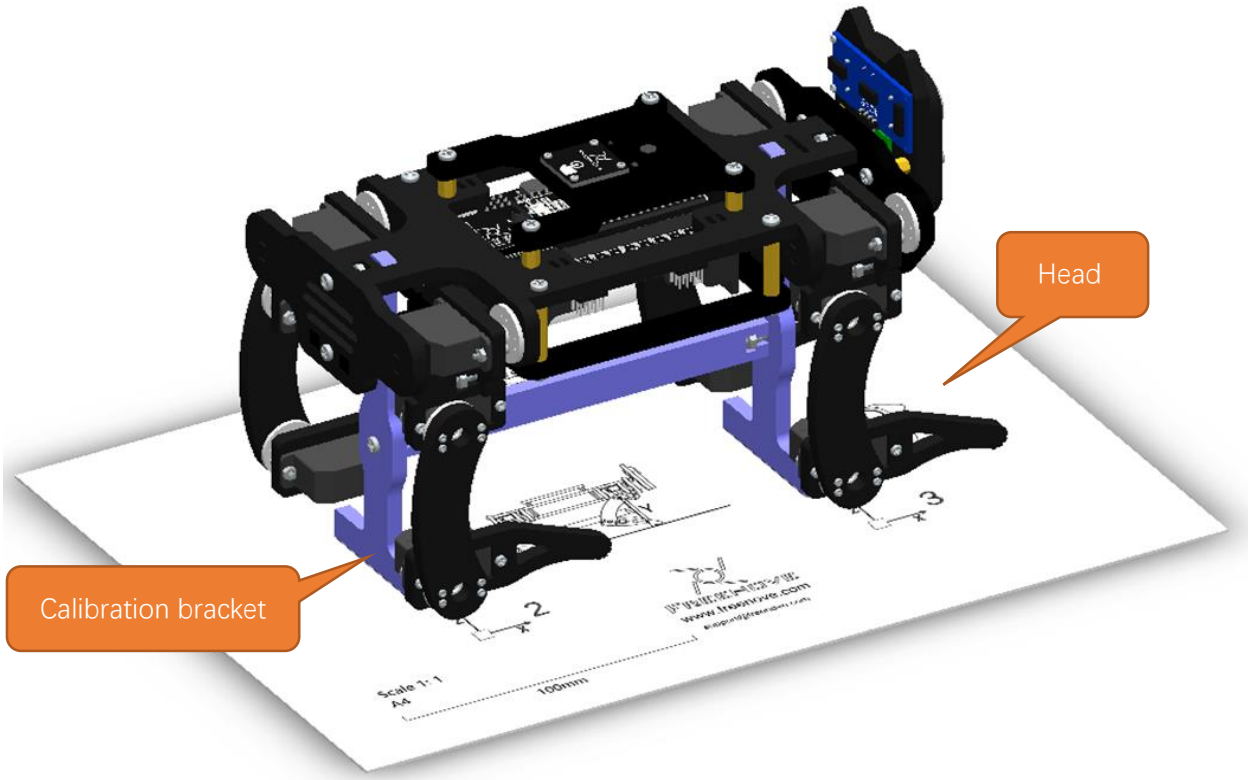
Step 10 Calibration

1. Take out the calibration graph.

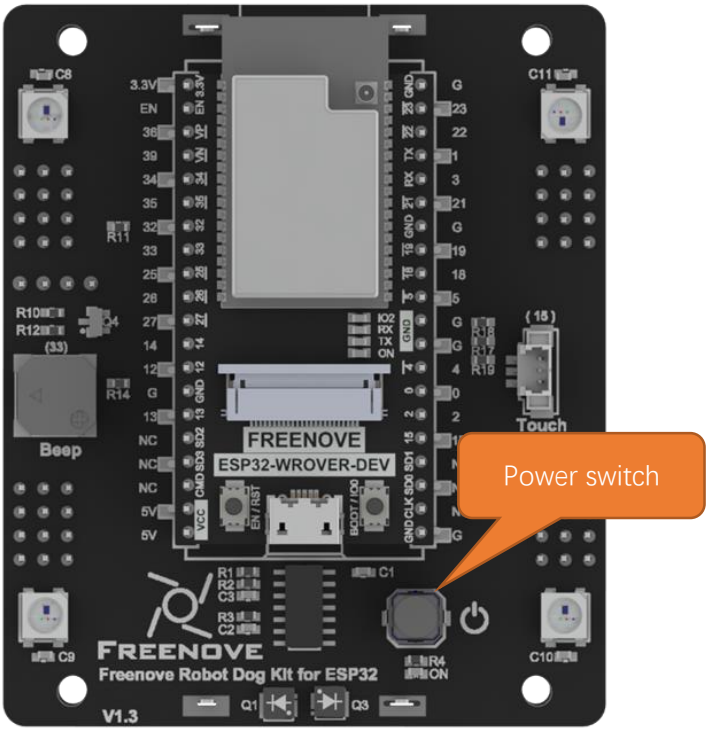




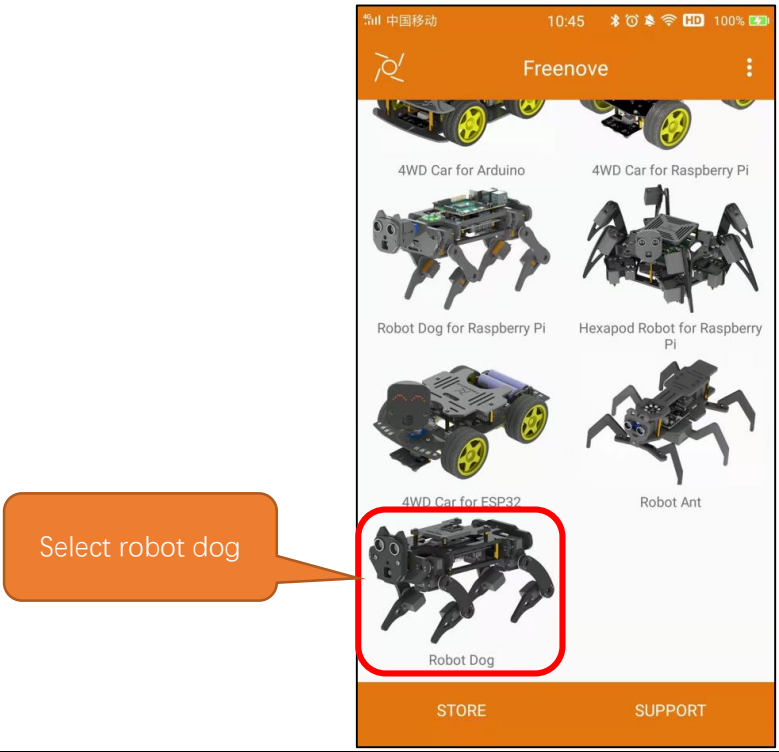
2. Put the robot on the calibration graph.



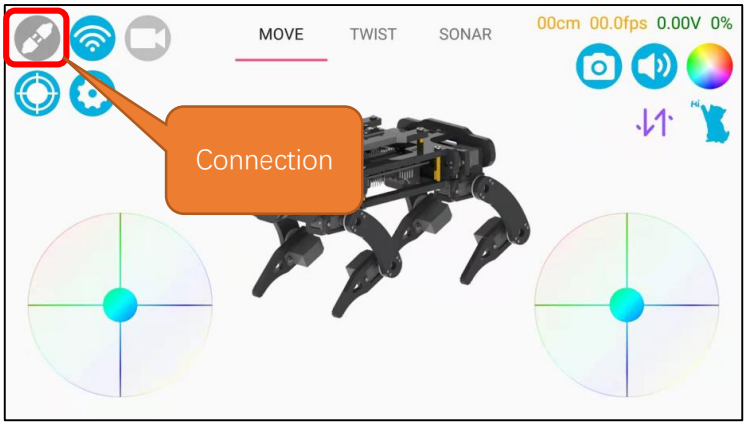
3. Turn ON the power switch on the driver board. (Batteries are not included. Please buy them yourself.)



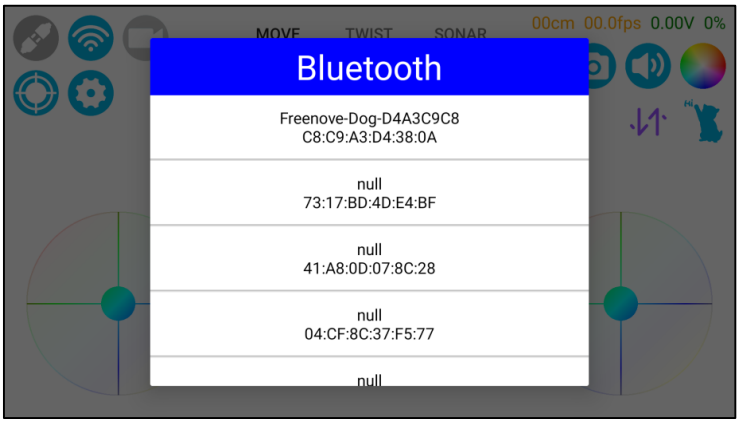
4. Open Freenove App and tap Robot Dog.



5. Turn ON Bluetooth of your phone and tap the Connect button on the app.

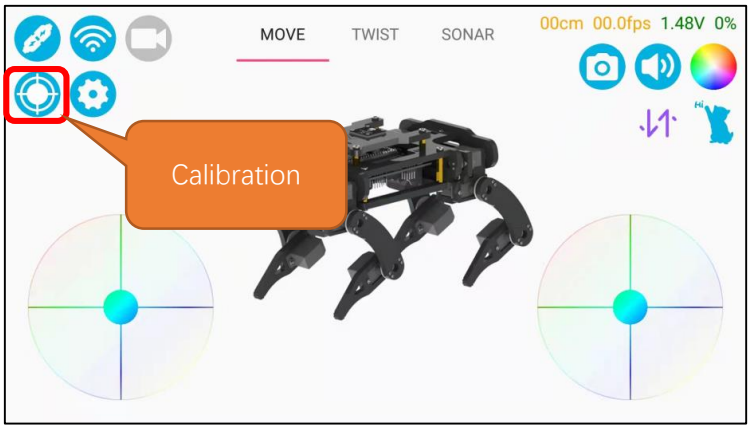


6. Select "Freenove-Dog-XXXXXXXX".

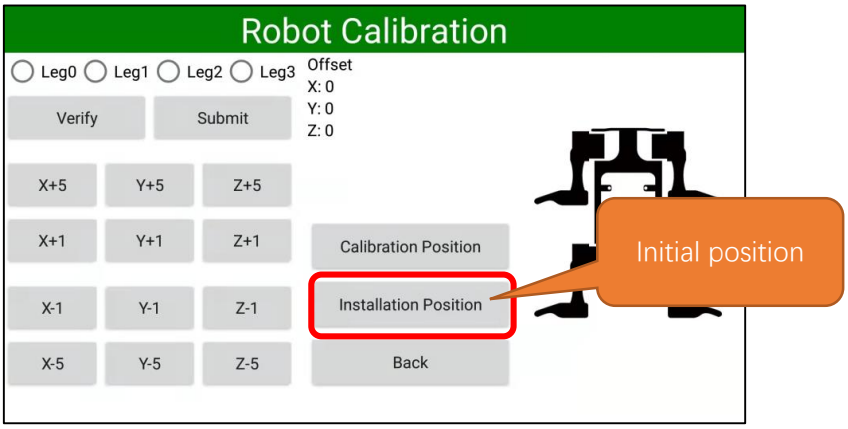


If you do not turn ON the power or upload code to ESP32, you cannot find the Bluetooth of robot dog.

7. Tap the calibration button.

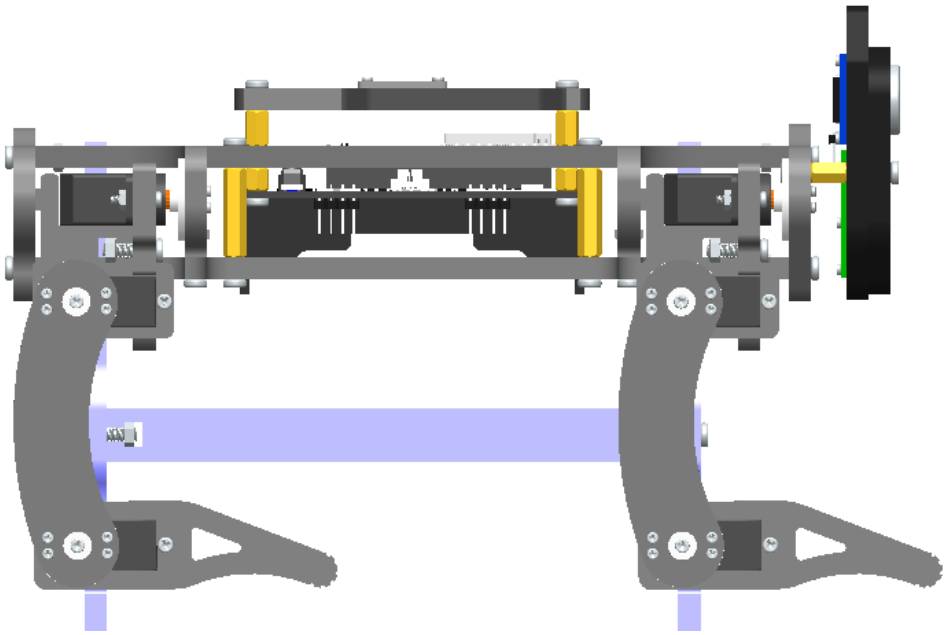


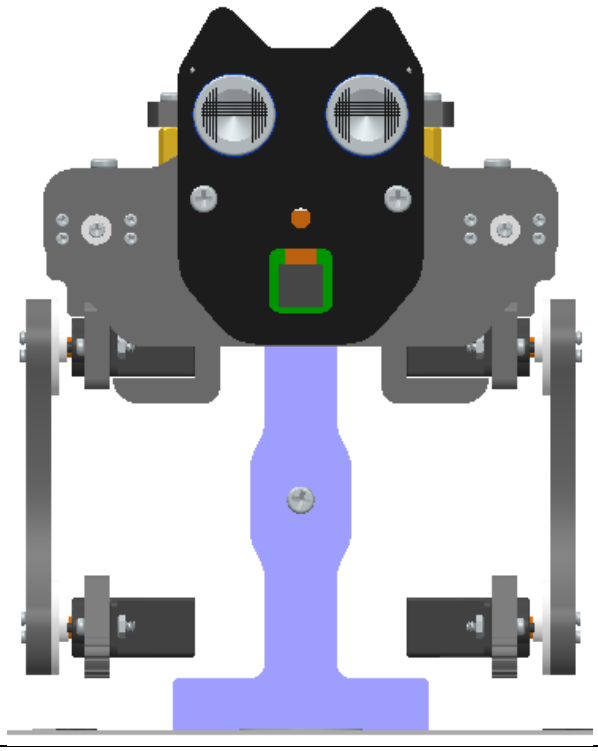
8. Tap Installation Position and all the servos will rotate to 90 degrees.



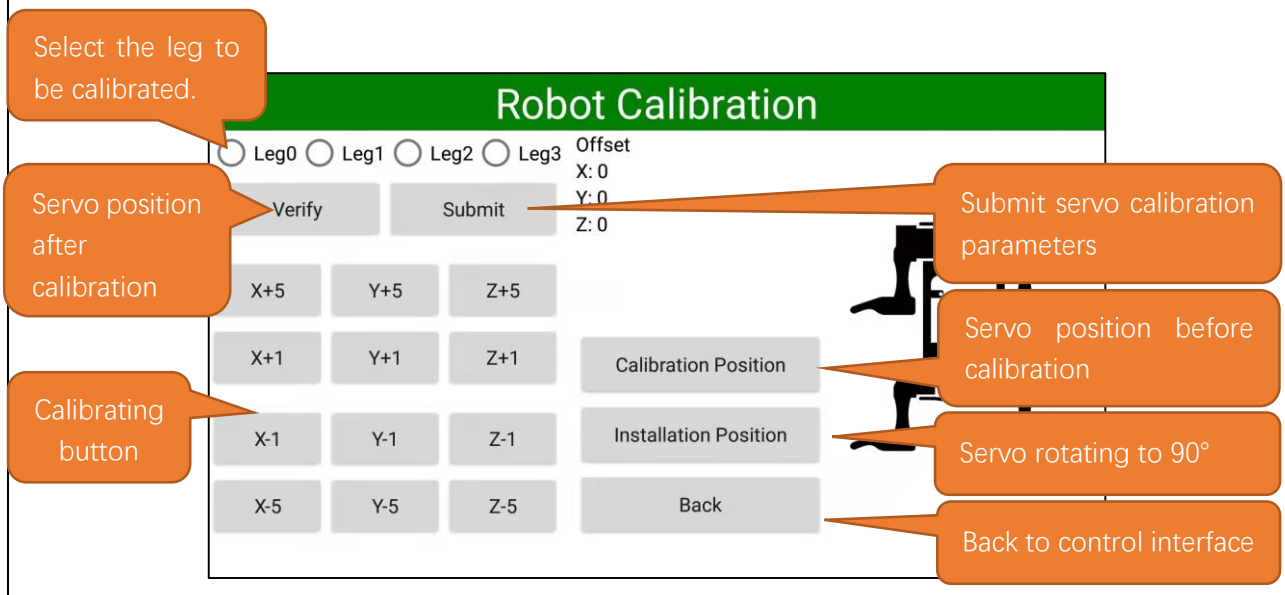
9. The robot dog turns all Servo into 90 degree position. As shown in the figure below.

Note: after pressing the button, if the Servo position in a different position from the following image, disassemble the Servo and install it in the correct position. The smaller the deviation Angle, the better.

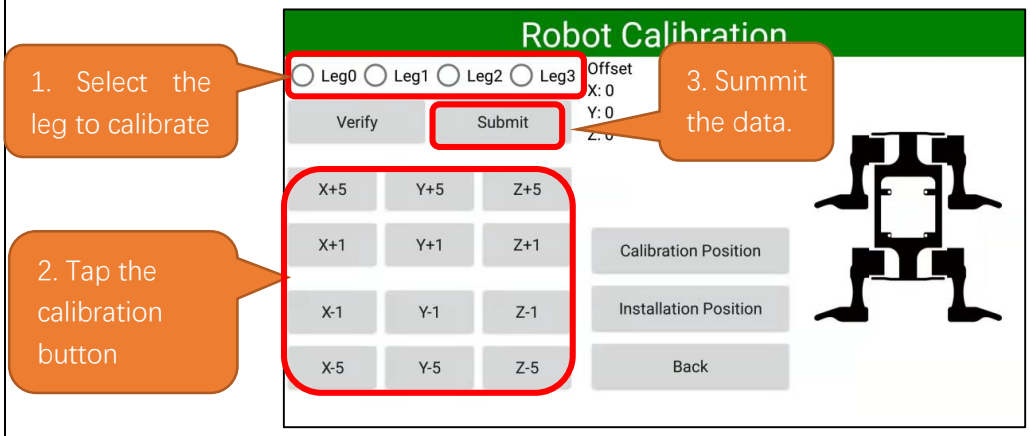




10. Introduction to the interface.



11. Select the leg to calibrate. Calibrate the legs by adjusting the X, Y and Z axes to make the tiptoe match the point on the calibration graph.

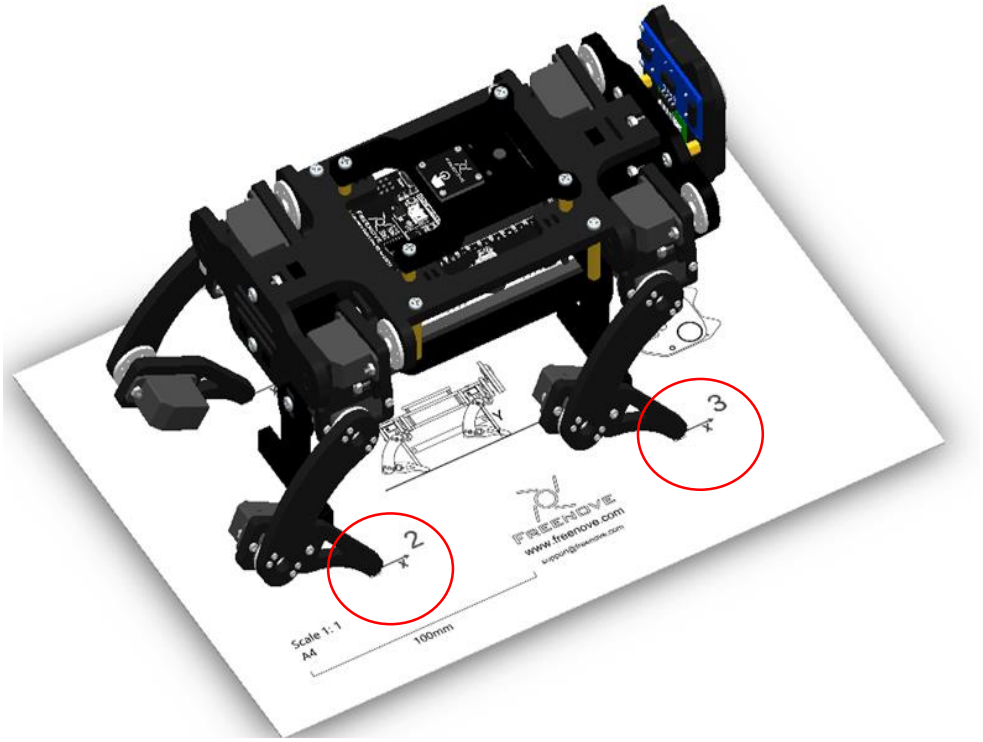


Operation process of robot dog leg calibration:

1. Select the leg to calibrate. Tap the calibration button to adjust the position until the tiptop match the point on calibration graph.
2. Tap “Submit” to upload the data after calibration to robot dog. Without this process, the result will not be saved.
3. Repeat the above steps until all the four legs complete calibration.

The robot after calibration is as shown below:

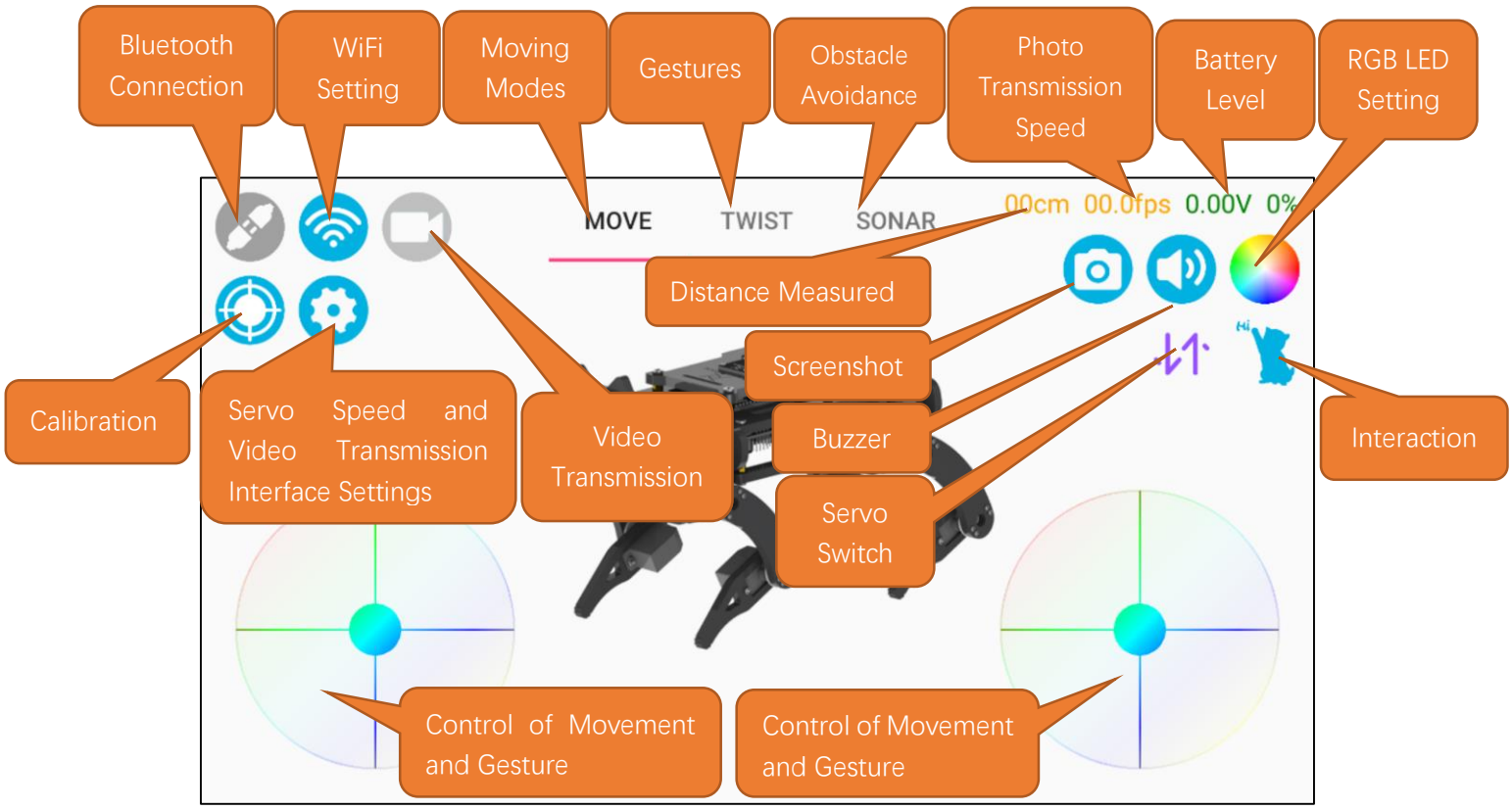
During the adjustment process, you can click the Verify button to Verify that the calibrated leg is accurate. If it is not accurate, the leg needs to be recalibrated. The corrected leg is allowed to have a certain error. The error of +-5mm is allowed in the XZ direction. The Y direction needs to hit the ground right, not jacking up the robot dog, and not hanging off the ground.



By now, all the preparation work for robot dog has been done. You can now play the robot for fun.

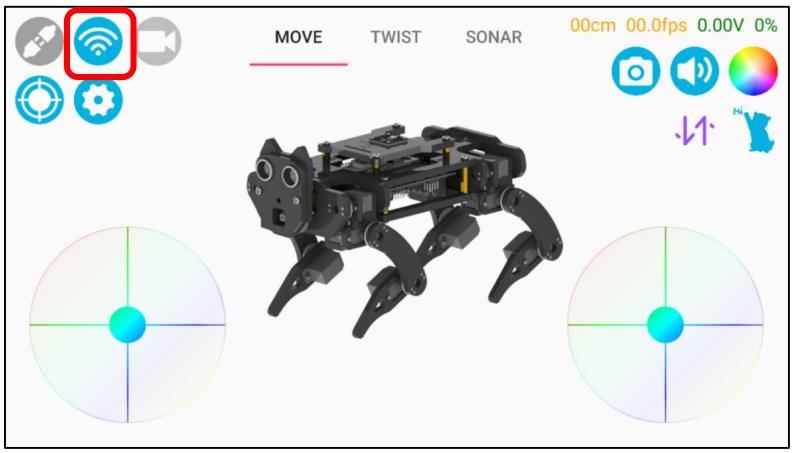
Chapter 3 Functions of Freenove App

Introduction to Main Interface



Wi-Fi Configuration

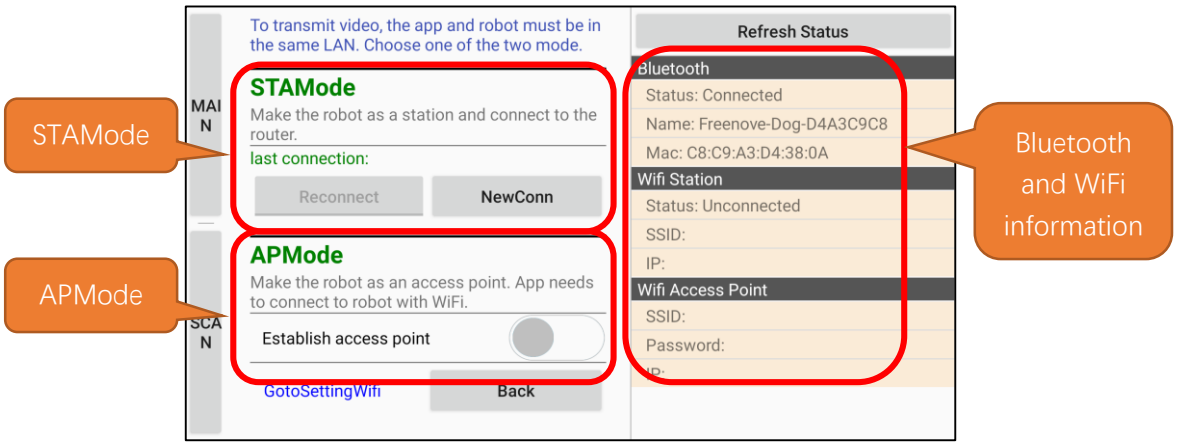
1. Tap Wi-Fi Setting button.



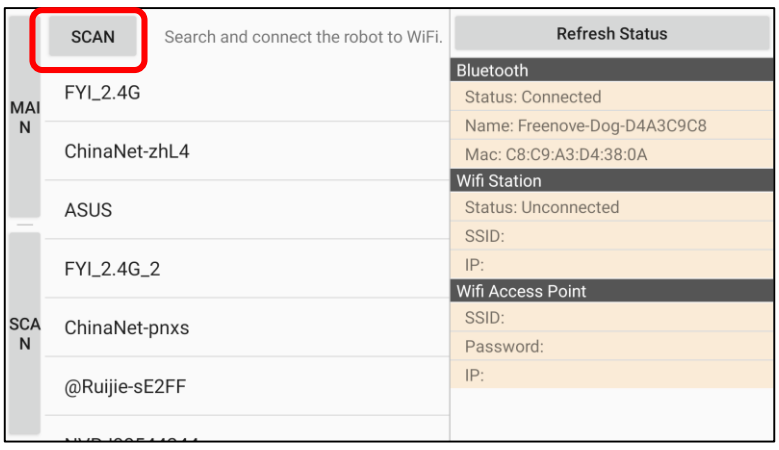
2. Introduction to Wi-Fi configuration interface.

A. To connect the robot dog to a Wi-Fi network, please select STAMode, which can connect the robot to a designated Wi-Fi.

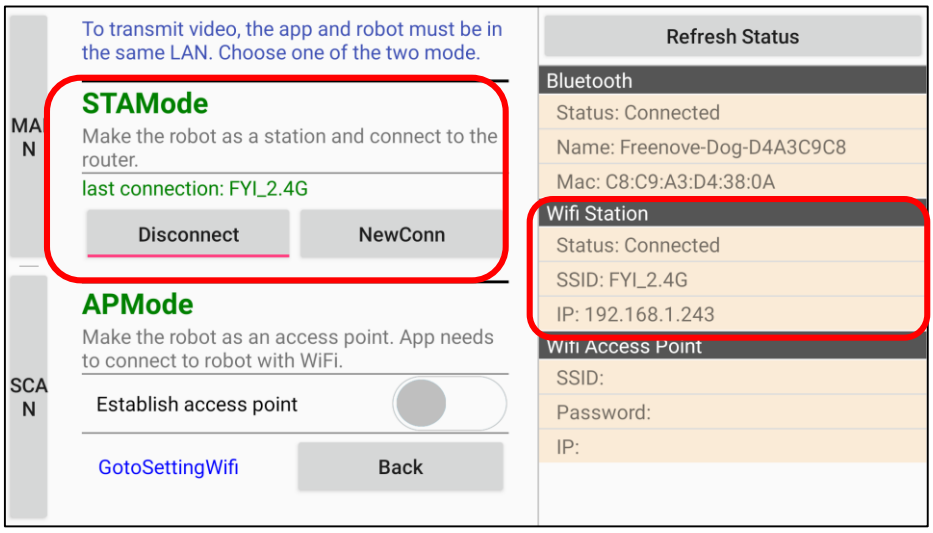
B. When you are outdoors or without available Wi-Fi network, you can select APMode. It can create Wi-Fi network on the robot dog itself to connect to your phone.



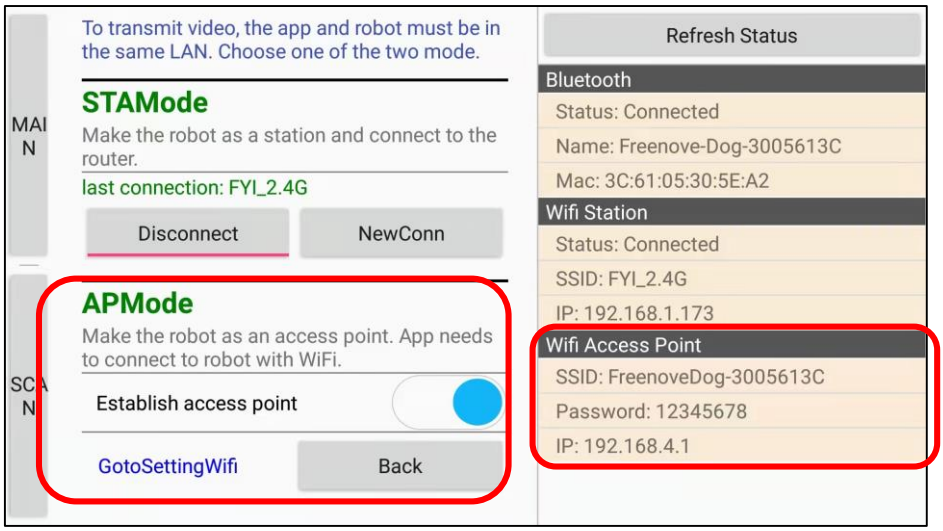
3. Tap NewConn button to enter the Scan interface. Tap Scan button and select the Wi-Fi to be connected.



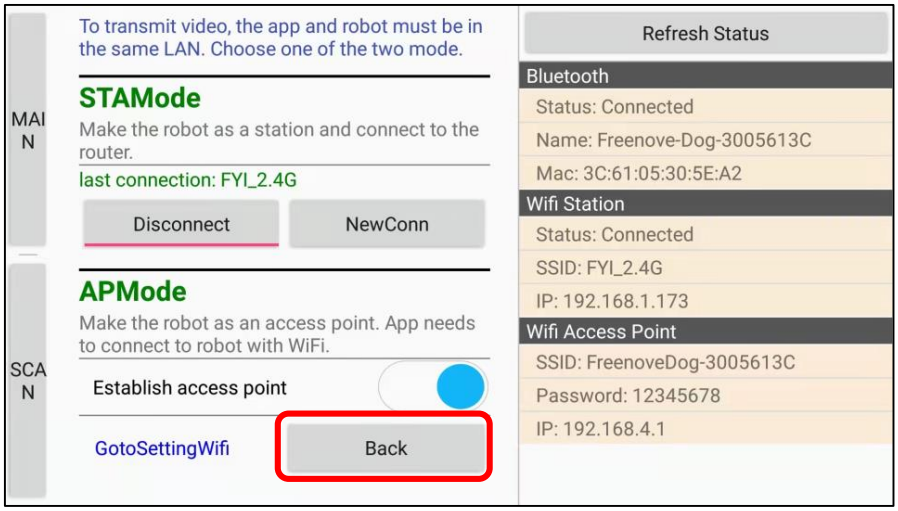
4. The interface of successful connection is as below.



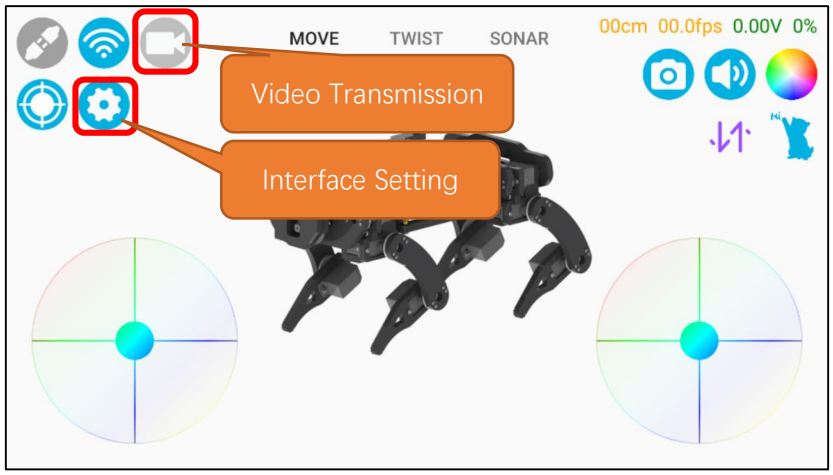
5. To use APMode, please tap the switch below and then connect your phone to the Wi-Fi shown on the right.



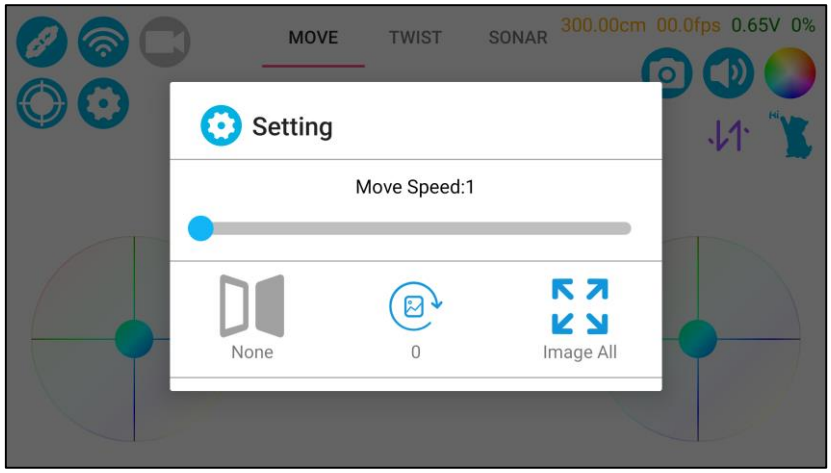
6. Tap Back to exit the configuration interface.



7. After the robot dog connects to Wi-Fi network, tap the video transmission and your phone will display the frames captured by the robot.



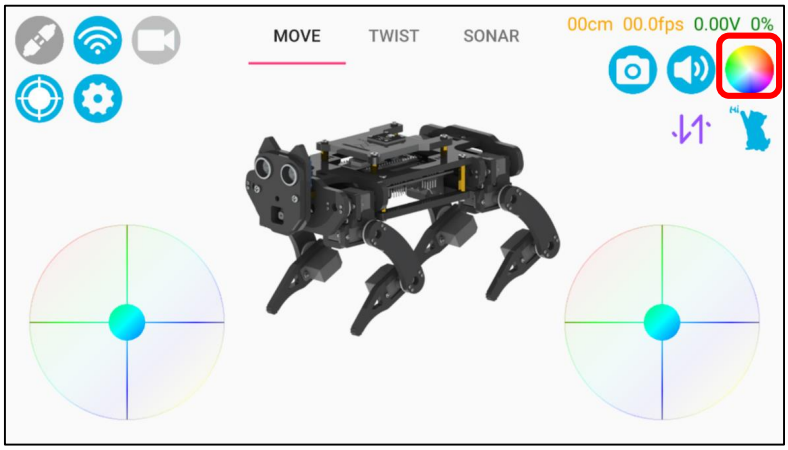
Tip: Tap the Interface Settings button and you can adjust the frames displayed on the phone.



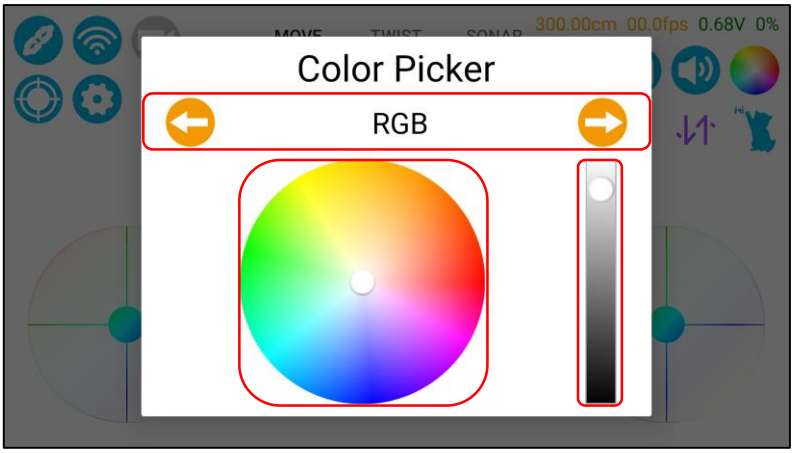
Note: Do not use speed above class 6 for long periods of time as there is a risk of damage to Servo.

RGB LED Control

1. Tap RGB LED control function.

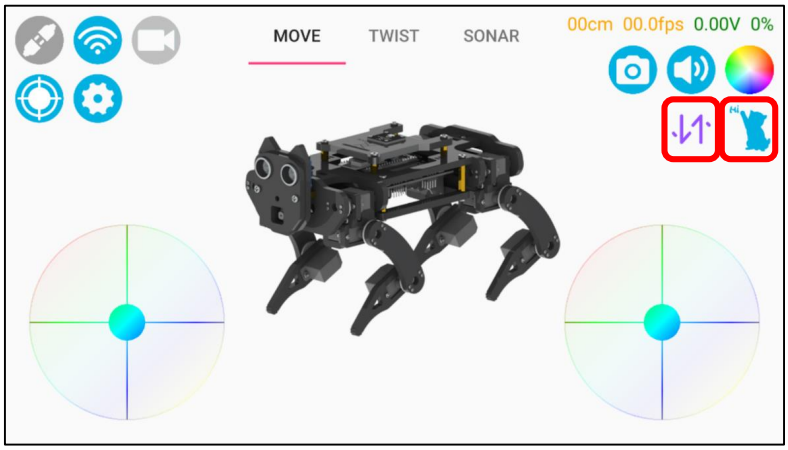


2. The left and right arrows are used to switch the LED modes, the slider to control the brightness and the color palette to set the color.



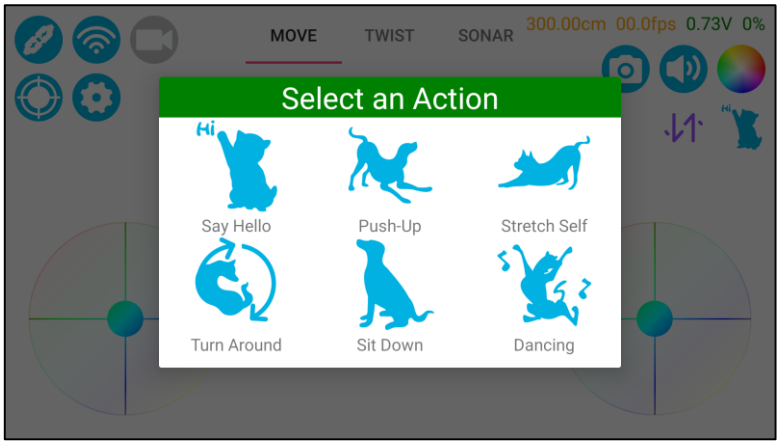
Interaction Function

1. Tap the Interaction button.



Tip: Tapping the up and down arrow icon can make the robot dog lie down and unload the servos.

2. The robot dog can do different actions with different actions being tapped.



Chapter 4 Q&A

1. The buzzer makes four warning sound after powered ON.

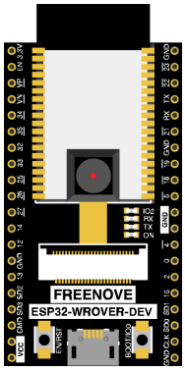
Reason: The robot makes the sounds indicating that data cannot be obtained from the camera.
Troubleshooting:

a. The camera does not contact well with the extension board.
Please remove and reconnect the camera to try again.

b. The FPC cable does not contact well with the extension board.
Please remove and reconnect the cable.

c. The FPC cable does not contact well with the extension board.
Please remove and reconnect the cable.

d. The camera may be damaged. Please try to connect the camera to esp32 directly to test.
If the issue remains, then the camera module is damaged.
Please send us an email (support@freenove.com) to solve the issue.



2. When using the video transmission function, the Bluetooth is disconnected.

Reason: As the Bluetooth and WIFI of ESP32 share the same antenna and a large amount of data is transmitted through WIFI during video transmission, turning off Bluetooth can better reduce the interference with WIFI communication. Therefore, once the video transmission function is used, the robot's Bluetooth is turned off by default, and both commands and video transmission are communicated through WIFI.

3. When using the video transmission function, sometimes the response of the robot dog is not timely.

Reason: When the robot dog uses video transmission, only WIFI is enabled for communication. Whether it has a lag depends on whether the signal of the router connected to the robot dog is stable. If the WIFI signal is poor at some point, it will cause the robot dog to be stuck.

4. It is better to control the robot dog using Bluetooth rather than WIFI when not using video transmission.

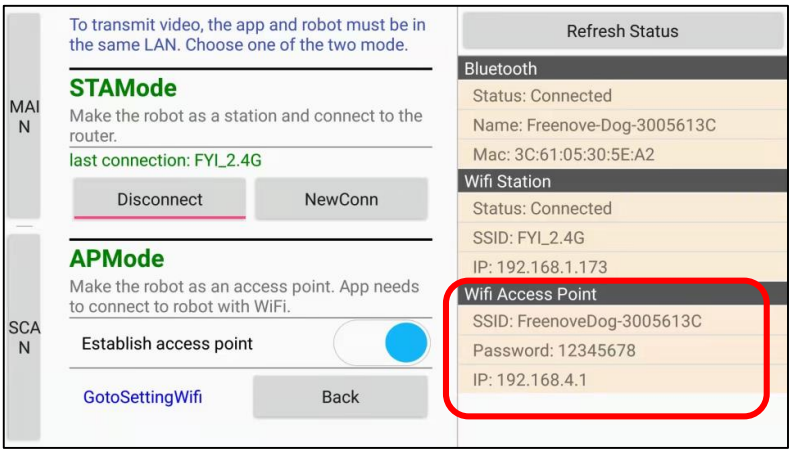
Reason: When not transmitting videos, little data is transferred between the mobile APP and the robot dog. In this case, both WIFI and Bluetooth can control the robot dog well, but the WIFI function may be affected by the router signal, while the Bluetooth function does not have such problem, as it is directly sent by the robot dog to the mobile phone. Therefore, it is strongly recommended to use the Bluetooth function to control the robot dog, and turn off WIFI to increase the stability of the Bluetooth function when video transmission is not used.

5. Q: Which mode is better? Can both modes be enabled simultaneously?

A: When not using video transmission, you can turn on Bluetooth and WIFI at the same time. However, they share the same control commands, so we recommend turning off WIFI and only enabling Bluetooth, which almost causes no lag.
When using video transmission, the robot's Bluetooth is turned off by default to avoid interference to the WIFI function.

6. Q: The WIFI has STA and AP modes, which one should I choose when using video transmission?

A: If there is a router with great signal available, we recommend using STA mode; otherwise, AP mode is recommended.
Note: In AP mode, you need to connect your phone to the robot's hotspot, whose SSID and password are as follows:



Development

Code Repository

The main purpose of this tutorial is to explain how to assemble and use the robot dog. If you want to learn more about the code, please visit:
https://github.com/Freenove/Freenove_ESP32_Dog_Firmware
There is a more detailed explanation of the code in the code repository, please download and learn by yourself.

Communication Command

If you do not want to understand the underlying code of the robot dog, but want to develop a control platform software for the robot dog, you can refer to the following communication commands, which explain each control command of the robot dog in detail.

Ways of Communication

The robot support three ways of communication, namely, serial port, Bluetooth Low Energy (BLE) and TCP Socket communication, as follows:

Ways	Description
Serial Port	Baud rate 115200
BLE	Bluetooth GATT
TCP Socket	Port 5000 is the command transmission port, and port 8000 is the video transmission port.

Note: All commands are valid once they are sent. It is recommended not to send too many commands repeatedly in a short period as the processing capacity of the robot dog is limited. All commands only need to be sent once.

Communication Command Format

1. Each command consists of four parts: command word, delimiter, parameter and terminator, among which, the number of command word is one and the parameters is variable, from 0 to n, depending on the specific command.
   A. The first character of each command is the command word, used to distinguish the major category of the command, such as "A".
   B. The character "#" is the delimiter between the command word and the parameter, used to separate the string.
   C. Each command is terminated with "\n", which is used to separate each command.
   Example: “A#10#20#30#40#50#\n”
2. Parse of Commands

When parsing commands, first separate the commands with "\n", and then separate the command word and parameters of each command with“#”. The characters after "\n" are divided to the next command for parsing.

Command Words

We have defined the following 18 command words.

```
#define ACTION_UP_DOWN                  'A'
#define ACTION_BODY_HEIGHT              'B'
#define ACTION_RGB                      'C'
#define ACTION_BUZZER                   'D'
#define ACTION_TWIST                    'E'
#define ACTION_MOVE_ANY                 'F'
#define ACTION_CAMERA                   'G'
#define ACTION_ULTRASONIC               'H'
#define ACTION_GET_VOLTAGE              'I'
#define ACTION_CALIBRATE                'J'
#define ACTION_SET_NVS                  'K'
#define ACTION_INSTALLATION             'L'
#define ACTION_AUTO_WALKING             'M'
#define ACTION_NETWORK                  'N'
#define ACTION_DANCING                  'O'
#define ACTION_SET_ROBOT                'R'
#define ACTION_TEST                     'T'
#define ID_CHECK                        'W'
```

Explanation of Communication Protocol Instructions

ACTION_UP_DOWN

Control the robot to stand up or lie down with one parameter. When lying down, the servos will be unloaded to reduce battery power consumption

App command	Action
A#0#\n	Switch between standing up and lying down
A#1#\n	Stand up
A#2#\n	Lie down

No return,

ACTION_BODY_HEIGHT

Set the robot dog's body to any height. This function has not been added to the app yet, but the robot dog can receive this command.

App command	Action
B#50#\n	Make the robot stand up and set the height to 50 cm.

ACTION_RGB

Set the running mode and color of the LEDs on the robot dog.

App command	Action
C#mode#red#green#blue#\n	Set the RGB LEDs to “mode” mode and specify the color values of the three channels（0-255）
C#1#255#0#0#\n	

The value range and meaning of mode, among which, in modes 2 and 5, the color cannot be changed. The parameters can be any value in the range of 0-255.	`#define LED_MODE_OFF 0`
	`#define LED_MODE_RGB 1`
	`#define LED_MODE_FOLLOWING 2`
	`#define LED_MODE_BLINK 3`
	`#define LED_MODE_BREATHING 4`
	`#define LED_MODE_RAINBOW 5`

Introduction to “mode” function

Macro Definition	Parameter	Description
LED_MODE_OFF	0	Turn OFF LEDs
LED_MODE_RGB	1	Static LEDs display. Color and brightness can be adjusted through the parameters.
LED_MODE_FOLLOWING	2	The LEDs alternately display four colors of red, green, yellow and blue.
LED_MODE_BLINK	3	LEDs blink. Color and brightness can be adjusted through the parameters.
LED_MODE_BREATHING	4	LEDs ON and OFF like breathing. Color and brightness can be adjusted through the parameters.
LED_MODE_RAINBOW	5	LEDs show the color of rainbow and change slowly.

ACTION_BUZZER

Set the frequency of the buzzer.

App command	Action
D#freq#\n	“freq” refers to the frequency of the buzzer.
D#2000#\n	Make the buzzer sound at the frequency of 2000
D#0#\n	Stop the buzzer.

ACTION_TWIST

Make the robot twist itself.

App command	Action
E#pitch#roll#yaw#\n	
E#20#0#0#\n	The robot is tilted by 20 degrees in the pitch direction.
E#10#10#10#\n	The robot is tilted by 10 degrees in three directions.

Unit: degree, ranging from 0 to 20 degrees.

ACTION_MOVE_ANY

F#alpha#stepLength#gama#spd#\n

Make the robot move sideways for alpha degrees counterclockwise in its forward direction while rotating alpha degrees at each step, with the step length of stepLength and the speed of spd.

```
/**
 * @brief The command for walking, in any direction, at any step length and any speed, with any rotation angle.
 *
 * @param alpha The moving direction, with the x-axis direction as 0 degrees, counterclockwise as positive and clockwise as negative. Unit: degree [0-360]. The x-direction means moving forward .
 * @param stepLength The length of each step (<=20)
 * @param gama The rotation angle. Rotate in place with Rotate in place, with counterclockwise as positive and clockwise as negative, and the unit is degrees. [0-360].
 * @param spd The moving speed. Unit: mm / 10ms [1, 8]
 */
```

App command	Action
F#0#20#0#5#\n	Moving forward at the speed of 5 and step length of 20mm.
F#90#10#-10#5#\n	The robot moves sideways to the left while rotating 10 degrees to the right at each step, with a step length of 10 and speed of 5.
F#0#0#0#5#\n	Stop moving

This command also only needs to be sent once. Once commanded, the robot keeps walking until it receives a new command, such as a command to stop walking or to twist its body.

ACTION_CAMERA

This is the command sent to the app to determine whether the camera is malfunctioned. The phone app receives and parses the command.

Robot command	Action

G#100#\n	The camera works fine, not need to process.
G#101#\n	The camera is malfunctioned, prompting via Toast.

If the camera is faulty, the robot will periodically send reminders to the app, and the app will send a prompt to the user after receiving the message.

ACTION_ULTRASONIC

Once the obstacle avoidance mode is turned ON, the robot will actively send the current distance measured by the ultrasonic wave to the app and the app needs to parse this command.

The App can also actively send this command for the robot dog to print out the distance measured by the ultrasonic wave through the serial port. Note that the command does not contain parameters, and there is currently no Action.

App command	Action
H#\n	The robot obtains the distance measured by the ultrasonic module once, and prints it out through serial port.

Robot command	Action
H#dist#\n	"dist" refers to the distance measured by the ultrasonic module
H#101#\n	The current measured distance is 101 cm.

ACTION_GET_VOLTAGE

The robot actively sends the current voltage value and battery percentage to the app every 3 seconds without the need of the app to inquire.

The unit of voltage is mV.

Robot command	Action
I#voltage#percent#\n	"voltage" refers to the current voltage of the batteries, and "percent" is the battery percentage.
I#8400#100%\nI	The current voltage is 8400mV, 100%.

ACTION_CALIBRATE

Calibrate the robot. This command must contain only five parameters.

Parameters	Action
J#legn#SSC#x#y#z#\n	
Legn	Leg number, numbered counterclockwise from left front to right front, 0,1,2,3
S: Select S: Set C: Confirm	1: Set the position of the legs without overlaying calibration information. 2: Confirm the calibration information. 3: Select one leg to calibrate.
x、y、z	They refer to the coordinates of the tiptoe of the robot dog, with the calibration point as the relative value of the origin. If the leg does not need calibration, then it is 0 0 0.

Examples:

App command	Action

J#2#3#0#0#0#\n	Leg 2 is selected to calibrate and the other legs are unloaded to prevent interference.
J#2#1#10#20#-10#\n	Set leg 2 to the relative position of 10 20 -10
J#2#2#10#20#-10#\n	Confirm and save the calibration information of 10 20 -20 to the robot.

ACTION_SET_NVS

Save data. This command is a debug command without the need to be sent by the app.

App command	Action
K#1#\n	Save the mode and color of the LEDs
K#2#\n	Clear all data in NVS.

ACTION_INSTALLATION

Put the robot into an installation or calibration pose.

App command	Action
L#1#\n	Put the robot in the installation pose, and place all servos at 90 degrees
L#2#\n	Put the robot in the calibration pose without overlaying the calibration information.

ACTION_AUTO_WALKING

Put the robot into automatic obstacle avoidance mode.

App command	Action
M#0#\n	Turn OFF obstacle avoidance mode.
M#1#\n	Turn ON obstacle avoidance mode.

ACTION_NETWORK

The robot's network related commands.

App sending

App command	Action
N#0#\n	The robot starts to scan WIFI and returns the results one by one in the following form: N#0#SSID#\n
N#1#ssid#psd#\n	The robot uses the password psd to connect to the WIFI hotspot named SSID and returns the result: Success: N#103#\n Failure: N#104#\n Later, regardless of success or failure, the WIFI status is sent again. (see the robot sending below)
N#2#\n	Disconnect the robot's WIFI connection, and then send the WIFI status.
N#3#\n	Establish a WIFI hotspot on the robot with the SSID as "FreenoveDog-RobotId" and the password as 12345678. Without this it will not success, The following results will be returned: N#301#AP_SSID#IP#Password#\n The above parameters are hotspot name, robot IP address and hotspot password respectively.
N#4#\n	Turn OFF the robot's hotspot.
N#5#\n	Obtain the robot WIFI and camera status and return them once.

Robot sending:

Robot command	Action
N#0#SSID#\n	Return the robot's WIFI scanning results one by one.
N#101#SSID#IP#\n	Robot's WIFI status: WIFI is connected. The parameters are the WIFI SSID and IP address of the robot in STA mode
N#102#\n	Robot's WIFI status: WIFI is not connected.
N#103#\n	The robot connects to WIFI successfully.
N#104#\n	The robot fails to connect to WIFI.
N#301#AP_SSID#IP#Password#\n	The robot's WIFI status: AP has been established. The parameters are the robot's WIFI SSID, IP address and password in AP mode.
N#302#\n	The robot's WIFI hotspot has been turned OFF.
N#5#\n	Obtain the robot WIFI and camera status and return them once.

ACTION_DANCING

Make the robot dance at some fixed actions.

App command	Action
O#n#\n	n refers to the fixed action modes.
O#0#\n	Say hello
O#1#\n	Push up
O#2#\n	Stretch itself
O#3#\n	Turn around
O#4#\n	Sit down
O#5#\n	Dance

The value and meanings of parameter n are as follows

```
#define DANCE_SAY_HELLO         0
#define DANCE_PUSH_UP           1
#define DANCE_STRETCH_SELF      2
#define DANCE_TURN_AROUND       3
#define DANCE_SIT_DOWN          4
#define DANCE_DANCING           5
```

ACTION_SET_ROBOT

Reserved.

ACTION_TEST

Reserved. Develop to use.

ID_CHECK

Check the basic information of the robot, which is used for verification in the future.

App command	Action
W#0#\n	Obtain the firmware version and robot name. The result returned are as follows: W#0#100#FREENOVE-DOG#\n among which, 100 refers to the version of V1.0.0 and the name of FREENOVE-DOG.
W#1#\n	Obtain the robot's firmware version with the result returned as follows: W#1#100#\n among which, 100 refers to the version of V1.0.0
W#2#\n	Obtain the robot's name with the result returned as follows: W#2#FREENOVE-DOG#\n referring to the name as FREENOVE-DOG
W#3#\n	Obtain the internal code with the current result returned as follows W#3#FNK006201#\n
W#4#FREENOVE#\n	Fixed command to check whether the source of the controller is valid.

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.
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