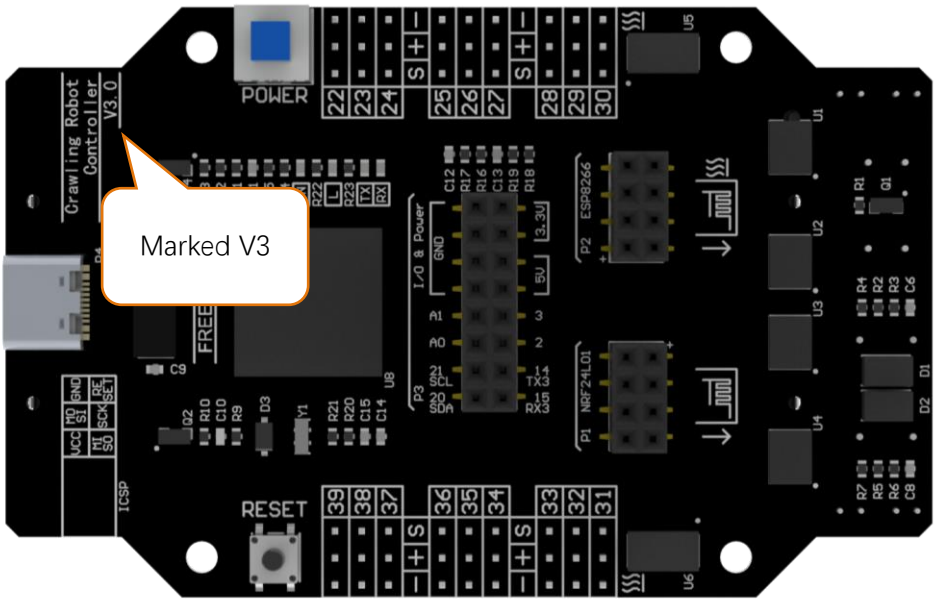
Note

You can refer to this video to assemble the robot: https://youtu.be/nivTZeGthf4
For remote control, please refer to this video: https://youtu.be/fK7IHMA60F4

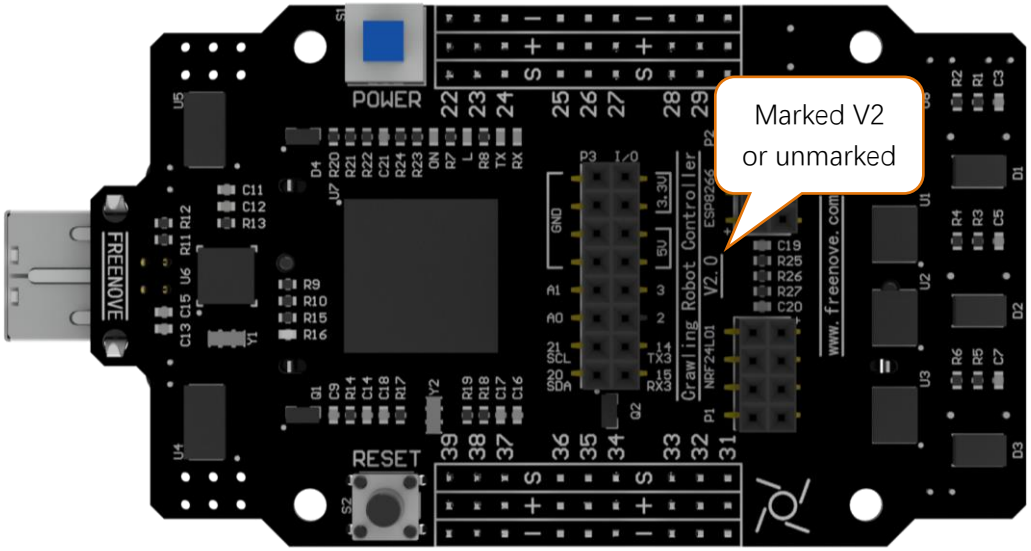
Please check the version of the control board included in the product you purchased first!

Note: Different versions of the control board use different types of batteries.
However, their functions are the same and they use the same code.

- If it is marked with V3, please buy battery according to "AboutBattery_for_V3.pdf" and assemble the robot according to "Tutorial_for_V3.pdf".



- If it is marked with V2 or unmarked, please buy battery according to "AboutBattery_for_V2.pdf" and assemble the robot according to this document.



Welcome

Thank you for choosing Freenove products!

! Please prepare the right batteries and fully charge them before assembling.
(See "AboutBattery_for_V2.pdf")

How to Start

When reading this, you should have downloaded the ZIP file for this product.
Unzip it and you will get a folder containing tutorials and related files. Please start with this PDF tutorial.

! Unzip the ZIP file instead of opening the file in the ZIP file directly.
! Do not move, delete or rename files in the folder just unzipped.

Get Support

Encounter problems? Don't worry! Refer to "TroubleShooting.pdf" or contact us.

When there are packaging damage, quality problems, questions encountering in use, etc., just send us an email. We will reply to you within one working day and provide a solution.

support@freenove.com

Attention

Pay attention to safety when using and storing this product:

- This product is not suitable for children under 12 years of age because of small parts and sharp parts.
- Minors should use this product under the supervision and guidance of adults.
- This product contains small and sharp parts. Do not swallow, prick and scratch to avoid injury.
- This product contains conductive parts. Do not hold them to touch power supply and other circuits.
- To avoid personal injury, do not touch parts rotating or moving while working.
- The wrong operation may cause overheat. Do not touch and disconnect the power supply immediately.
- Operate in accordance with the requirements of the tutorial. Fail to do so may damage the parts.
- Store this product in a dry and dark environment. Keep away from children.
- Turn off the power of the circuit before leaving.

About

Freenove provides open source electronic products and services.

Freenove is committed to helping customers learn programming and electronic knowledge, quickly implement product prototypes, realize their creativity and launch innovative products. Our services include:

- Kits for learning programming and electronics
- Kits compatible with Arduino®, Raspberry Pi®, micro:bit®, ESP32®, etc.
- Kits for robots, smart cars, drones, etc.
- Components, modules and tools
- Design and customization

To learn more about us or get our latest information, please visit our website:

http://www.freenove.com

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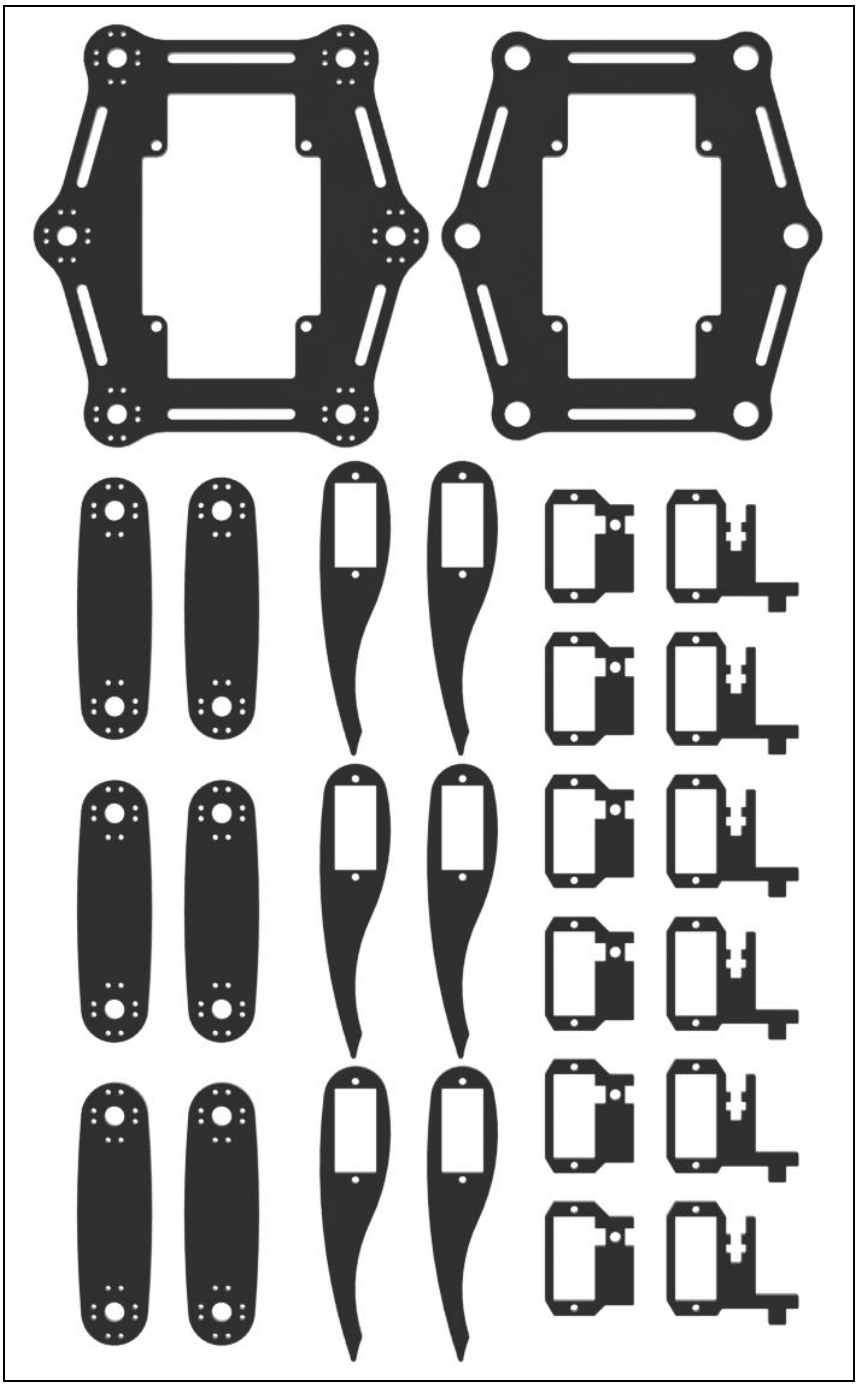
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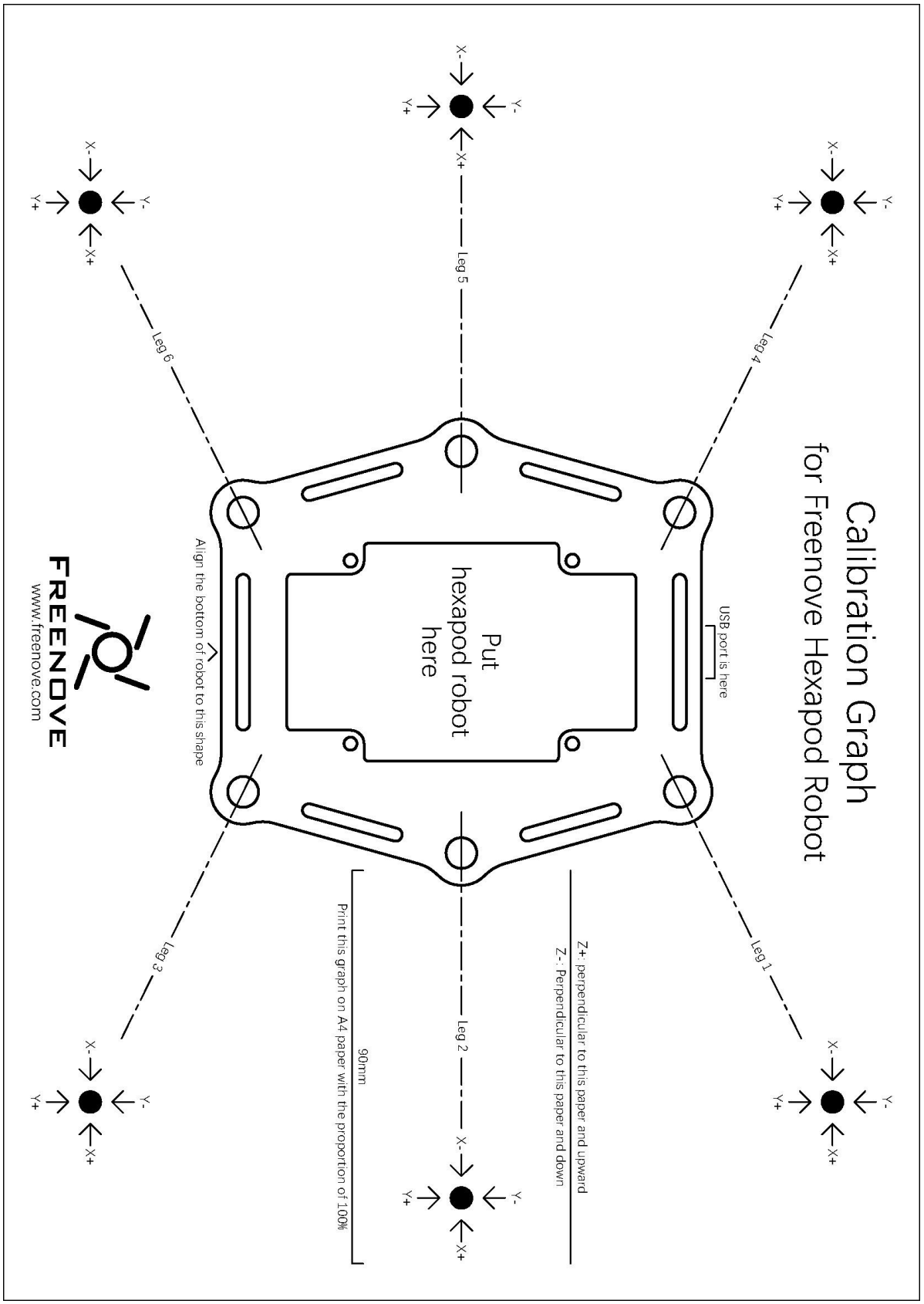
List

Acrylic Parts



The surface of the acrylic parts is covered with a layer of protective film, you need to remove it first.
Some holes in the acrylic parts may have residues, you also need to clean them before using.

Calibration Graph

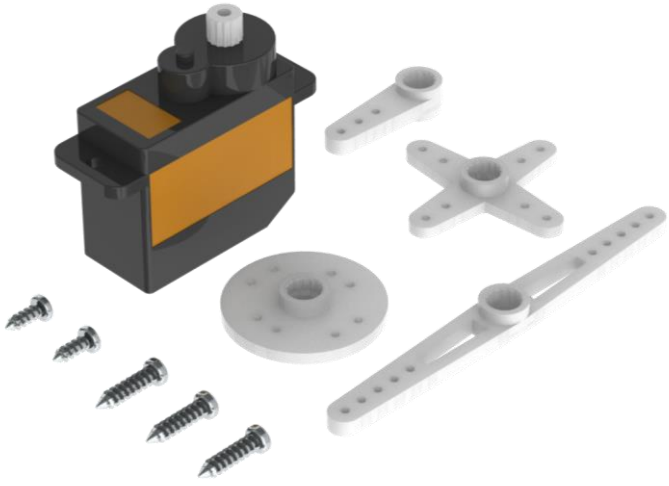


Mechanical Parts

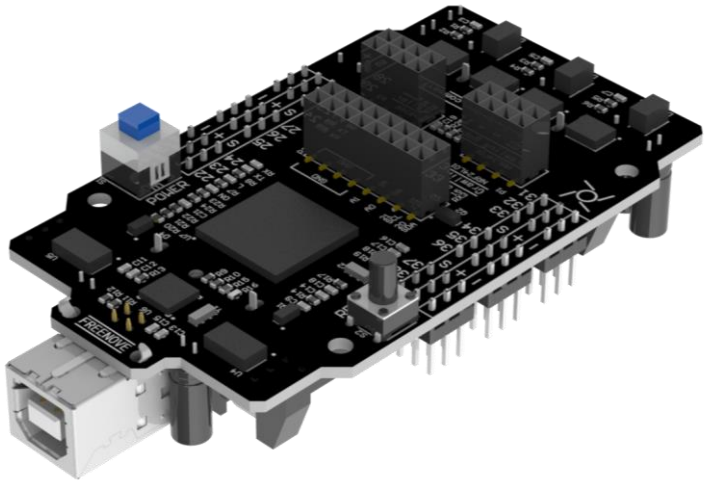
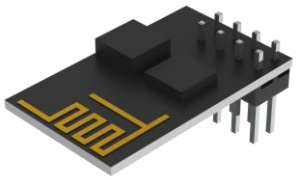
M3*27 Copper Standoff  x6 Freenove	M3*5 Copper Standoff  x6 Freenove	M3*12 Screw  x8 Freenove	M3*8 Screw  x10 Freenove
M2 Nut  x40 Freenove	M3 Nut  x8 Freenove	M2*10 Screw  x40 Freenove	M1.2*7 Self-tapping Screw  x160 Freenove

Dynamic Parts

Servo x18



Electronic Parts

Freenove Crawling Robot Controller x1 	ESP8266 Wi-Fi Module x1 
USB Cable x1 	
Cable Tidy x75cm 	

Tools

Cross Screwdriver x1



Required but NOT Contained Parts

3.7V 14500 rechargeable battery x2

! Please prepare the right batteries and fully charge them before assembling.
(Refer to "AboutBattery_for_V2.pdf" for detailed information about battery.)
! Assembling without right batteries will cause installation errors, which may damage the servos.



Charger for 3.7V 14500 rechargeable battery x1
(Any charger that can charge 3.7V 14500 rechargeable battery.)

Preface

This is a robot kit compatible with Arduino IDE and Processing IDE, which are both free and open source software that can be run on Windows, macOS and Linux computers. We will have a detailed introduction later.

You can use this kit to assemble a cool robot and control it to move and act wirelessly. You can also directly control the IO ports on control board. In details, you can use the following devices to control the robot:

- Laptop or desktop with Wi-Fi adapter. (Run Windows, macOS or Linux, including Raspberry Pi OS)
- Android phone or tablet. (Run Android 4.4 or later version, installed Freenove App from Google Play.)
- iPhone. (Run iOS 10 or later version, installed Freenove App from App store.)
- Remote. (Freenove Remote Control Kit, FNK0028)

We provide complete code, but you can also write code for this robot by yourself easily. By using the code library we provided, you only need to write a few lines of code to control the action and movement of the robot. You can also connect sensors and modules to the IO ports and power ports on the control board.

The assembled robot is shown below (the wires are not shown).



Arduino IDE

! Please do NOT skip this chapter if you have never installed Arduino IDE or are not familiar with it.

The control board of the robot is compatible with Arduino® IDE. (Arduino® is a trademark of Arduino LLC.)

The Arduino IDE is free and open source. We will use it to write and upload code to the control board.

Arduino IDE

Arduino IDE uses C/C++ programming language.
Please visit https://www.arduino.cc, click "RESOURCES" > "REFERENCE" for details.

! If you want to learn it easily, please visit http://www.freenove.com for kits designed for starters.

First, install Arduino IDE. Visit https://www.arduino.cc/en/software. Scroll down and find **Legacy IDE (1.8.X)**. Then select and download corresponding installer according to your operating system. If you are a windows user, please select the "Windows Installer".

! Do not download “Arduino IDE 2.x.x” unless you are familiar with it, or you may encounter problems.
! “Windows app” is not recommended. It is reported that it sometimes fails to work properly.

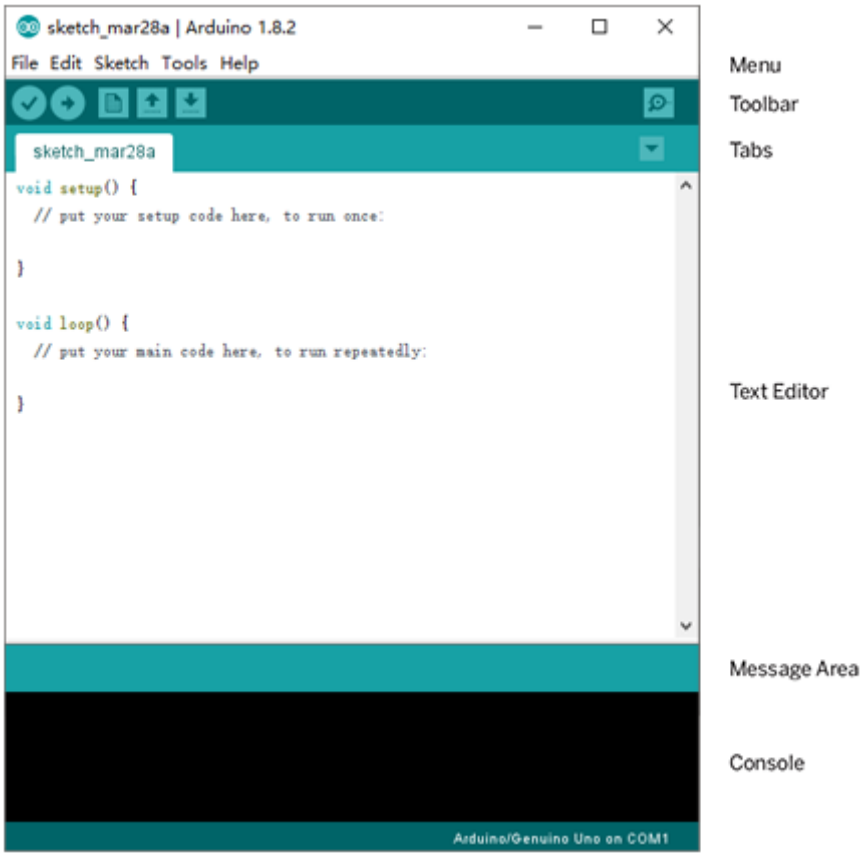


After the downloading completes, run the installer. For Windows users, there may pop up a dialog box for installing driver during the installation process. When it is popped up, please allow the installation.

After installation is completed, an shortcut will be generated in the desktop.



After the downloading is completed, run the installer and complete the installation.
Open the Arduino Software, the interface of Arduino Software is as follows:



Programs written using Arduino IDE are called **sketches**. These sketches are written in the text editor and are saved with the file extension**.ino**. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino IDE, including complete error messages and other information. The bottom right-hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.



Verify
Checks your code for errors compiling it.



Upload
Compiles your code and uploads it to the configured board.



New
Creates a new sketch.



Open
Presents a menu of all the sketches in your sketchbook. Clicking one will open it within the current window overwriting its content.



Save
Saves your sketch.

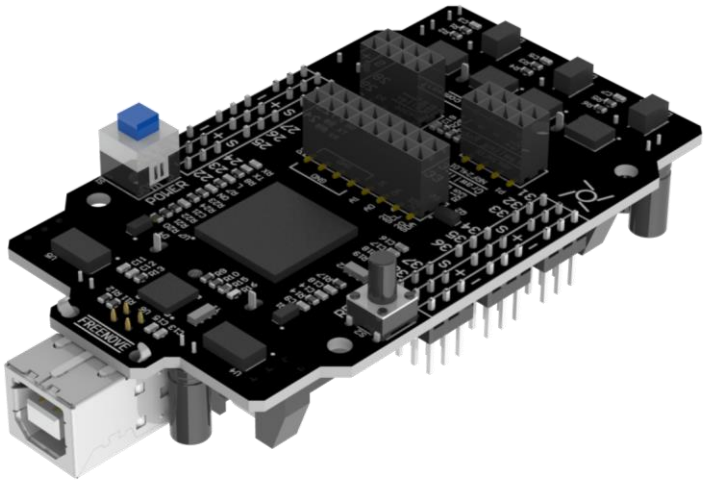


Serial Monitor
Opens the serial monitor.

Additional commands are found within the five menus: File, Edit, Sketch, Tools, Help. The menus are context sensitive, which means only those items relevant to the work currently being carried out are available.

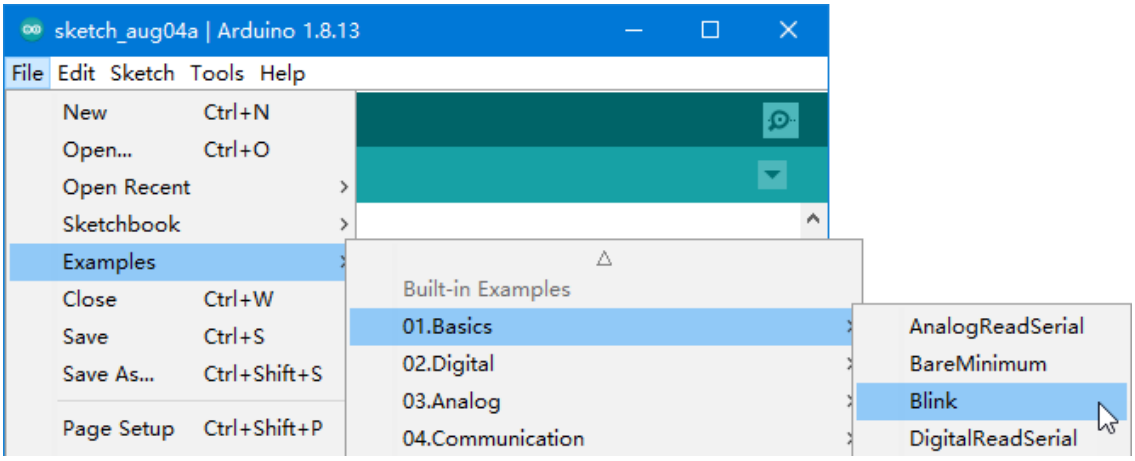
Control Board

The control board of the robot (Freenove Crawling Robot Controller) is used to drive this robot.
It can connect 18 servos, an ESP8266 Wi-Fi module and a NRF24L01 wireless module. There are also some spare IO ports and power ports available.

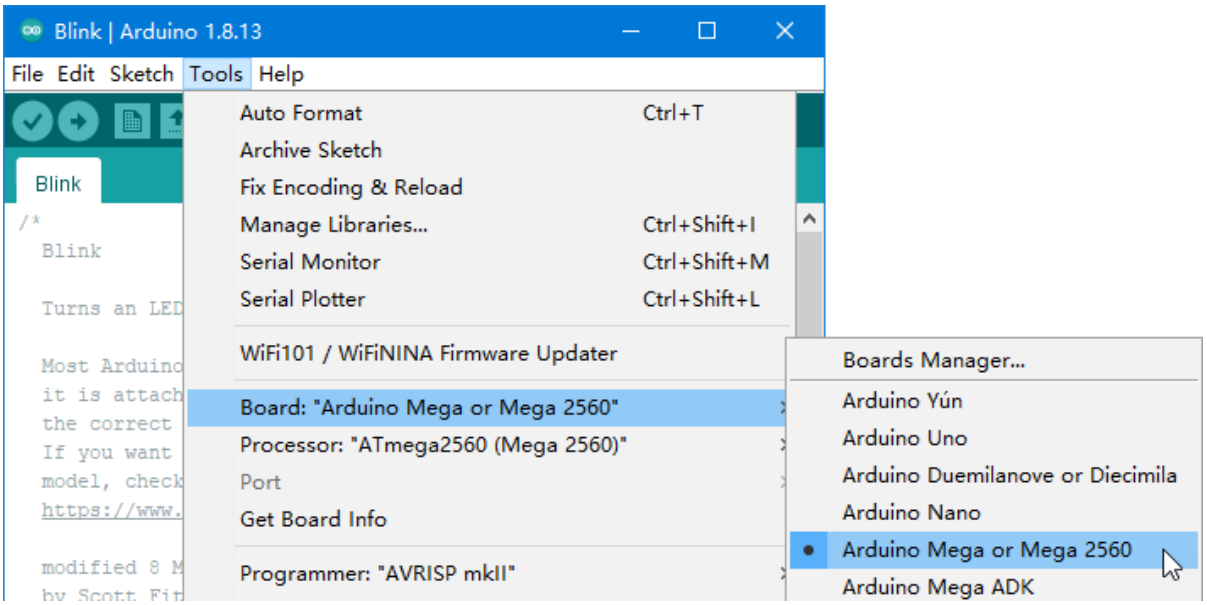


First Use

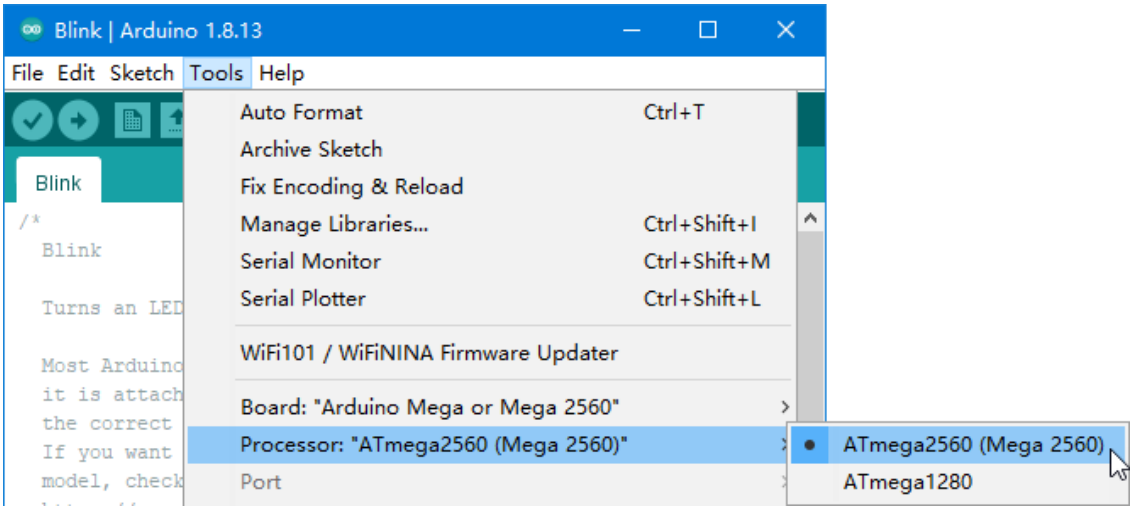
Open the example sketch "Blink".



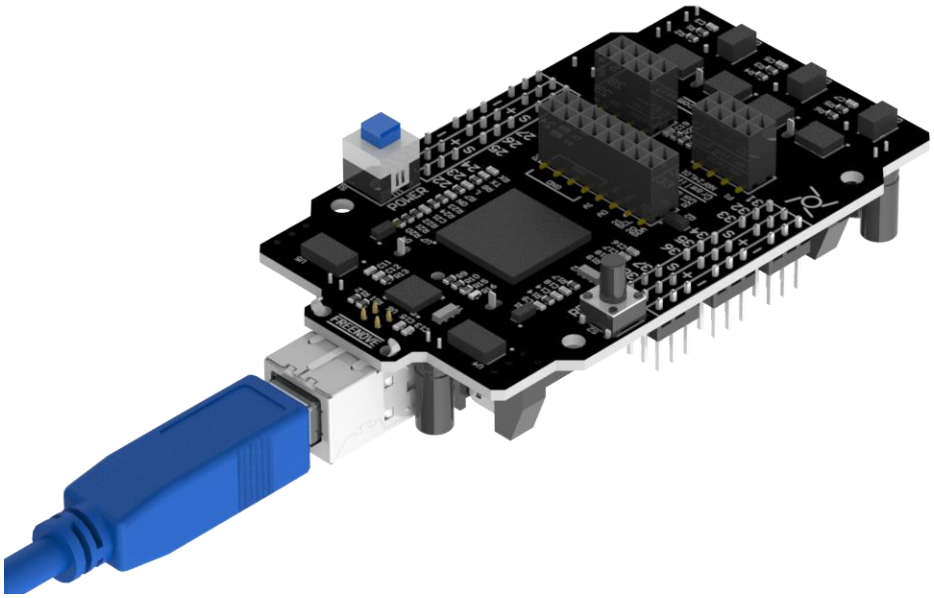
Select "Board" > "Arduino Mega or Mega 2560". (The control board is compatible with this board.)



Select "Processor" > "ATmega2560 (Mega 2560)".



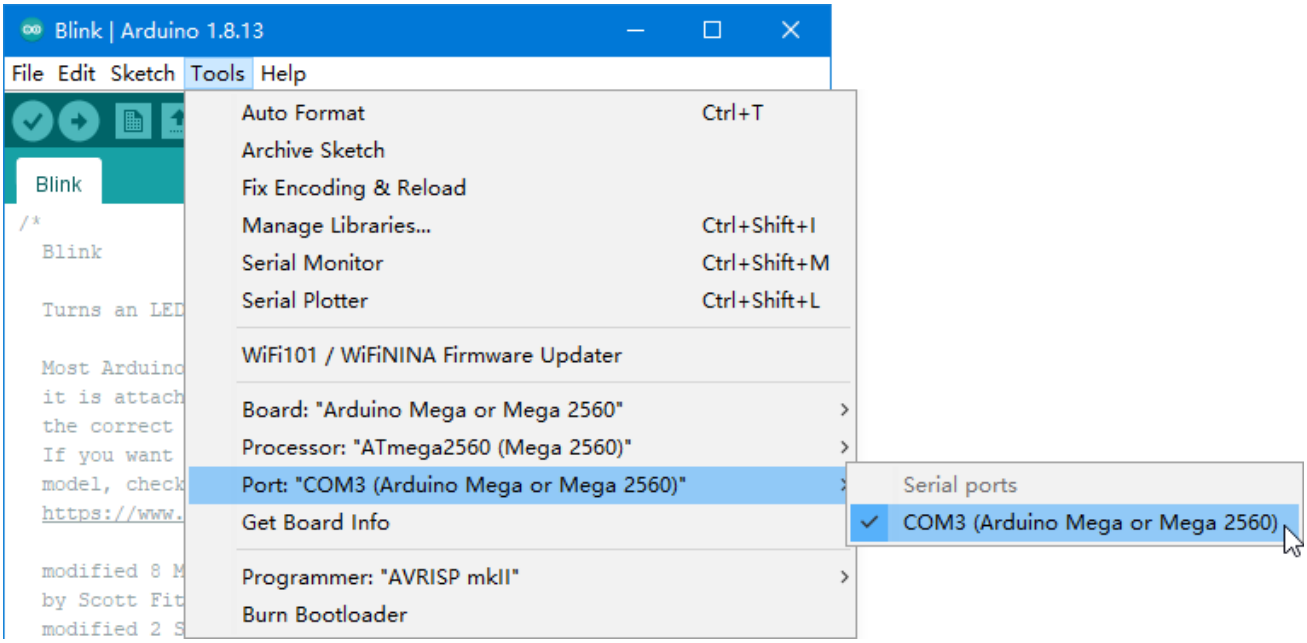
Connect the control board to your computer with a USB cable.



Select the port.

Note: Your port may be different from that in the following figure.

- On Windows: It may be COM4, COM5 (Arduino Mega or Mega 2560) or something like that.
- On Mac: It may be /dev/cu.usbserial-710, /dev/cu.usemodem7101 (Arduino Mega or Mega 2560) or something like that.
- On Linux: It may be /dev/ttyUSB0, /dev/ttyACM0 or something like that.



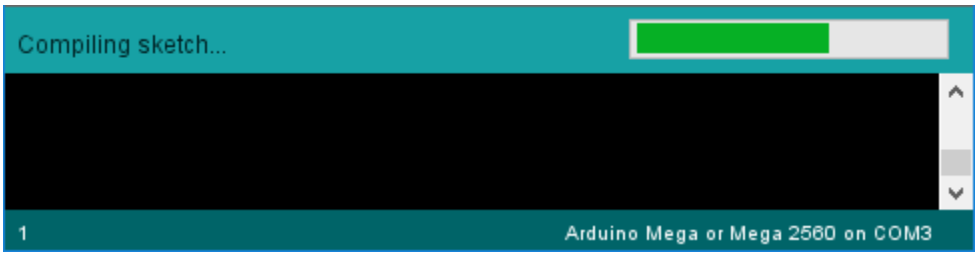
Note: If there are more than one ports and you cannot decide which one to choose, disconnect the USB cable and check the port. Then connect the USB cable and check the port again. The newly appeared one is the correct port.

Having problems? Contact us for help! Send mail to: support@freenove.com

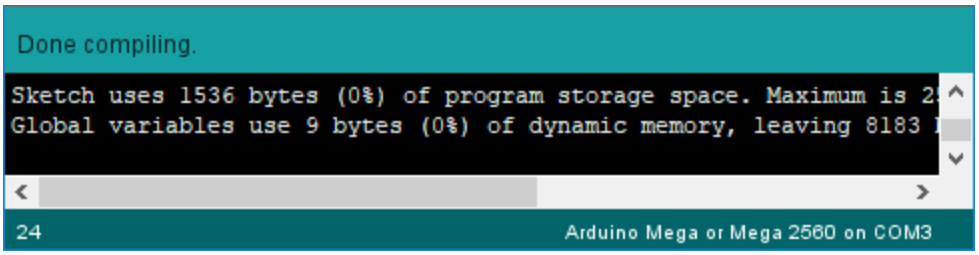
Click "Verify" button.



Figure below shows the code is being compiled.



Wait a moment for the compiling to be completed. Figure below shows the code size and percentage of space occupation. If there is any error in the code, the compilation will fail and the details will be shown here.



Click "Upload" button.

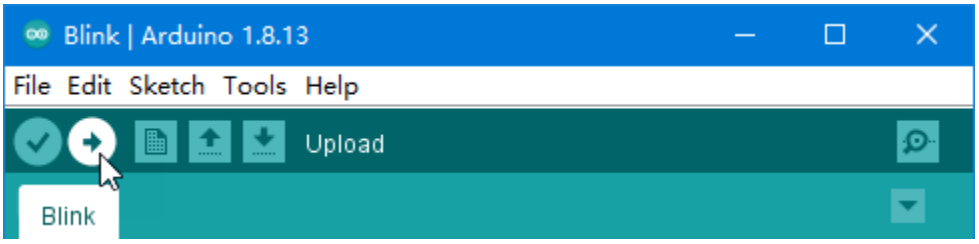
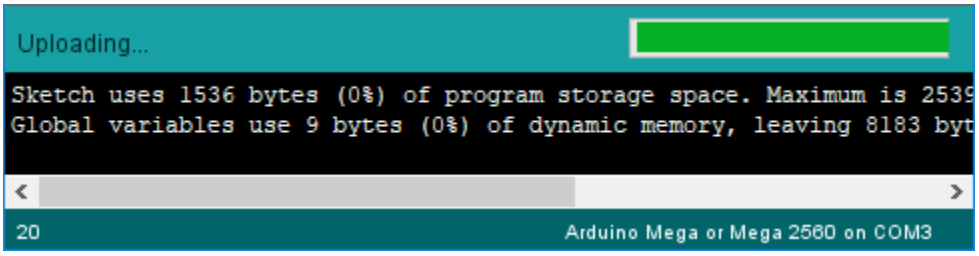
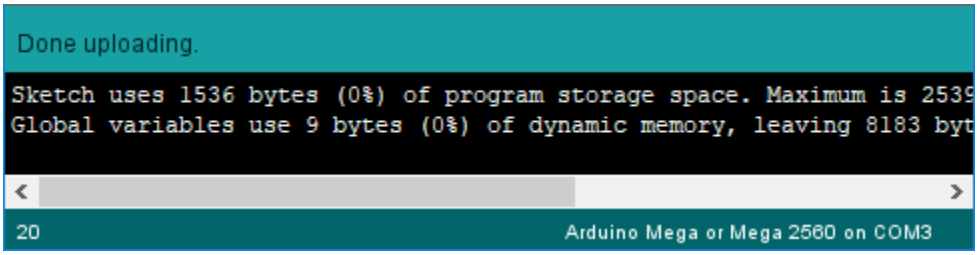


Figure below shows the code is being uploaded.

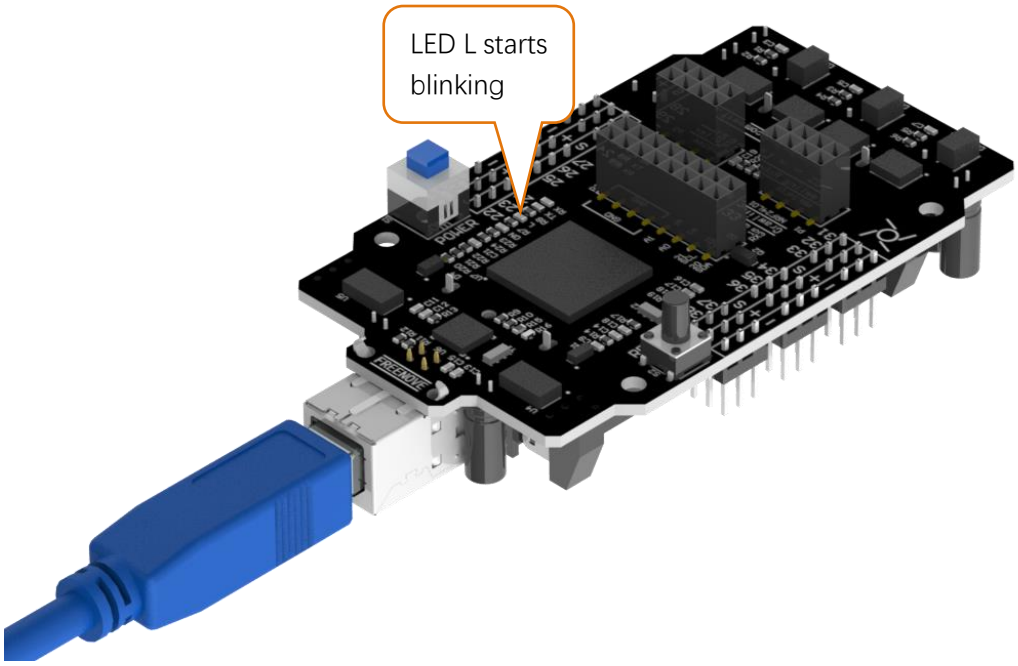


Wait a moment for the uploading to be completed.



Having problems? Contact us for help! Send mail to: support@freenove.com

After that, we will see the LED marked with "L" on the control board starts blinking. It indicates that the code is running now!



So far, we have completed the first use. I believe you have felt the joy of it.

Processing IDE

! Please do not skip this chapter if you have never installed Processing IDE or are not familiar with it.

The Processing IDE is free and open source. It is used to write graphical programs run on computers. Most code written with it can run directly on Windows, macOS and Linux without any changes.

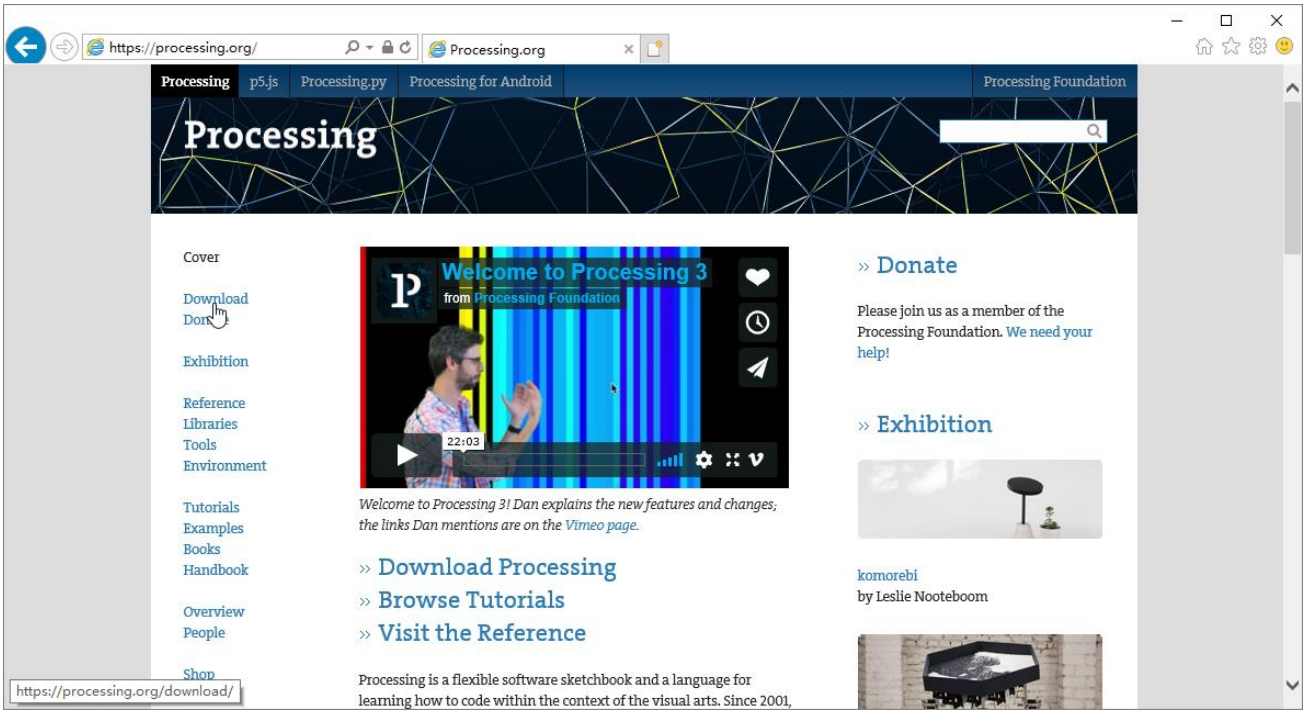
We provide a Processing sketch to configure and control the robot.

Processing IDE

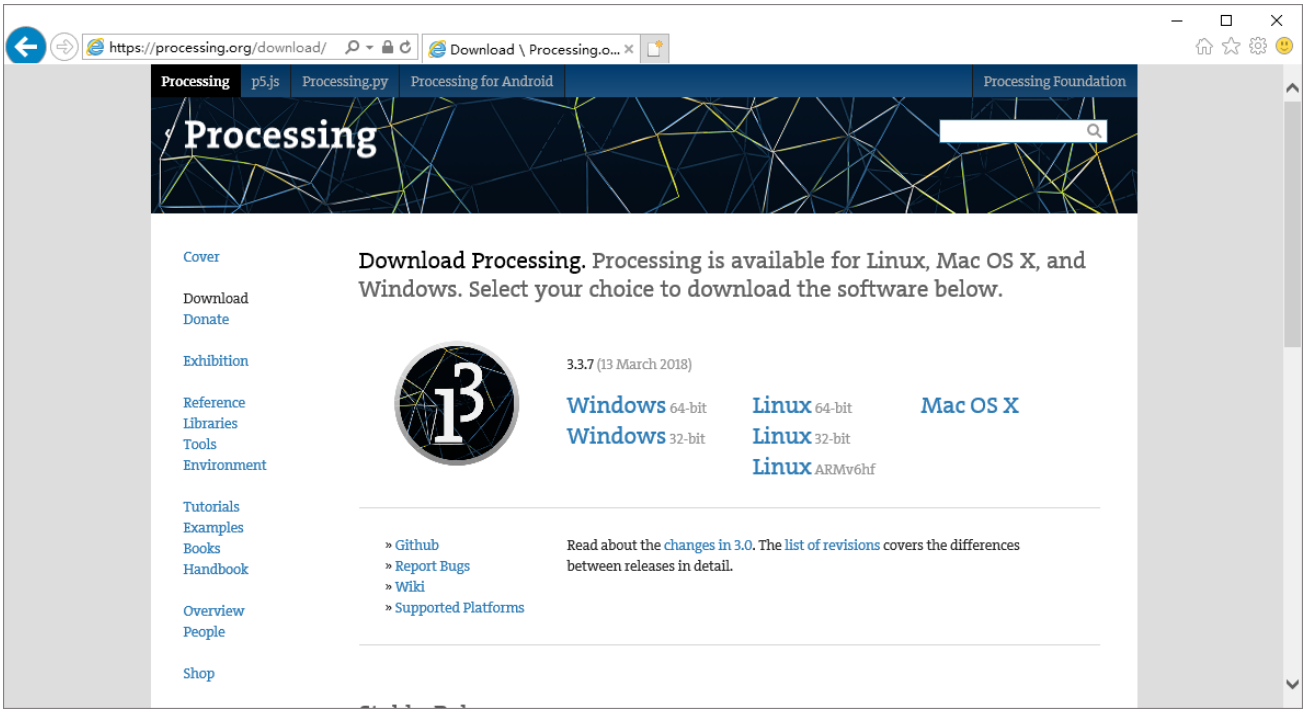
Processing IDE uses Java programming language by default.
Please visit https://processing.org/, click "Reference" for details.

! Do not worry if you do not know Java, because we provide complete code.

First, install Processing IDE. Visit https://processing.org/, click "Download" to enter the download page.



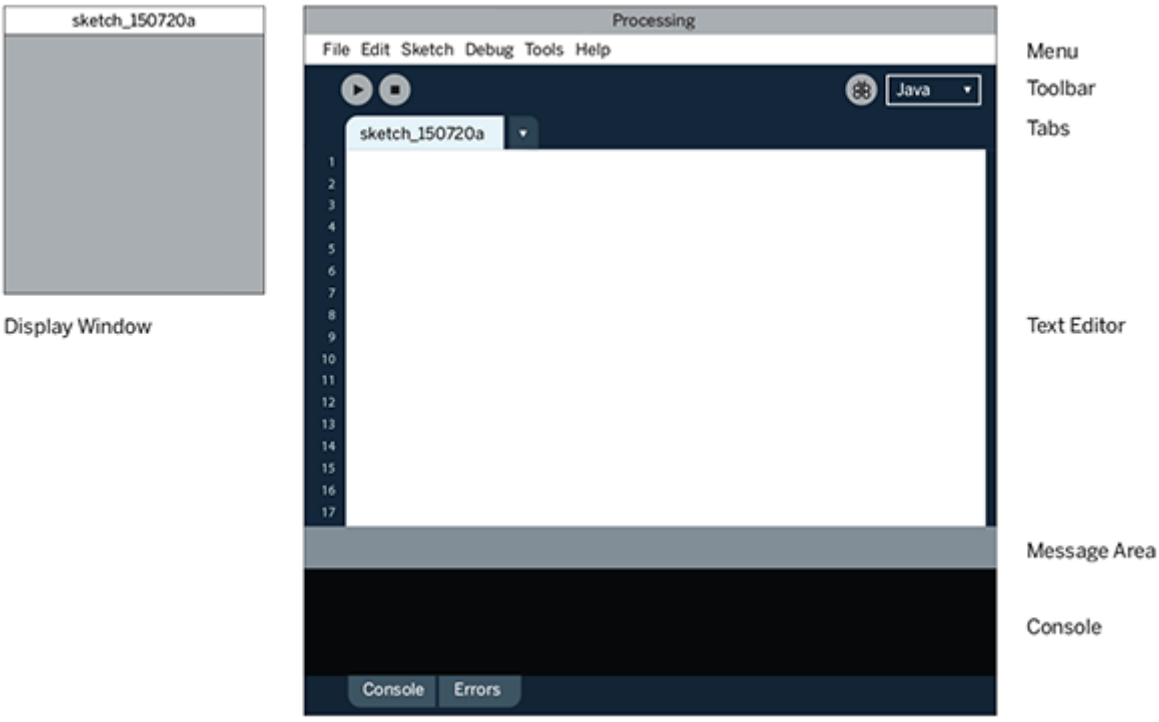
Select the Mac, Windows, or Linux version, depending on what machine you have.



Installation on each machine is straightforward:

- On Windows, you'll have a .zip file. Double-click it, and drag the folder inside to a location on your hard disk. It could be Program Files or simply the desktop, but the important thing is for the processing folder to be pulled out of that .zip file. Then double-click processing.exe to start.
- The Mac OS X version is also a .zip file. Double-click it and drag the Processing icon to the Applications folder. If you're using someone else's machine and can't modify the Applications folder, just drag the application to the desktop. Then double-click the Processing icon to start.
- The Linux version is a .tar.gz file, which should be familiar to most Linux users. Download the file to your home directory, then open a terminal window, and type:
  tar xvfz processing-xxxx.tgz
  (Replace xxxx with the rest of the file's name, which is the version number.) This will create a folder named processing-2.0 or something similar. Then change to that directory:
  cd processing-xxxx
  and run it:
  ./processing

With any luck, the main Processing window will now be visible. Everyone's setup is different, so if the program didn't start, or you're otherwise stuck, visit the troubleshooting page for possible solutions.



Programs written using Processing Software (PDE) are called **sketches**. These sketches are written in the text editor and are saved with the file extension **.pde**. It has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by Processing sketches including complete error messages and text output from sketches with the print() and println() functions. (Note that the console works well for occasional messages, but is not intended for high-speed, real-time output.)

The buttons on the toolbar can run and stop programs:



Run
Runs the sketch. In Java mode, it compiles the code and opens a new display window.



Stop
Terminates a running sketch.

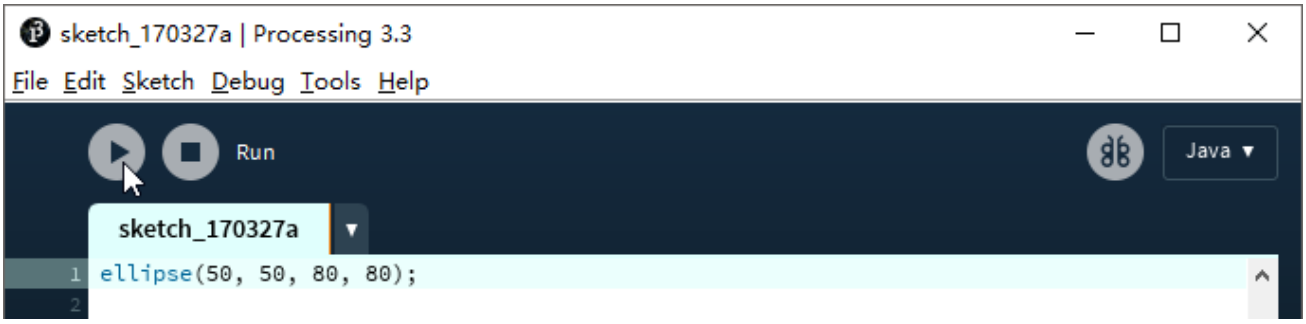
Additional commands are found within the six menus: File, Edit, Sketch, Debug, Tools, Help. The menus are context sensitive which means only those items relevant to the work currently being carried out are available.

First Use

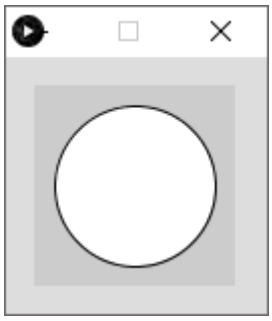
In the editor, type the following:

```
1  ellipse(50, 50, 80, 80);
```

This line of code means "draw an ellipse, with the center 50 pixels over from the left and 50 pixels down from the top, with a width and height of 80 pixels." Click the Run button (the triangle button in the Toolbar).



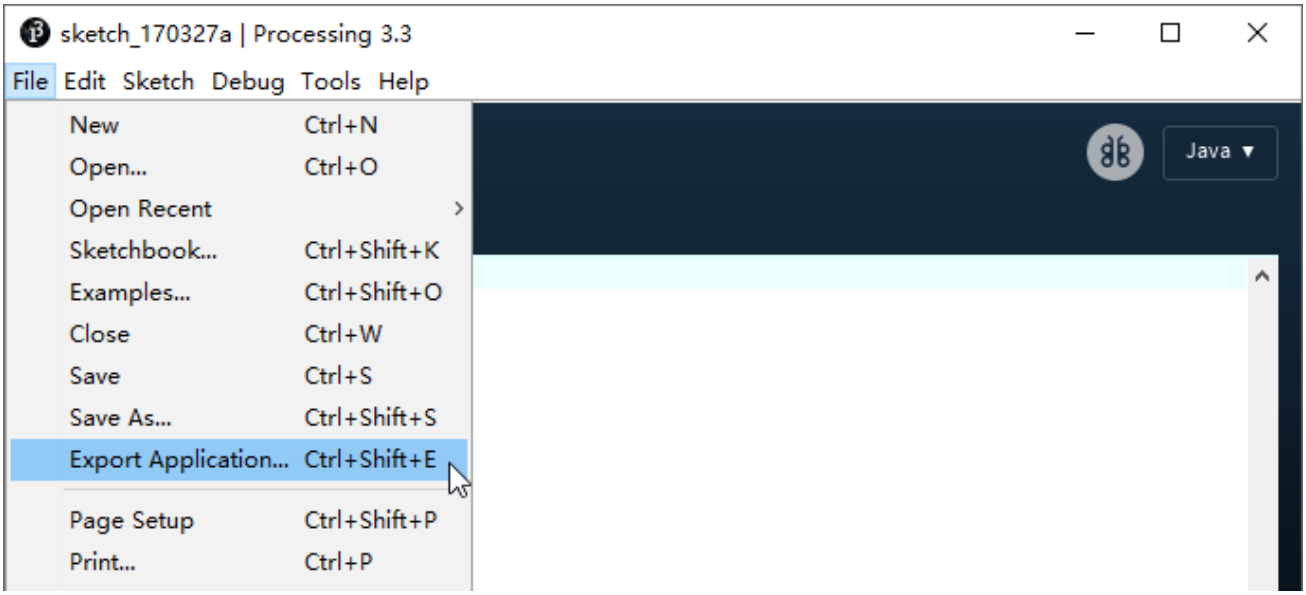
If you've typed everything correctly, you'll see a circle on your screen.



If you didn't type it correctly, the Message Area will turn red and complain about an error. If this happens, make sure that you've copied the example code exactly: the numbers should be contained within parentheses and have commas between each of them, and the line should end with a semicolon.



You can export Processing sketch to an application to run it directly without opening the Processing.
To export the sketch to the application, you must save it first.



So far, we have completed the first use. I believe you have felt the joy of it.

Assembly

Now let us start assembling the robot.

! Please prepare the right batteries and fully charge them before assembling.
(See "AboutBattery_for_V2.pdf")
Assembling without right batteries will cause installation errors, which may damage the servos.

! Please read and complete the previous chapters "Arduino IDE" and "Processing IDE" first.
In the previous chapters we showed you how to install the required software.

! Please follow the tutorial strictly and do not skip any steps.
Ask our support for help if you encounter a problem instead of ignoring it.

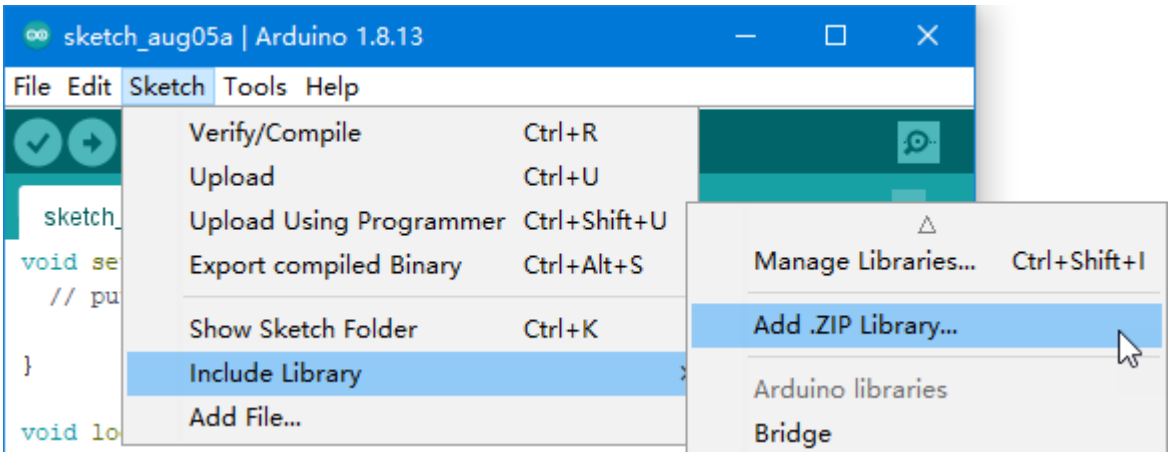
! Do not open files in the original ZIP file directly.
After you download the ZIP file for this product, unzip it before use.

Step 01

First, we need to upload the default sketch to the control board (Freenove Crawling Robot Controller).

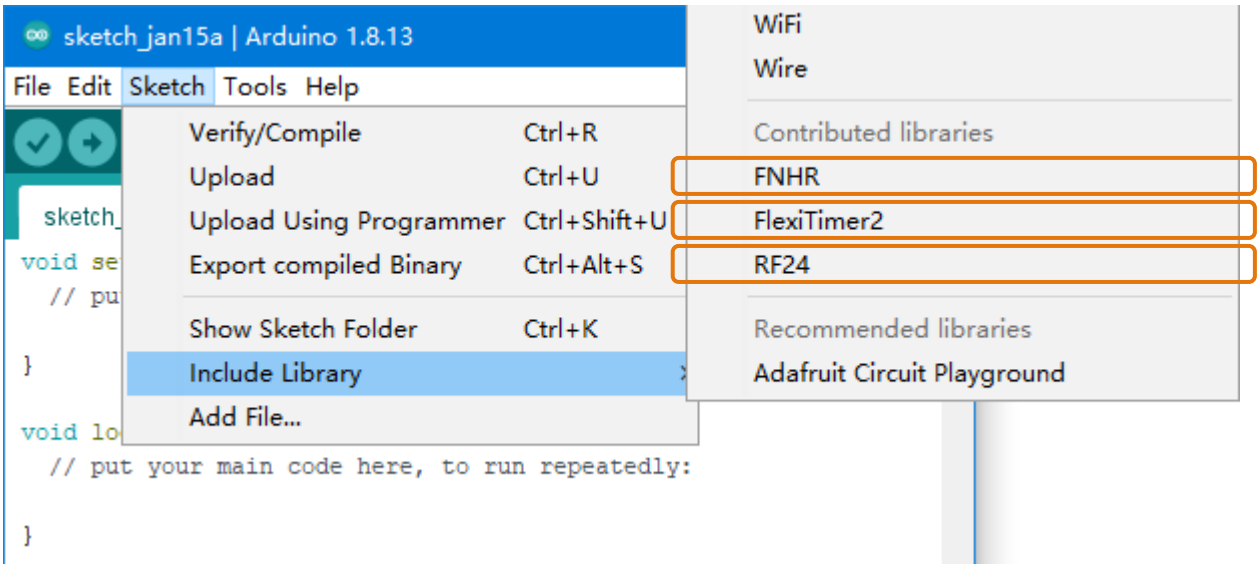
Libraries are collections of code that makes programming simple.
The "FNHR" (Freenove Hexapod Robot) library is used to control this robot. We need to add it and other necessary libraries to Arduino IDE.

Open Arduino IDE, click "Sketch" > "Include Library" > "Add .ZIP Library..." to add a library file.

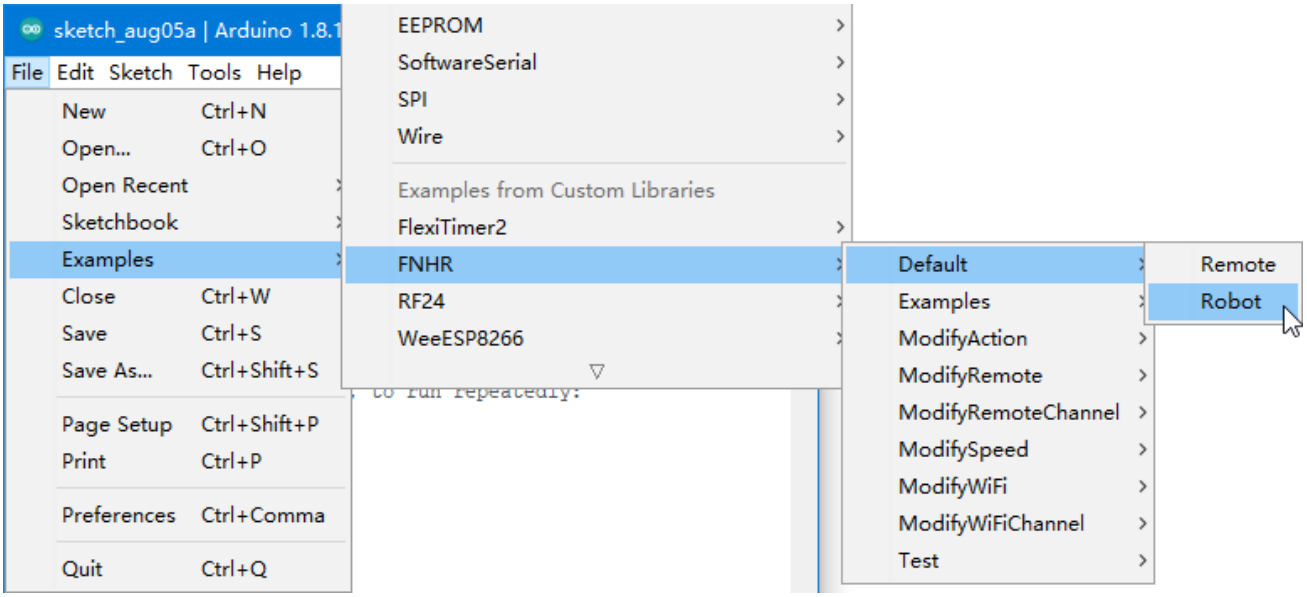


Add all library files in "**ArduinoLibraries**" folder. **This folder is in the folder that contains this PDF tutorial.**

You can find the added libraries in “Sketch” > “Include Library”. Make sure all the following libraries have been added.

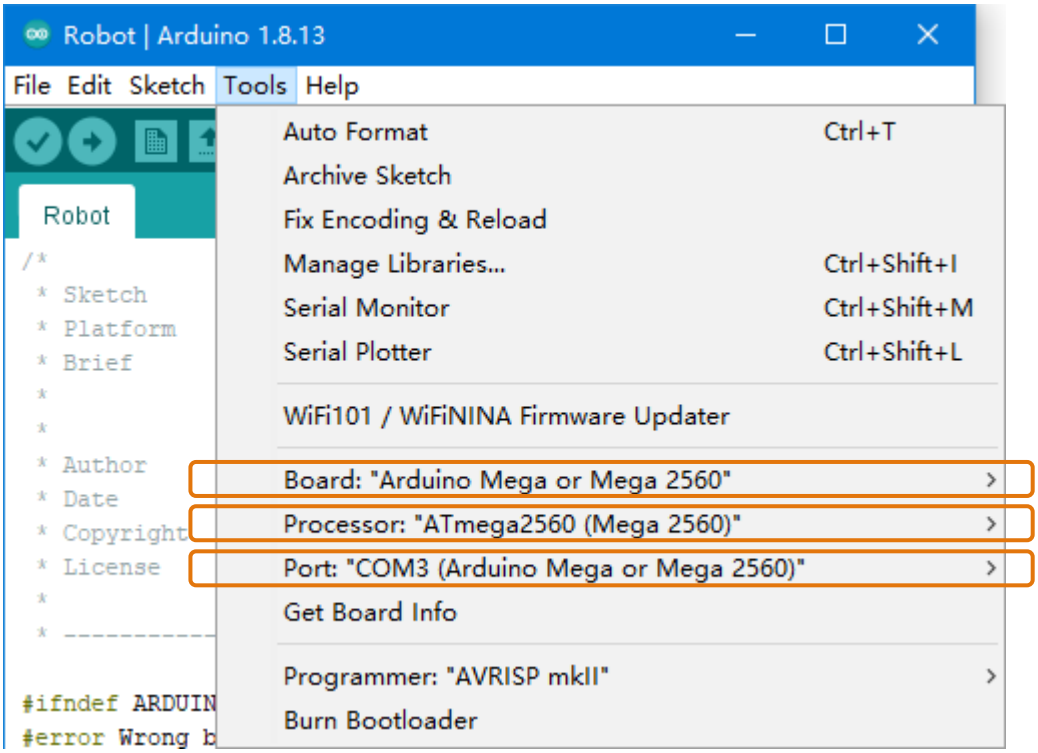


Now open "File" > "Examples" > "FNHR" > "Default" > "Robot".

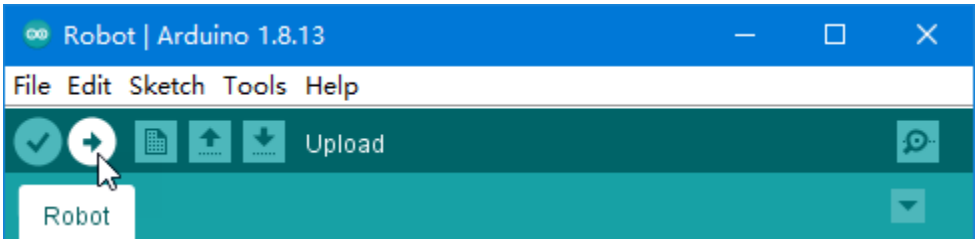


Select the correct Board, Processor and Port.

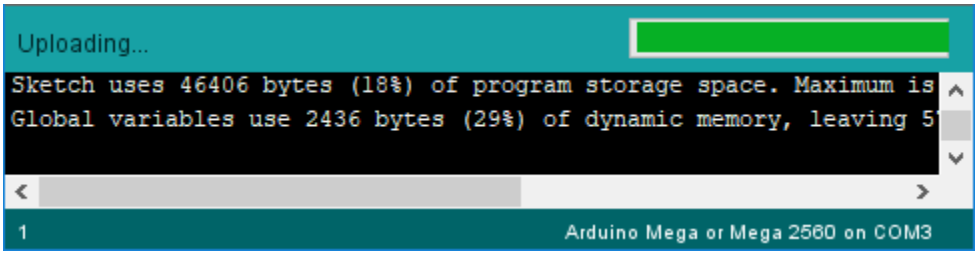
! Your port may be different from that in the following figure. See previous chapter “Arduino IDE” for details.



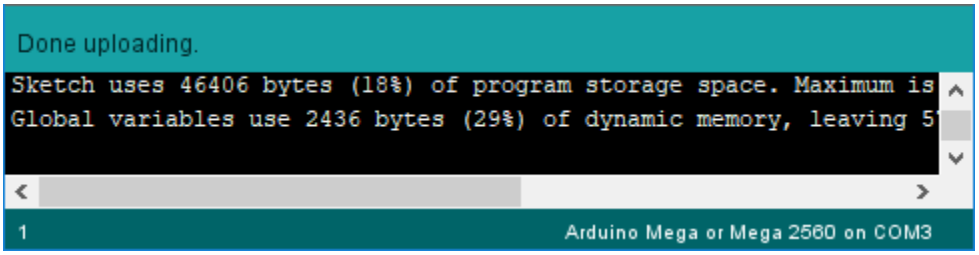
Then click “Upload” button to upload the default sketch to the control board.



Wait for uploading. It will take a few seconds.



Once you see "**Done uploading**", it means the upload is successful.

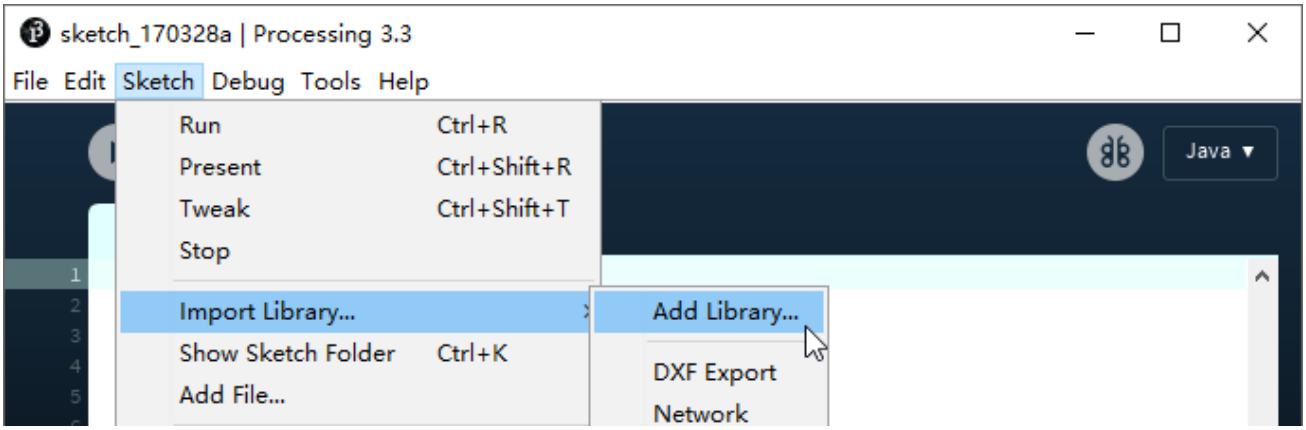


Step 02

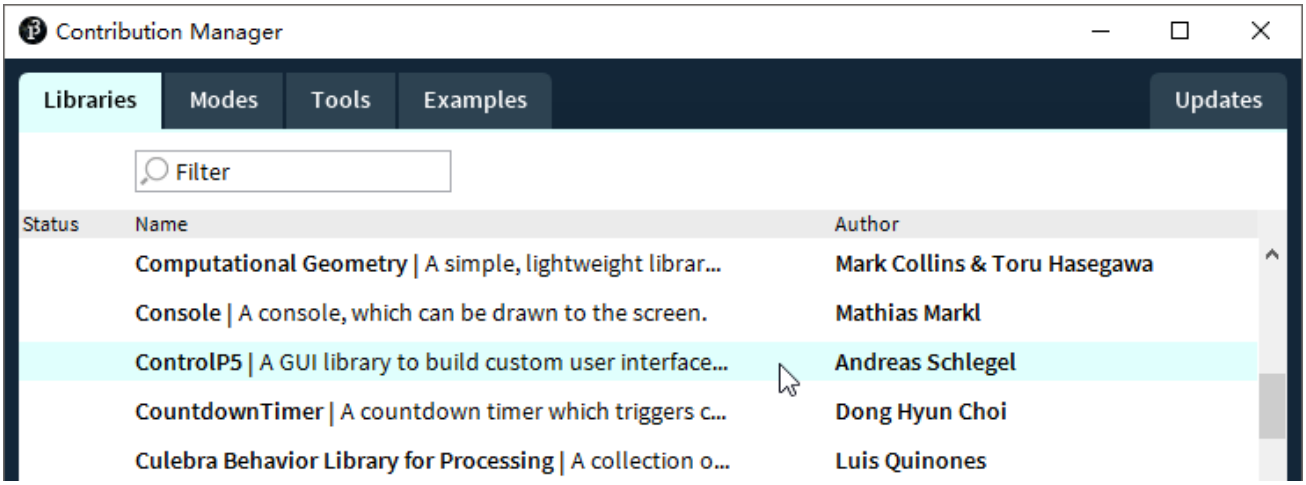
Now we need to run a Processing sketch. It will allow us to configure the control board.

We also need to add library to Processing IDE.

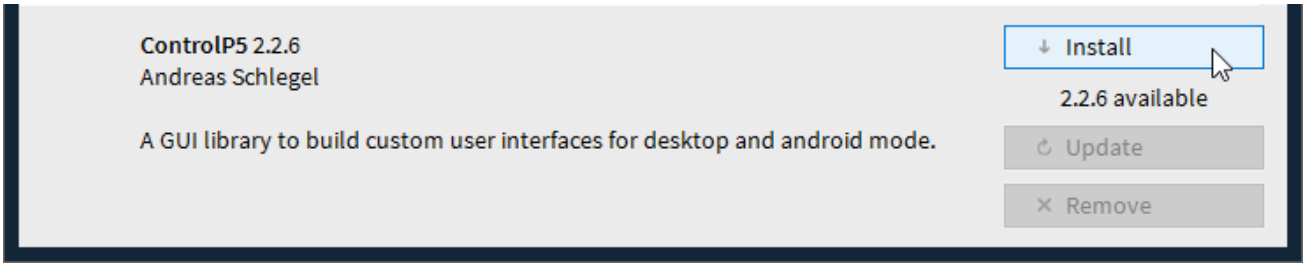
We can add library online. Click "Add Library..." to open "Contribution Manager".



Find "ControlP5" in the "Libraries" tab, and click to select it.



Then click “Install”.



After the installation succeeds, close “Contribution Manager” window.

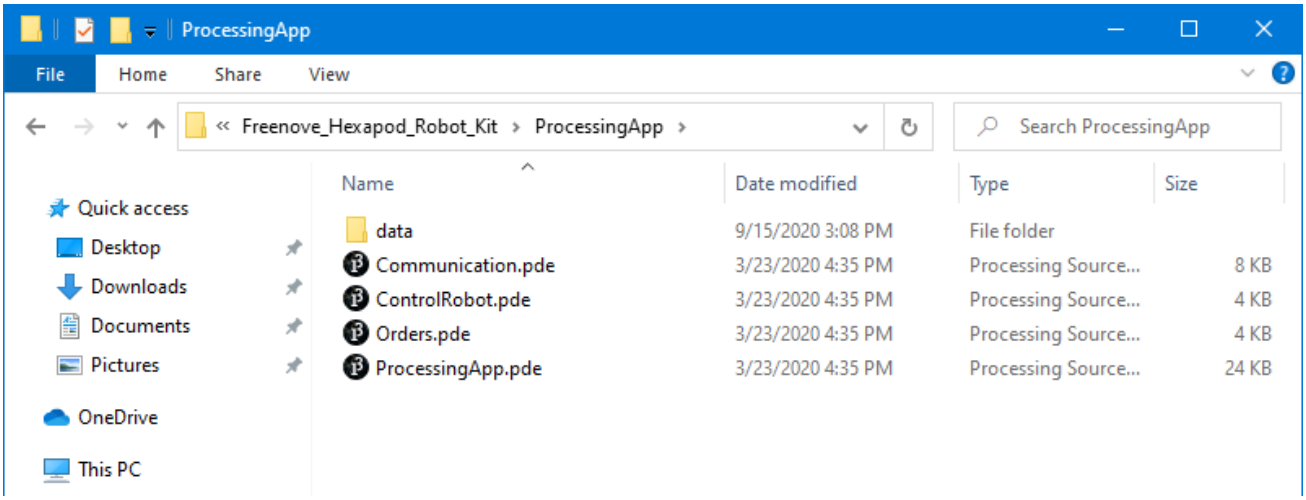
! If you cannot complete the online installation, you can install it offline.
Just unzip “ProcessingLibraries\controlP5.zip” to "libraries" folder under "Sketchbook location" in the “Processing software” > "File" > "Preferences" window. You will need to create the "libraries" folder if this is your first adding library. After that, restart Processing software.

After library files are installed, open "**Freenove_Hexapod_Robot_Kit\ProcessingApp\ProcessingApp.pde**" with Processing IDE. This file is in the folder that contains this PDF tutorial.

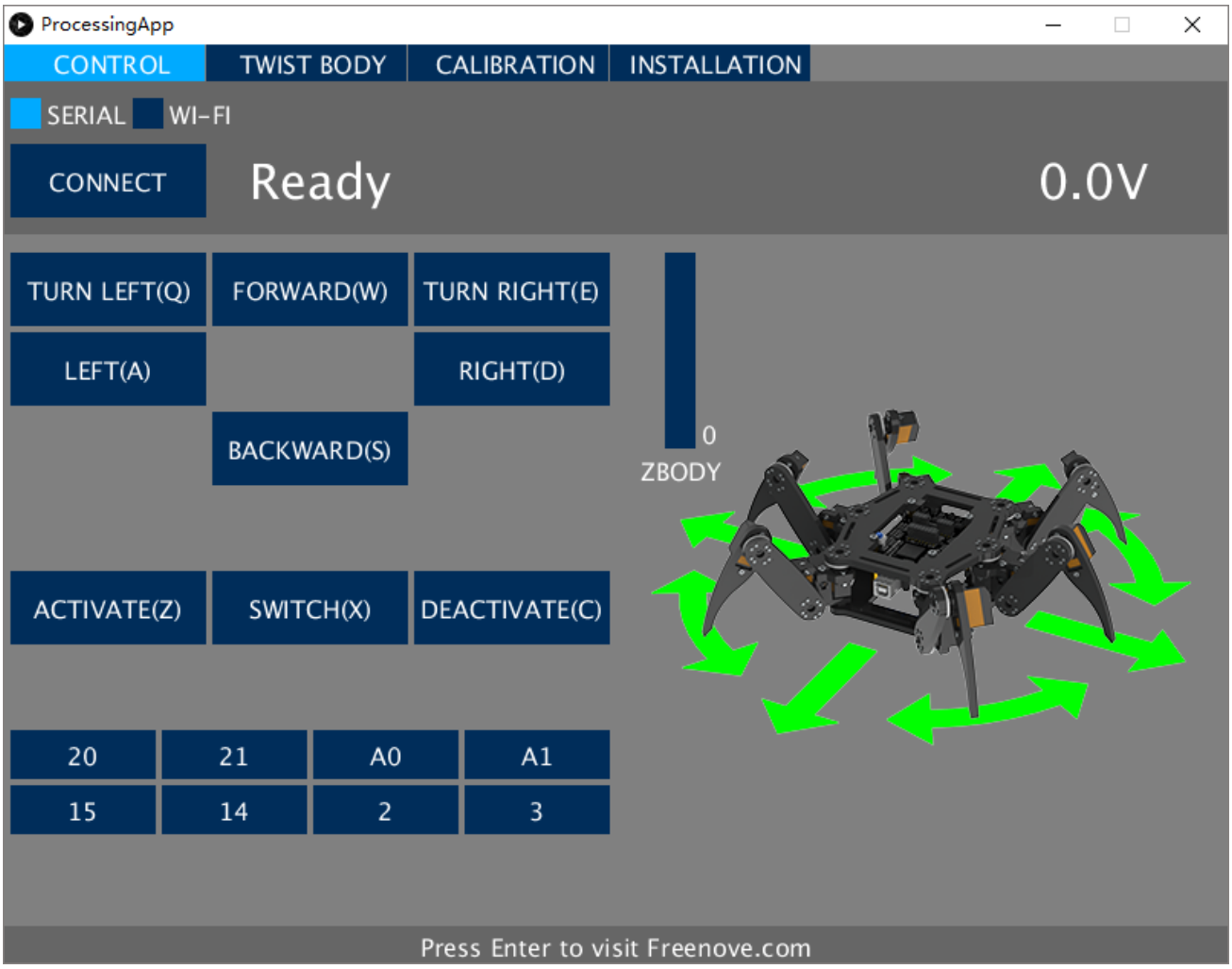


Note:

1. Make sure you have unzipped the downloaded file.
2. Keep the files in same folder. Do not seprate them.



Click "Run", then the Processing App window appears.



Now let us try it. Connect the control board to your computer via a USB cable.

Select "SERIAL" in Processing App, then click "CONNECT".



Wait for processing. It may take a few seconds. Do NOT click again when it's processing.



When the "CONNECT" button changes to "DISCONNECT", it means the connection is successful.



! If the connection is unsuccessful, the default sketch may not have been uploaded successfully.
Go back to “Step 01”, upload the default sketch to the control board and then try again.

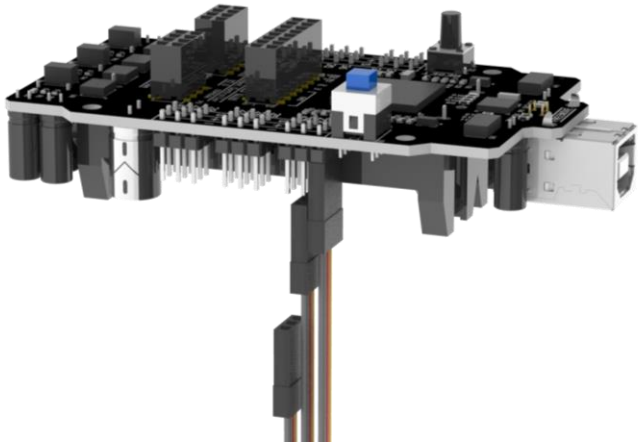
Having problems? Contact us for help! Send mail to: support@freenove.com

Click "DISCONNECT" button to disconnect.

Step 03

Now we will make a test and then set the control board to installation mode.

Take out all the servos and connect all of them to the control board (yellow wire of servo to S, red to +, black to -). Servos can be connected randomly to the port 22~39.
(The name of the port is marked on the front of the control board.)



Then install your batteries and keep power off.

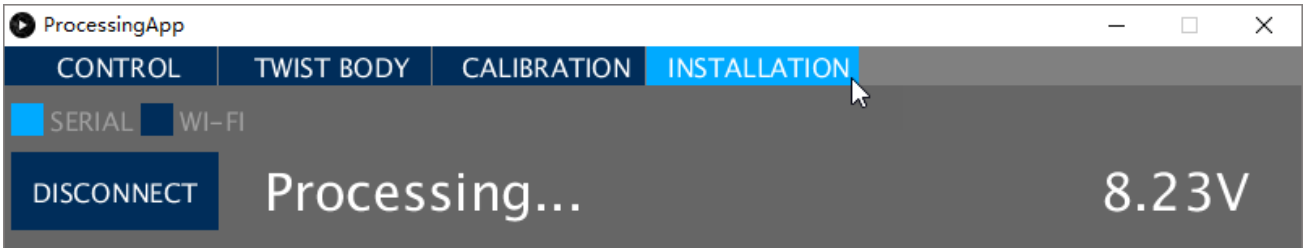
Connect the control board to computer via USB cable. Then open Processing App and click “CONNECT”. After the connection succeeds, turn on the power. The servos will rotate and then stop. The battery voltage will be displayed on the Processing App.



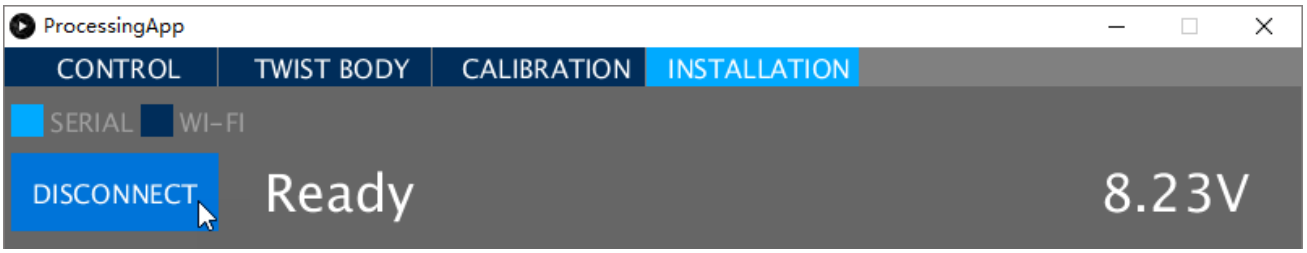
! The battery voltage should be around 8.0~8.4V.

If the voltage is less than 8V, please charge the batteries and then try again. If you still get the same result, maybe you have wrong batteries. Please check the type of your battery or check whether there is a protective board. Refer to “AboutBattery_for_V2.pdf” for detailed information about battery.

If there is no problem with the voltage, then we need to set the control board to installation mode.
Click "INSTALLATION" on the top. Wait for processing and the servos will rotate again.



Click “DISCONNECT” to disconnect. The control board will restart and the servos will rotate again.



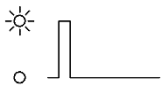
! The LED "L" on the control board now should flash three times at intervals.
It is indicating that the control board is under installation mode.
If the LED L does not flash like this, you need to use Processing App to set the control baord again.
You have to do this step correctly. Otherwise, it will cause installation errors and damage the servos.
If you meet problems, check your batteries or ask our support team for help.

! Switch the power off, disconnect the USB cable, remove the batteries and disconnect all the servos.

Now let us learn about the signal LED (LED “L” on the control board), which can indicate current state of the robot. You should always observe it, which is very important and useful. See “SignalLED.mp4” in “Videos” folder.

The signal LED will flash several times every few seconds (circularly).

In each cycle, if the LED lights up several times and then stays OFF, it indicates different working mode:


Blinks once: ready mode.
This mode should be set after completing installation and calibration of the robot.


Blinks twice: calibration mode.
This mode should be set when calibrating the robot.


Blinks 3 times: installation mode.
This mode should be set when installing the robot.

The working mode of the robot can be set through Processing App. The robot will remember the working mode you set, even if you restart the power, the robot will still enter the mode you set originally.

In each cycle, if the LED goes off several times and then stays ON, it indicates an error state:
(Only applicable to V2.0 and later versions control board)


Blinks once: power error.
It indicates that the voltage of battery is too low and that it needs to be charged.

The robot will stop all movements and cut off power of all servos when there is an error. You must troubleshoot the error before you can continue to use it.

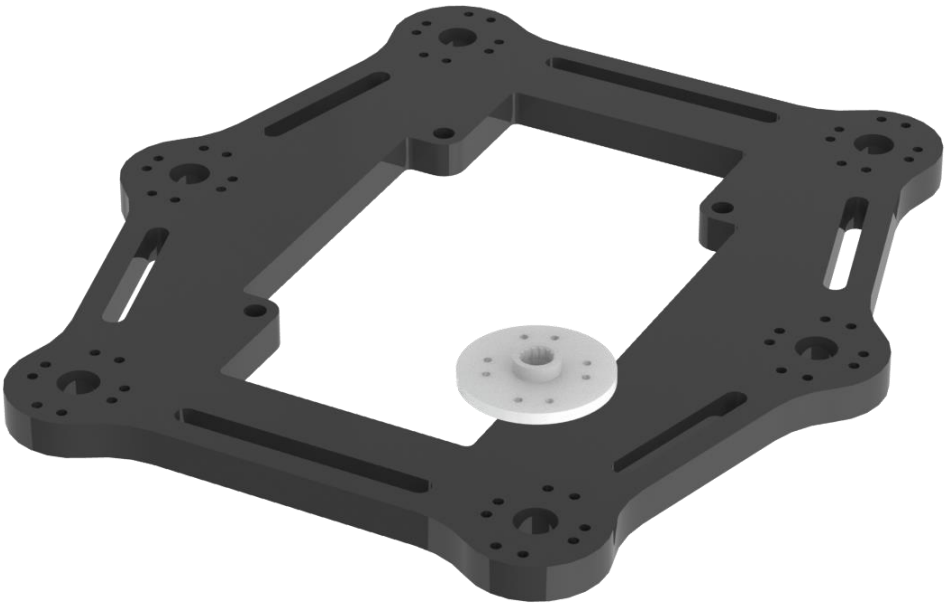
Step 04

Now let us assemble the robot.

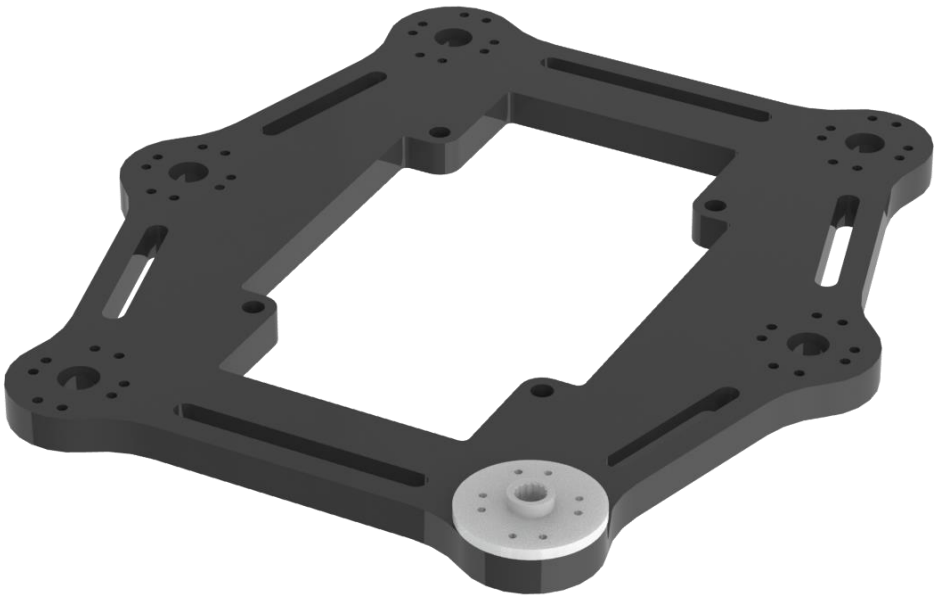
! Make sure the batteries are correct and the control board has been set to the installation mode.

! Please assemble and use the robot on a smooth surface such as a desk.
Assembling and using the robot on rough surfaces such as carpets will damage the servos.

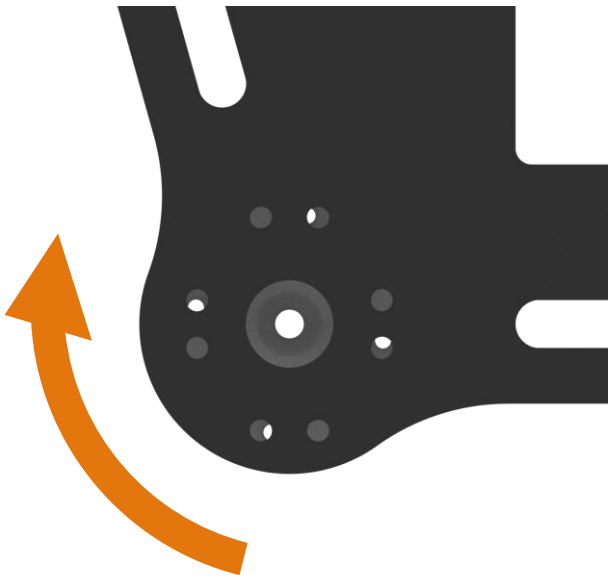
Place disc servo arm on the following acrylic plate.
(Disc servo arm and servo are packed together.)



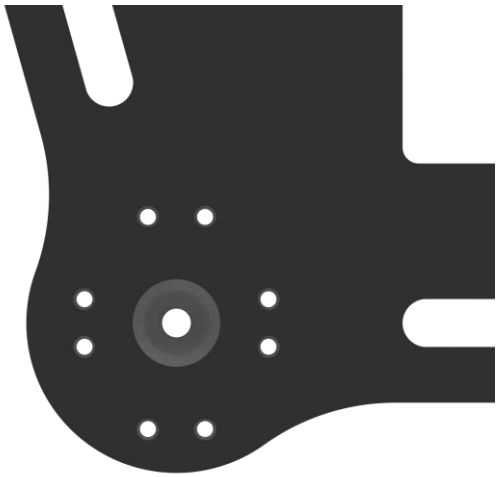
The correct location is as below.



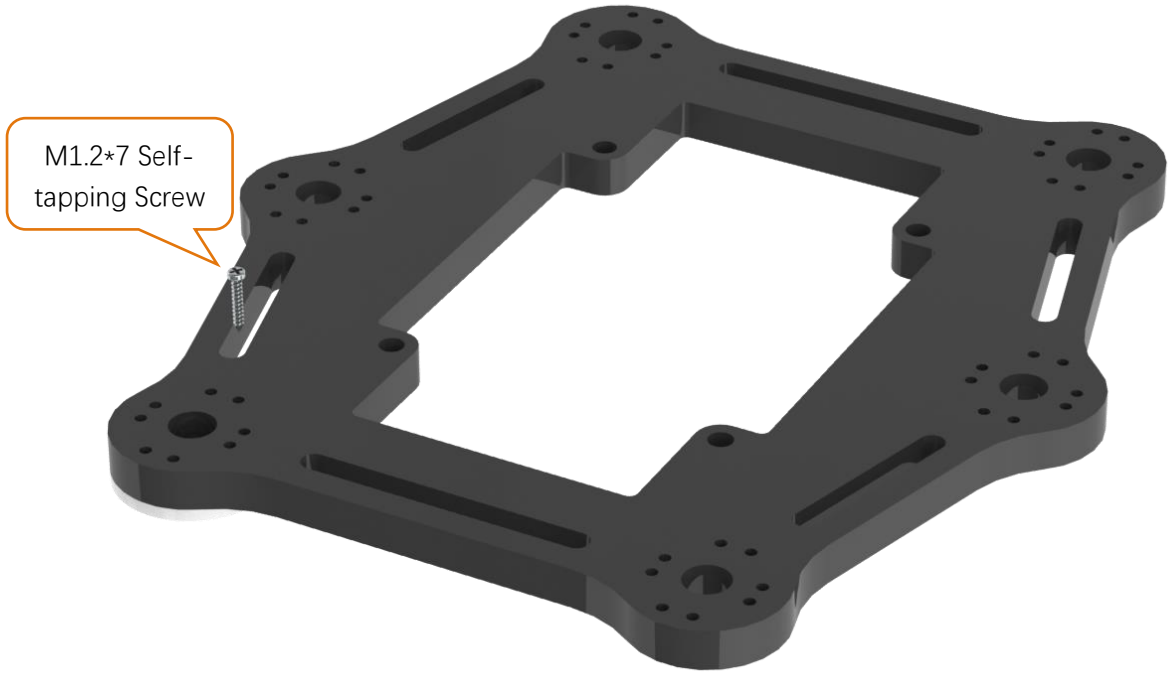
Rotate disc servo arm to align its hole with the hole on the acrylic plate.



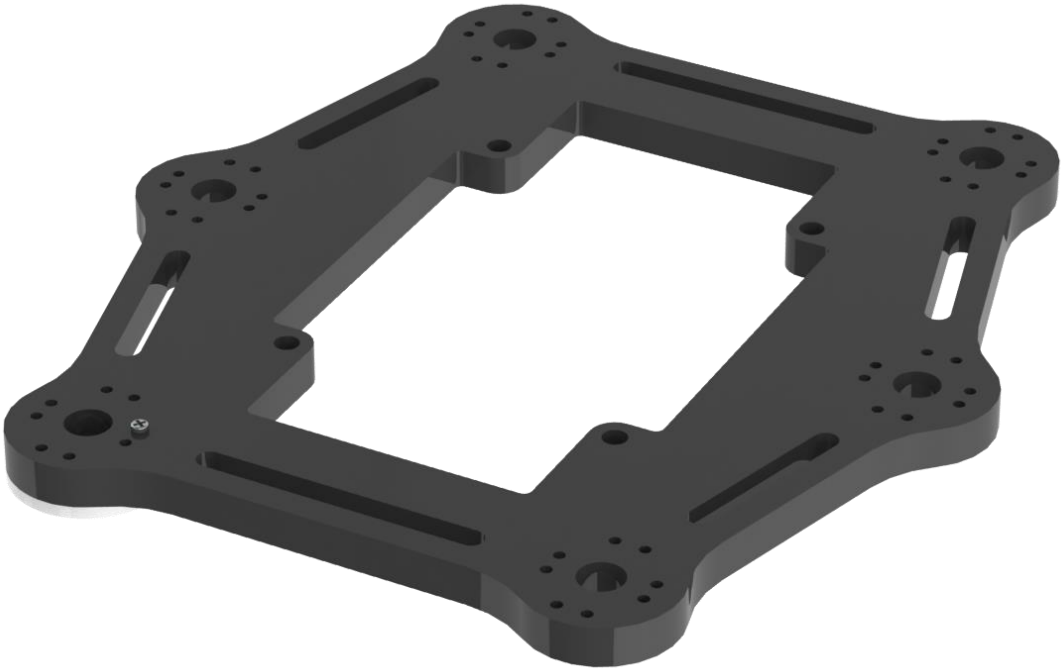
When all holes align:



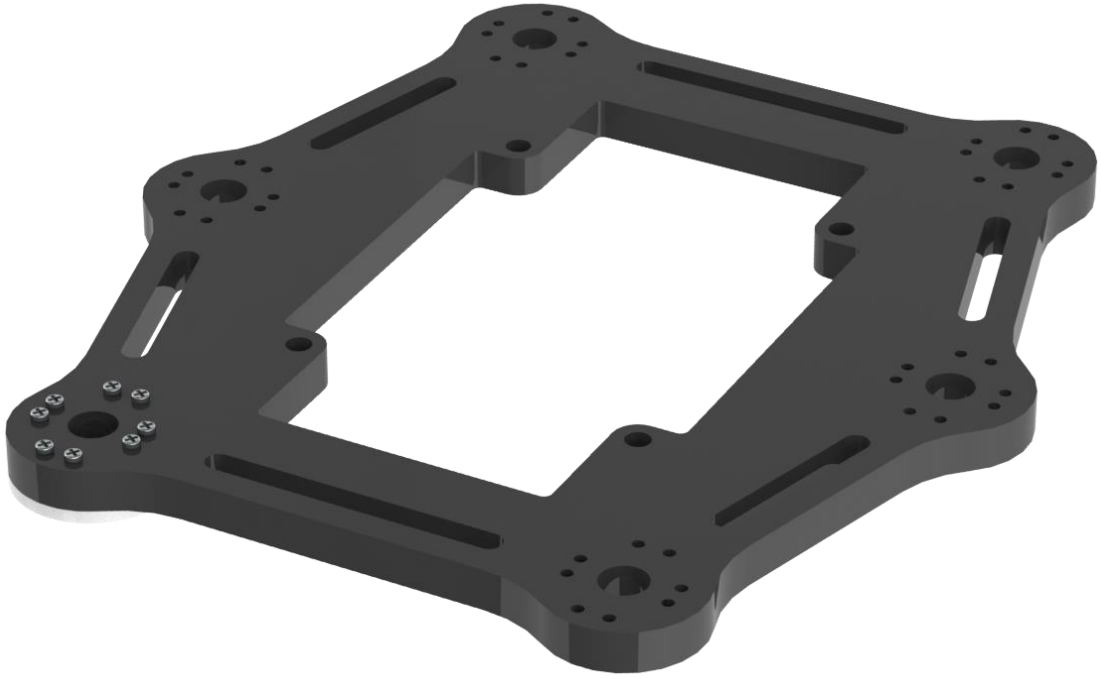
Use the screws to fix disc servo arm to acrylic plate.



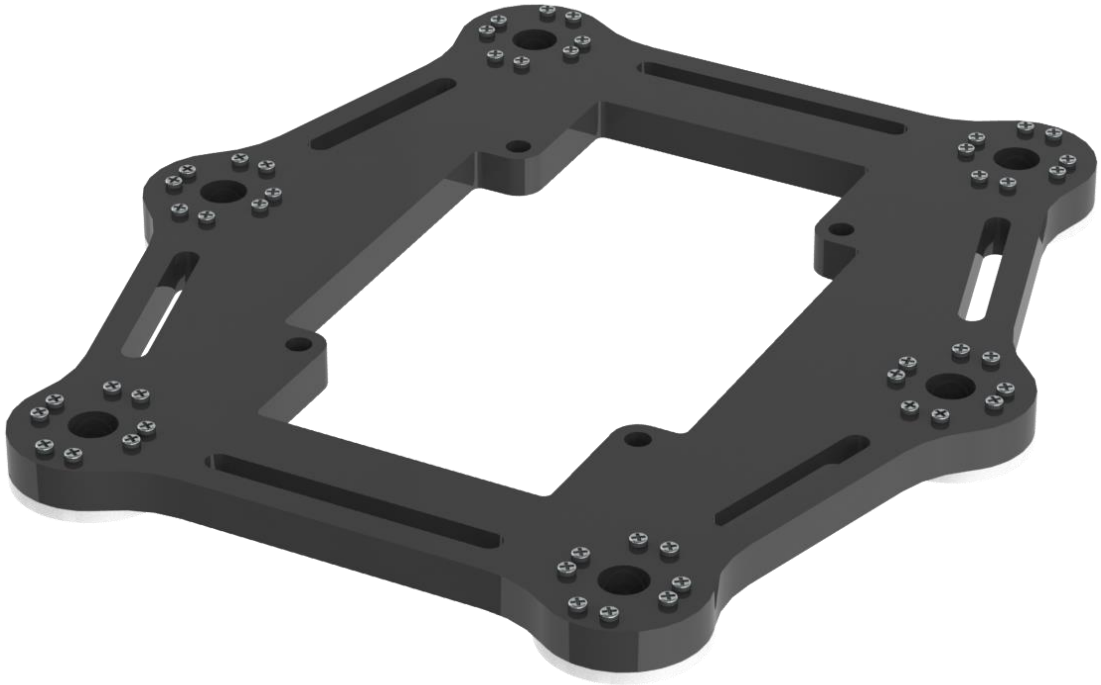
Tighten the screws as below.



Use the same screws to fix other holes of disc servo arm.

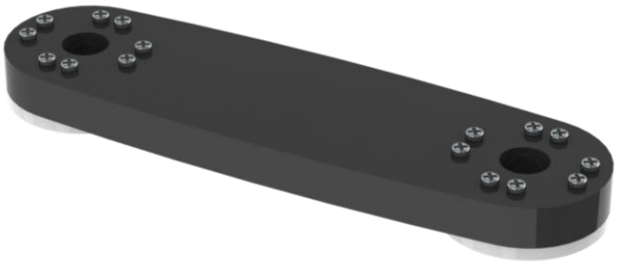


Use the same size of screws to fix 5 other disc servo arms to acrylic plate.



Step 05

Use the same size of screws to fix 2 disc servo arms to the following acrylic plate.

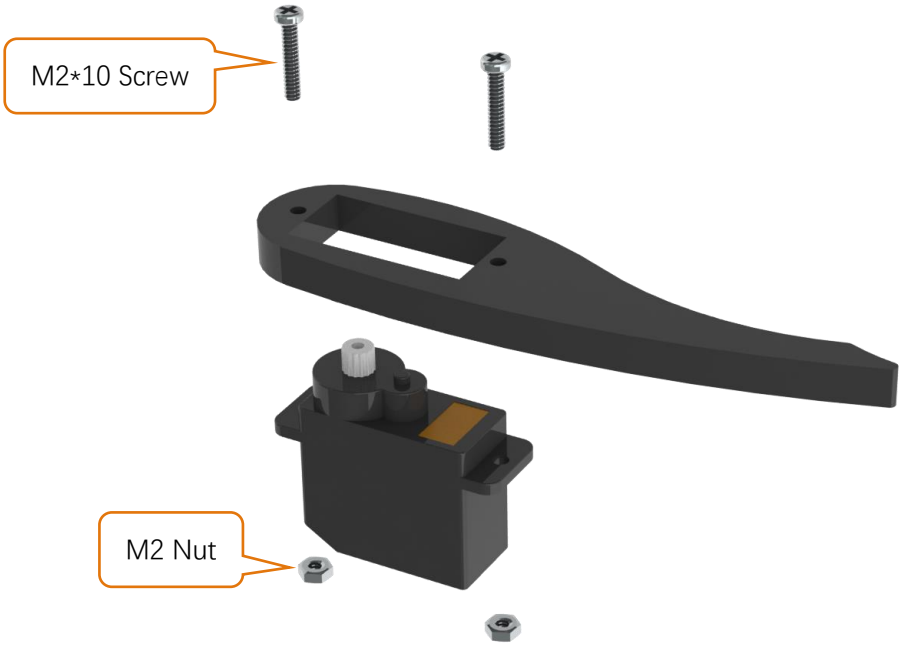


Assemble 5 other acrylic plates as below.

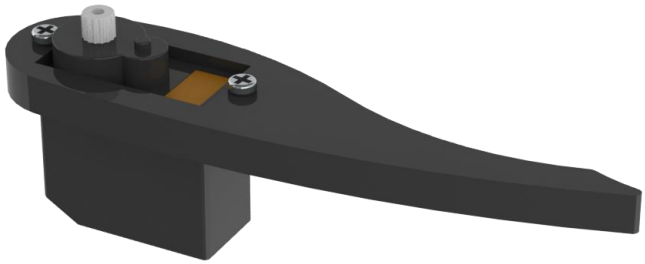


Step 06

Use screws and nuts to fix servo to the following acrylic plate.



Fix them as below. Note the position of the servo shaft.



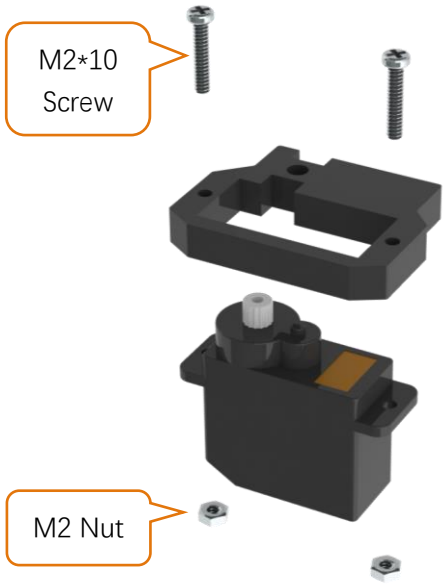
Assemble 5 other acrylic plates.

Note the direction of acrylic plates. Three of them are opposite to the other three.

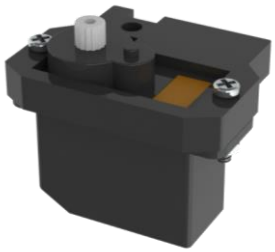


Step 07

Use screws and nuts to fix servo to the following acrylic plate.



Fix them as below. Note the position of the servo shaft.



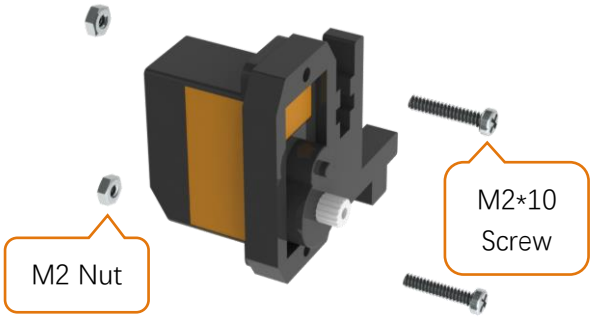
Assemble 5 other acrylic plates.

Note the direction of acrylic plates. Three of them are opposite to the other three.

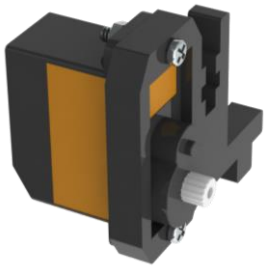


Step 08

Use screws and nuts to fix servo to the following acrylic plate.



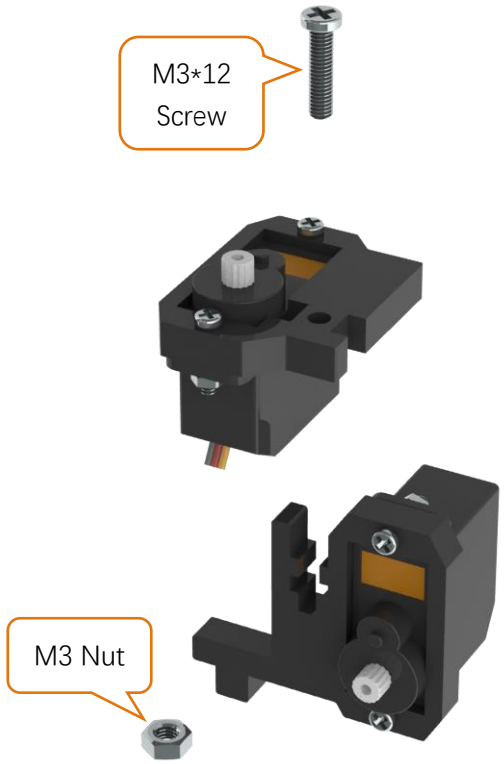
Fix them as below. Note the position of the servo shaft.



Assemble 5 other acrylic plates.
Note the direction of acrylic plates. Three of them are opposite to the other three.



Step 09

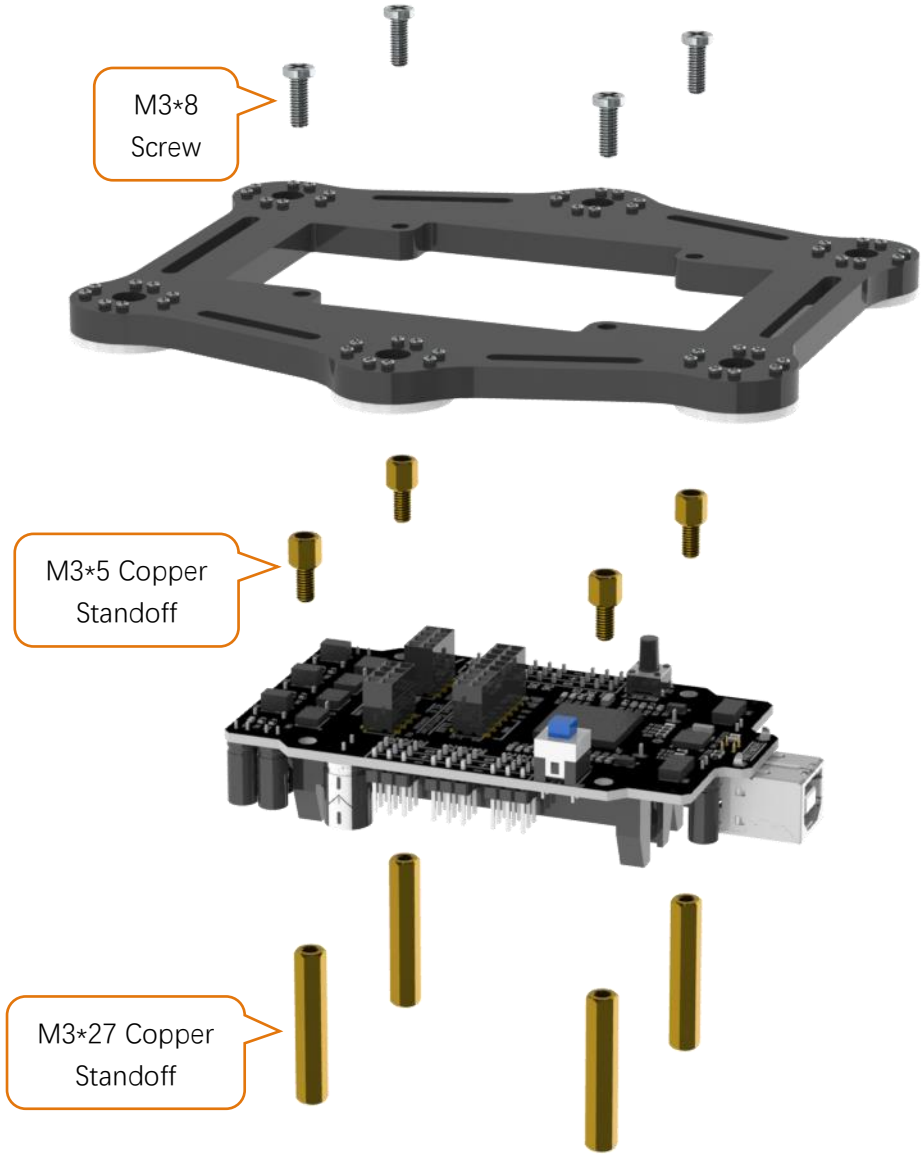
Use screws and nuts to fix two parts assembled before. 	Fix them as below. Three sets of them need to be assembled. 
Use screws and nuts to fix two parts assembled before. 	Fix them as below. Three sets of them need to be assembled. 

After the assembly is completed, the following 6 components are obtained.
Note that three of them are different from the other three.

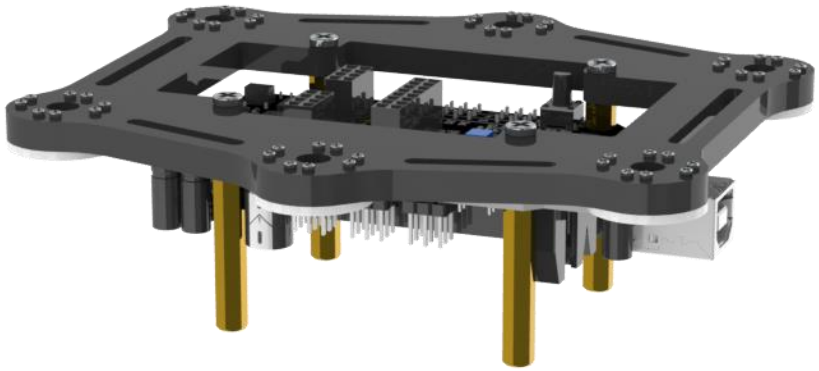


Step 10

Use screws and copper standoffs to fix control board to the following part assembled before.



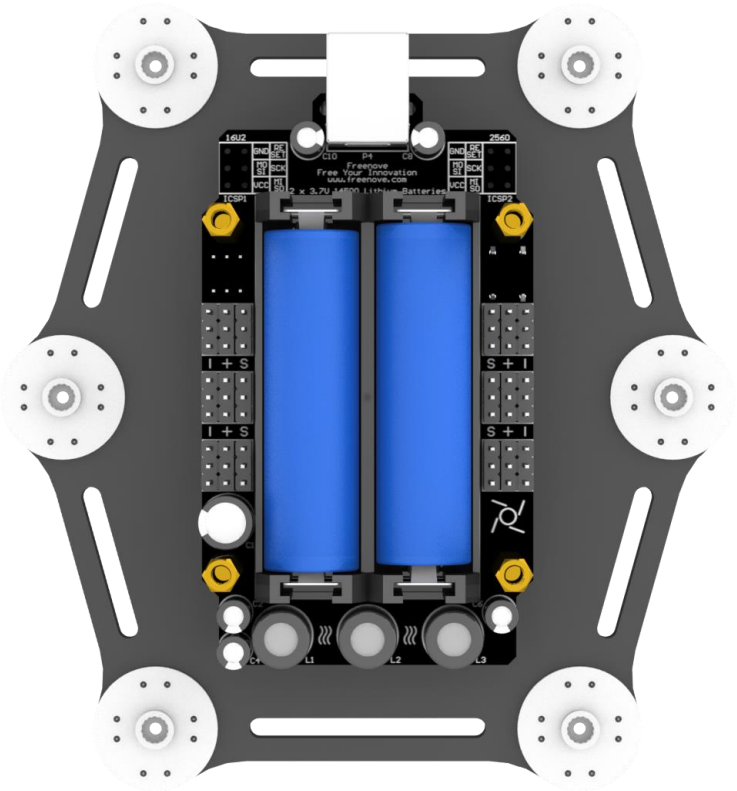
Fix them as below.



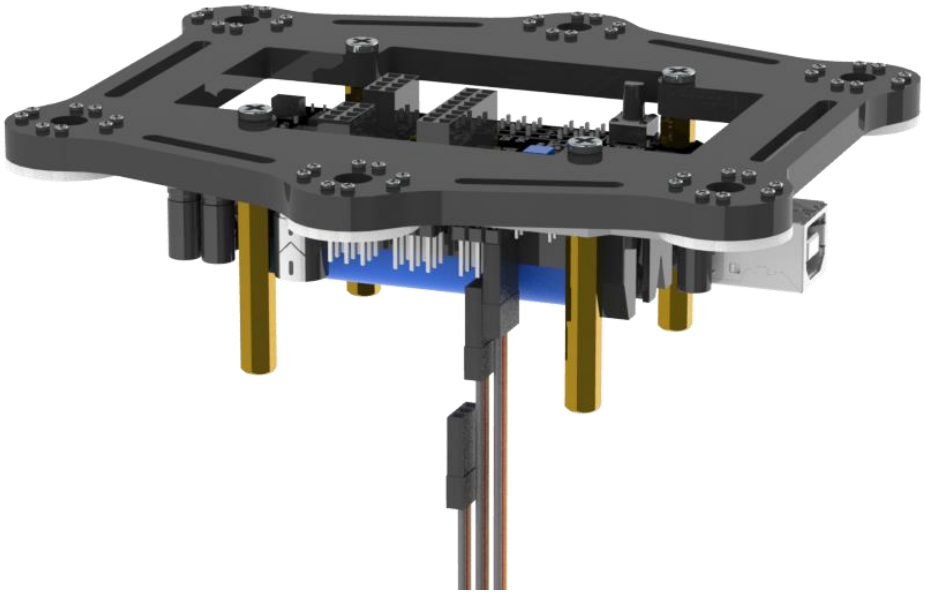
Install batteries for the control board.

! You have to install the right batteries that are fully charged. (Refer to "AboutBattery_for_V2.pdf")

Assembling the robot without right batteries will cause installation errors and damage the servos.



Make sure the power is turned off, and then connect all servos to control board.
(yellow wire of servo to S, red to +, black to -)
(servos can be connected randomly to port 22~39)
(The name of the port is marked on the front of the control board.)



! Keep all servos connected to the control board unless they are required to disconnect.

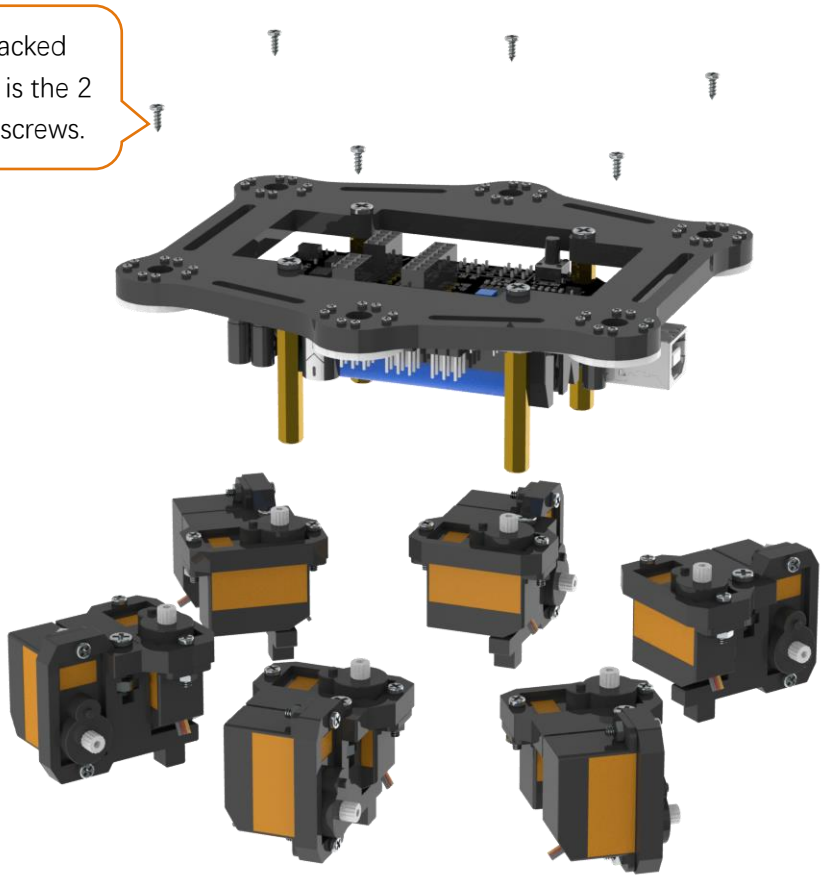
Step 11

Turn on the power. The servos will rotate and then stop.

! Keep power on unless it is required to turn off.
! The wires of servos are not shown in the future steps.

Use screws to fix the 6 parts assembled before.
Please note the installation angle of 6 parts. (Refer to the installation result at the end of this step.)
! When installing, you must keep the power on and all servos connected.

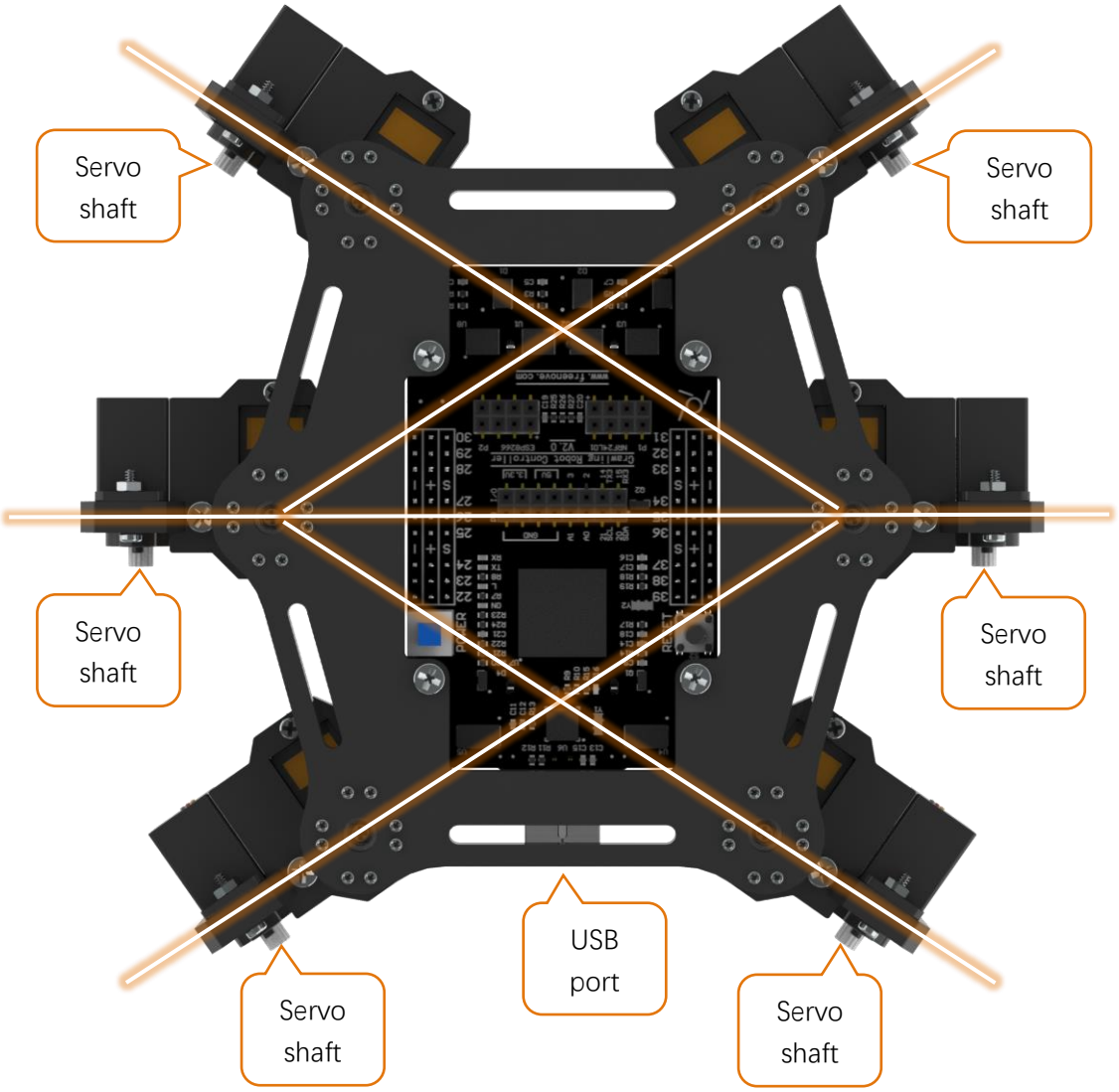
This screw is packed with servo and it is the 2 smaller of the 5 screws.



Fix them as below.



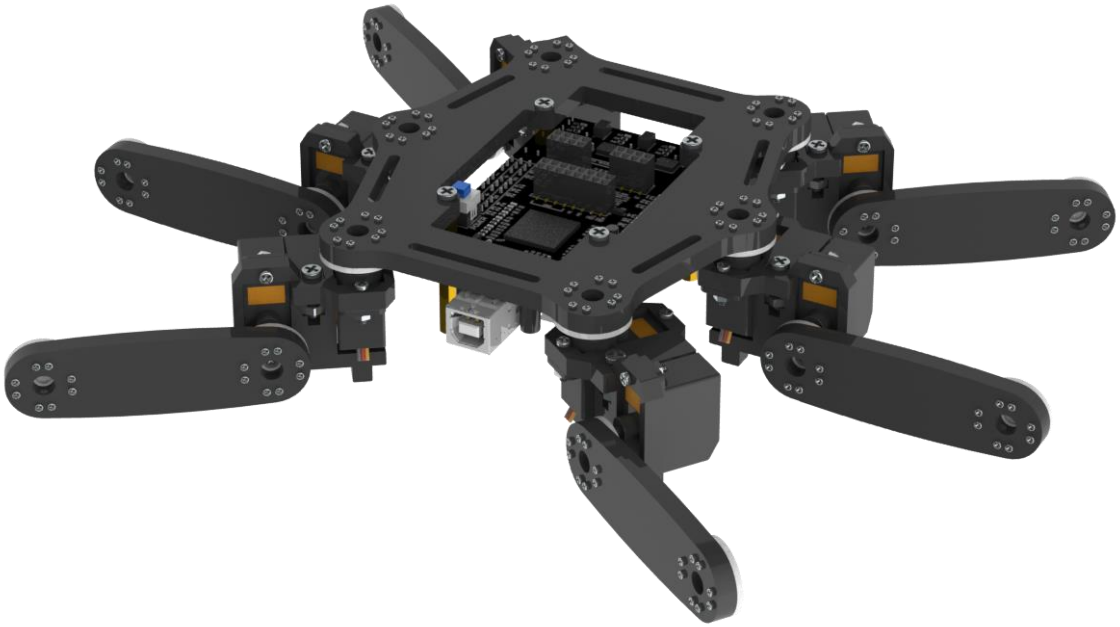
When the power is turned on, the angles of 6 parts should be as shown below.
Please try to get them close to the required angle. A small deviation is acceptable. We will correct the deviation in future calibration step.



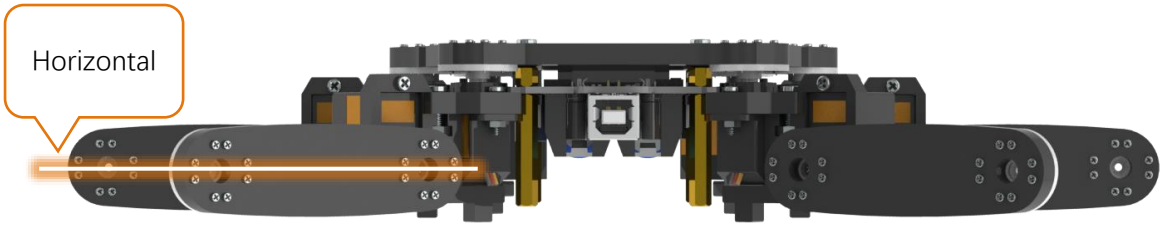
Step 12

Use the same sizes of screws to fix 6 parts assembled before.
Please note the installation angle of 6 parts. (Refer to the installation result at the end of this step.)
! When installing, except tightening the screws, you must keep the power ON and all servos connected.

When you tighten the screws, it may be obstructed by other parts. You can turn off the power temporarily and rotate the servo to facilitate tightening the screws. When you complete tightening the screws, you need turn on the power first, then continue following steps.



When the power is turned on, the angle of 6 parts should be as shown below.
Please try to get them close to the required angle. A small deviation is acceptable. We will correct the deviation in future calibration step.



Step 13

Use the same size of screws to fix 6 parts assembled before.

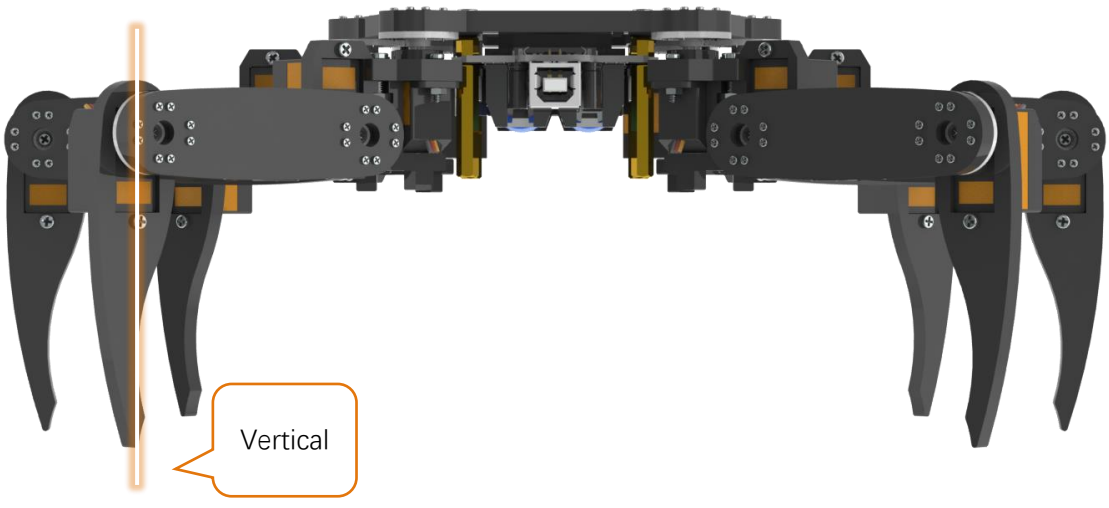
Please note the installation angle of 6 parts. (Refer to assembly result later).

! When installing, you must keep the power on and all servos connected.



When the power is turned on, the angle of 6 parts should be as shown below.

Please try to get them close to the required angle. A small deviation is acceptable. We will correct the deviation in later calibration step.



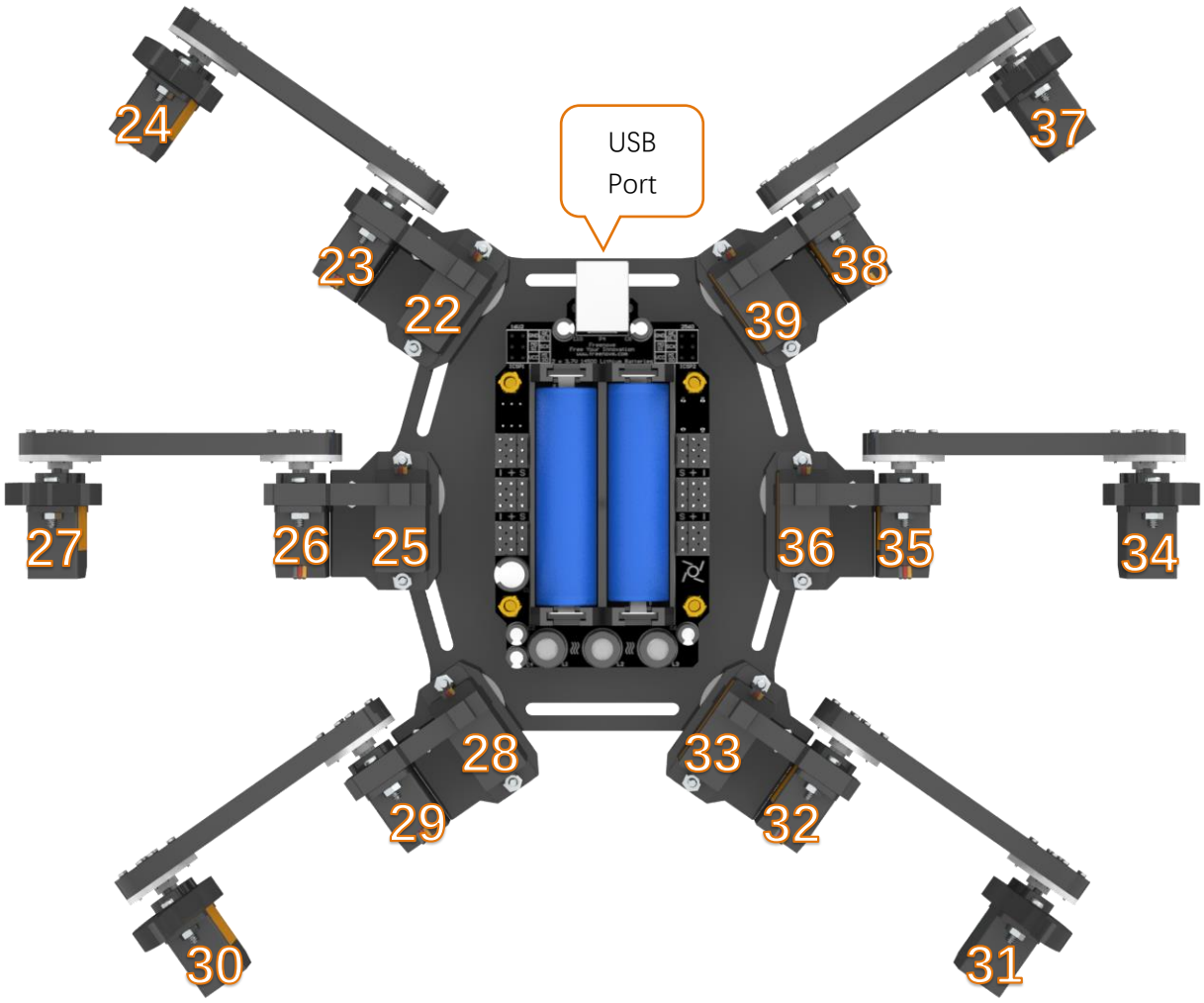
Step 14

! Turn off the power and pull off all the wires of servos.

Then reconnect the servos to control board, the ports they should be connected to are shown below.

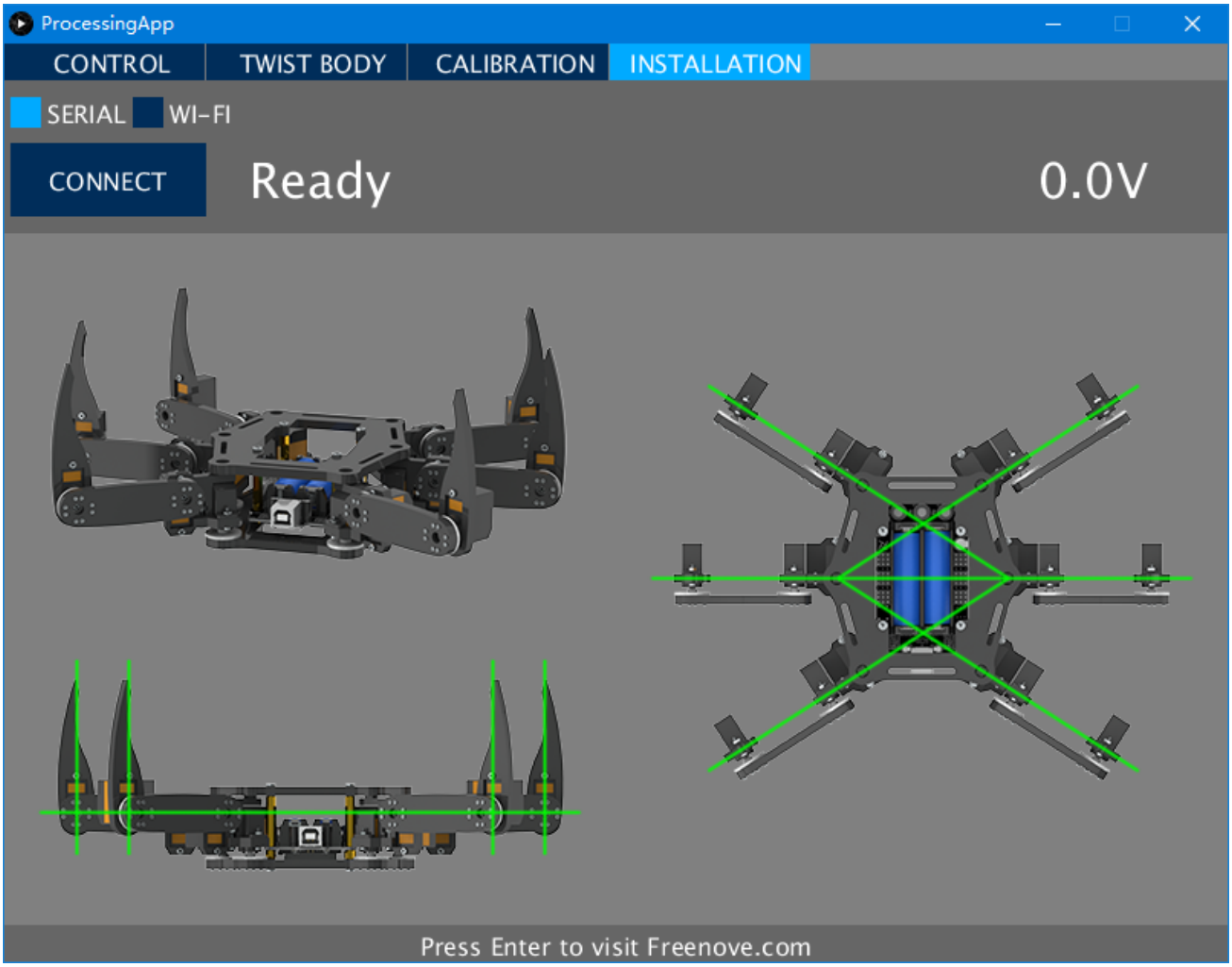
! The view of the picture below is from the bottom of the robot (you can see the battery).

! The name of the port is marked on the front of the control board.



Now, check if you have installed the servos correctly.

Hold up the robot and turn on the power. Check whether the posture of the robot is close to that on the installation page of the Processing App.

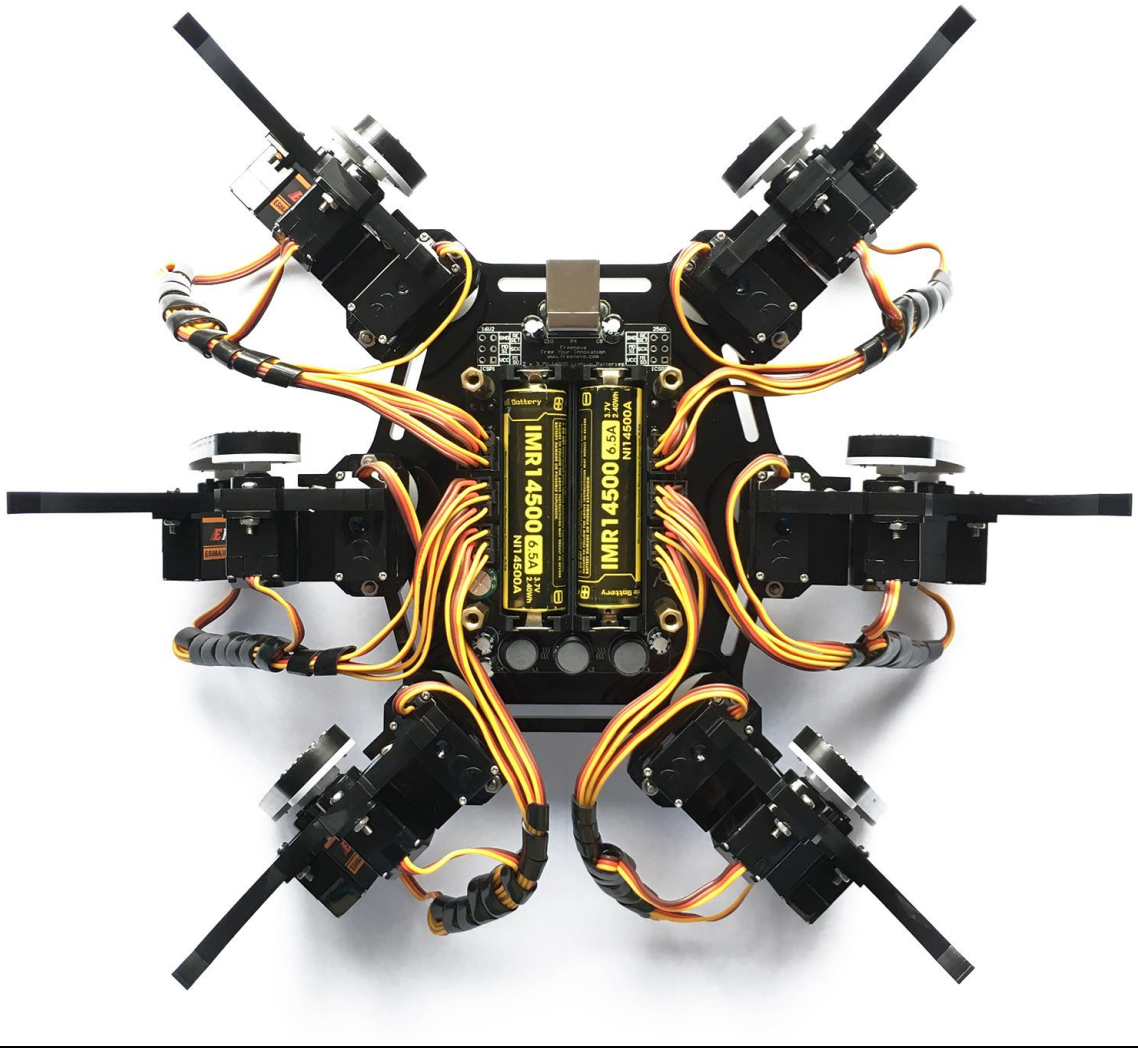


! If there is a lot of difference, it means that the servos have not been installed correctly.
Please return to the "Step 1" to reinstall.

If there is not much difference, turn off the power and continue.

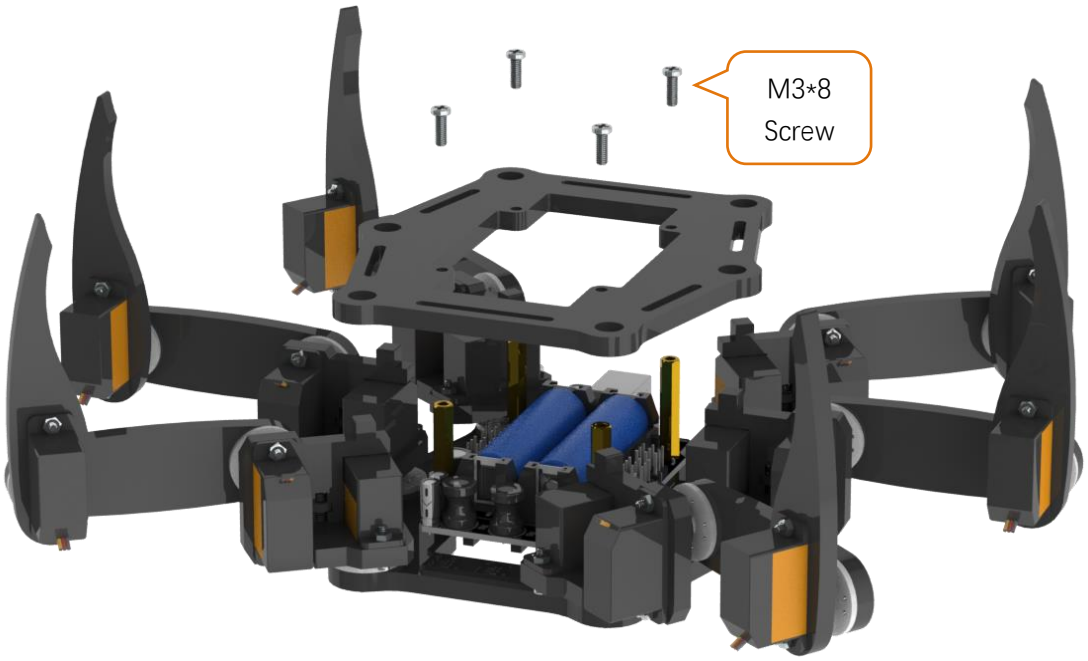
Use cable tidy to arrange the wires of servos.

Do not wrap the wires too tight, so that the servos can move freely.



Step 15

Use screws to fix the following acrylic plate.



Fix it as below.



Step 16

Fix ESP8266 module to control board.



Fix it as below.

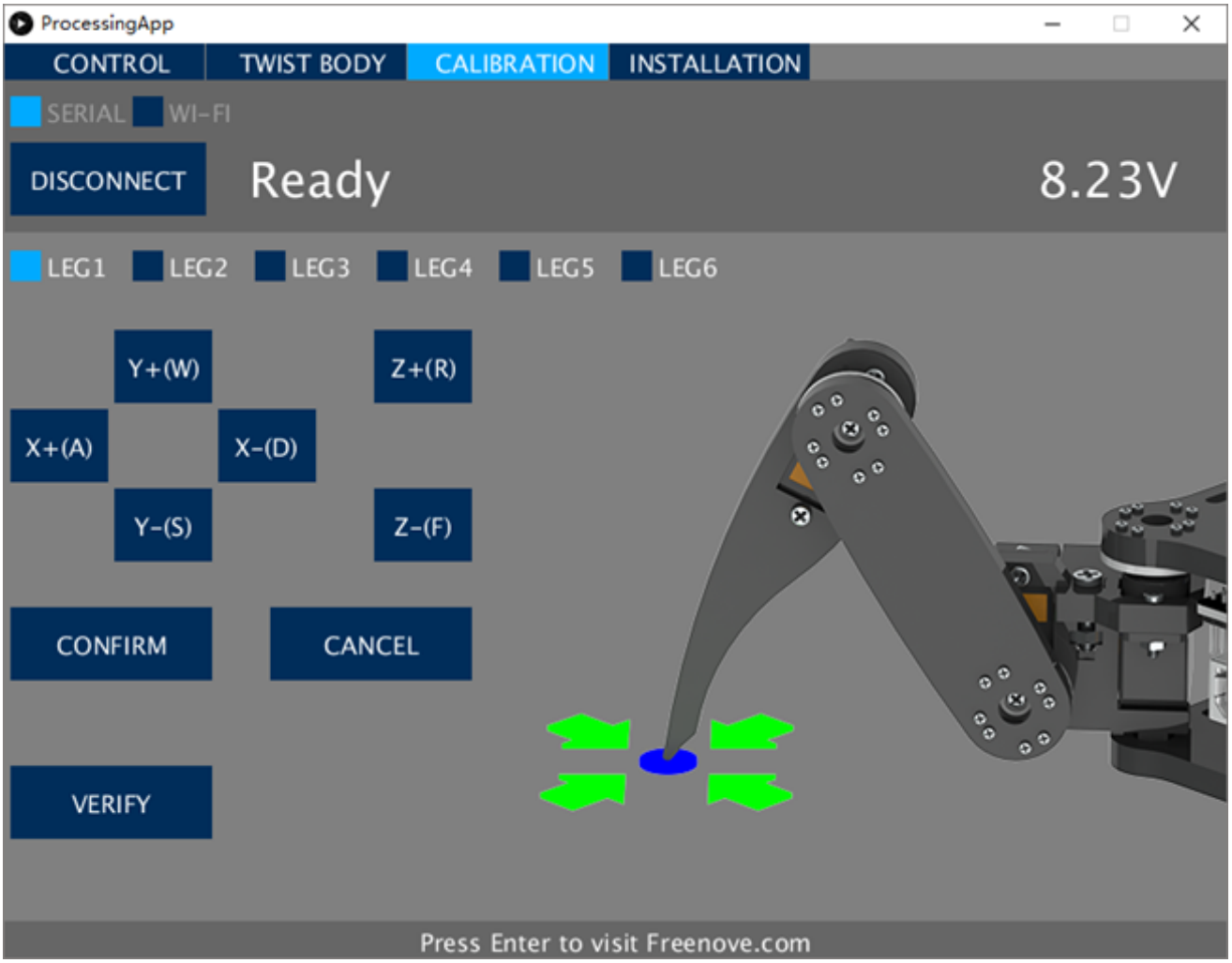


Step 17

At the end of the assembly, let us calibrate the servos.

Keep the power off.

Then connect the robot with Processing App. After the connection succeeds, click "CALIBRATION" on the top.

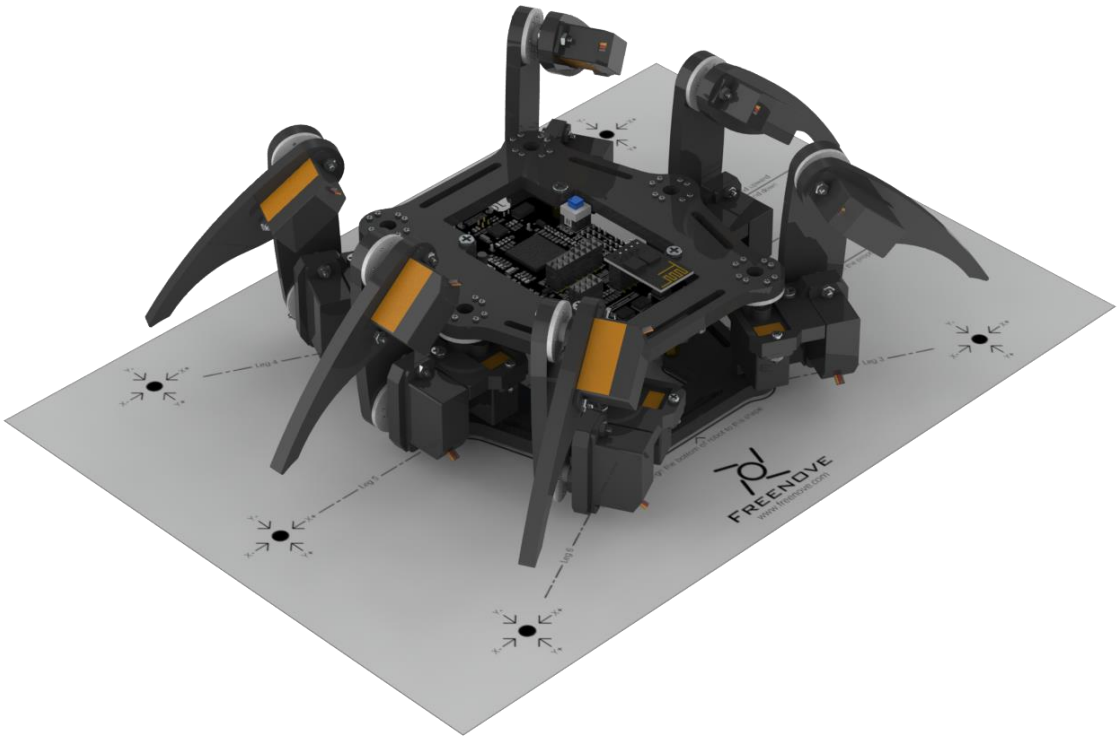


Turn on the power. The robot will move to the following posture, indicating it is already in calibration mode.

! If there is a lot of difference, it means that the servos have not been connected correctly.
Please return to the “Step 14” to reconnect.



Put the robot on the calibration graph. The bottom of the robot should coincide with the specific outline in the graph. USB interface should also coincide with the mark in the graph.



If the calibration graph is missing or damaged, you can print a copy. Print the "CalibrationGraph_for_V2.pdf" by 1:1 (100%) on A4 paper.

Then start calibrate. Select "LEG1", and then click "X+", "X-", "Y+", "Y-" and "Z+", "Z-", until the end of Leg1 is aligned with the black dots in the graph.

! Please note that each click will only move the leg by 1mm, so you may need to click many times.
You can use keyboard to move the leg. The key is marked in brackets on the button.

Then select the "LEG2", "LEG3", "LEG4", "LEG5"and “LEG6" to move other legs to corresponding dots as shown below.



Click "CONFIRM" and the calibration data will be stored in the robot.

Click "VERIFY", and then the robot will restore to the state before calibration. Then converted to the state after calibration, which indicates that the calibration is completed. If the end of legs is not aligned with the dots, click RESET and restart from moving the legs to try again.

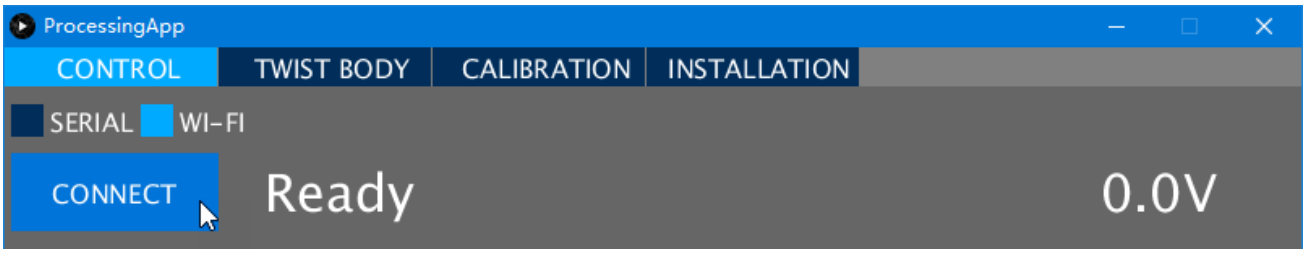
The calibration needs to be executed only once. Its data is stored in EEPROM. It will not be changed if you upload the default sketch again. If you disassemble the robot, replace the servo or control board, you need to calibrate the robot again. If you are not satisfied with the results of the latest calibration, you can also choose to calibrate again.

Default Functions

Now we can control the robot.

Use Computer

Now you can connect the robot through Wi-Fi. Turn on the switch, the robot will create a Wi-Fi hotspot named "Freenove Hexapod Robot" with password "Freenove" (case sensitive) in a few seconds. Connect the computer to this hotspot, select "WI-FI" in Processing App, and then click "CONNECT" button.

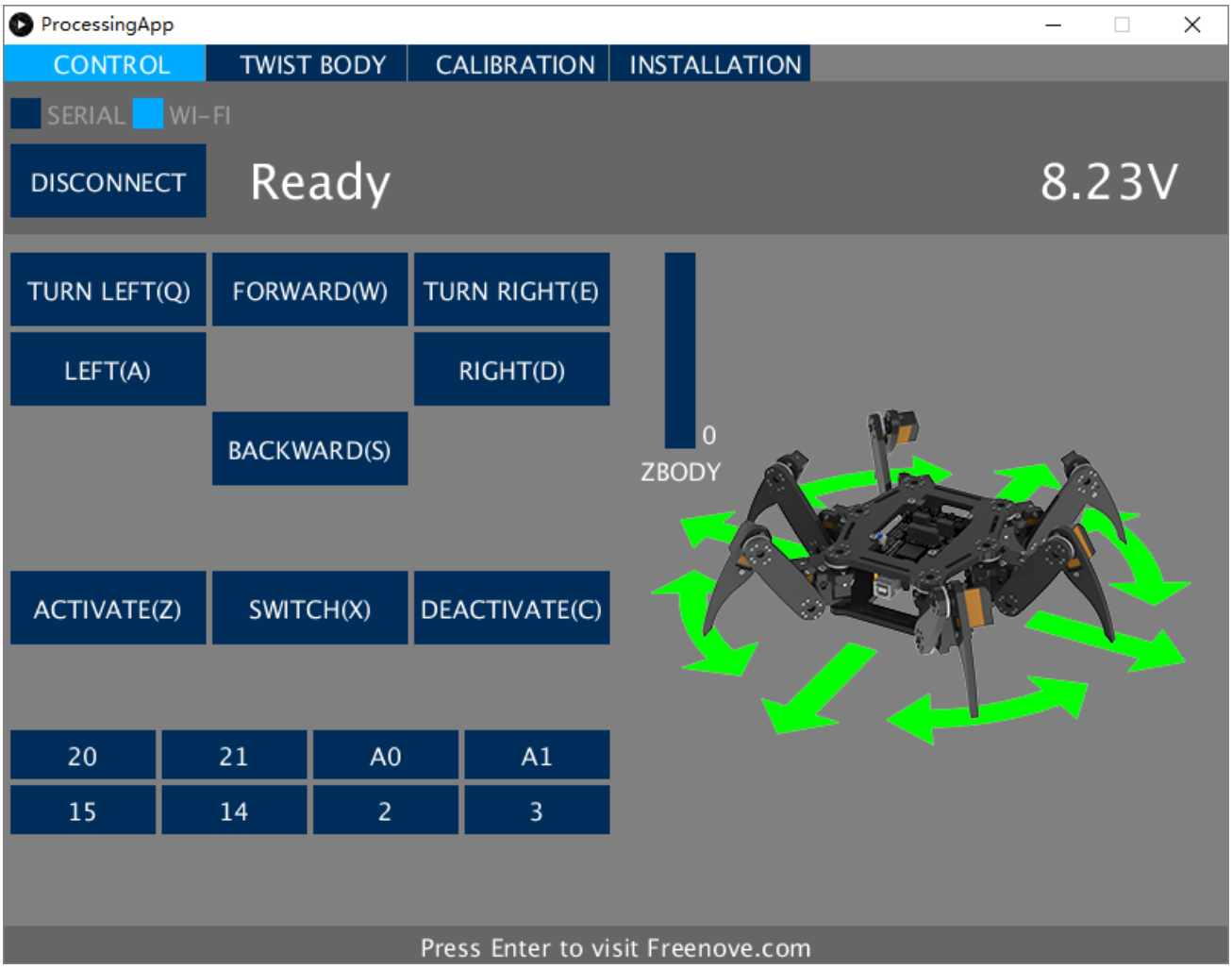


! If the Processing App cannot connect to the robot, please try the following:

1. Check if the ESP8266 module is installed correctly.
2. Fully charge the battery.
3. Go back to step 01 and upload the default sketch for the robot again.

Having problems? Contact us for help! Send mail to: support@freenove.com

In the "CONTROL" page, you can control the basic functions of the robot.

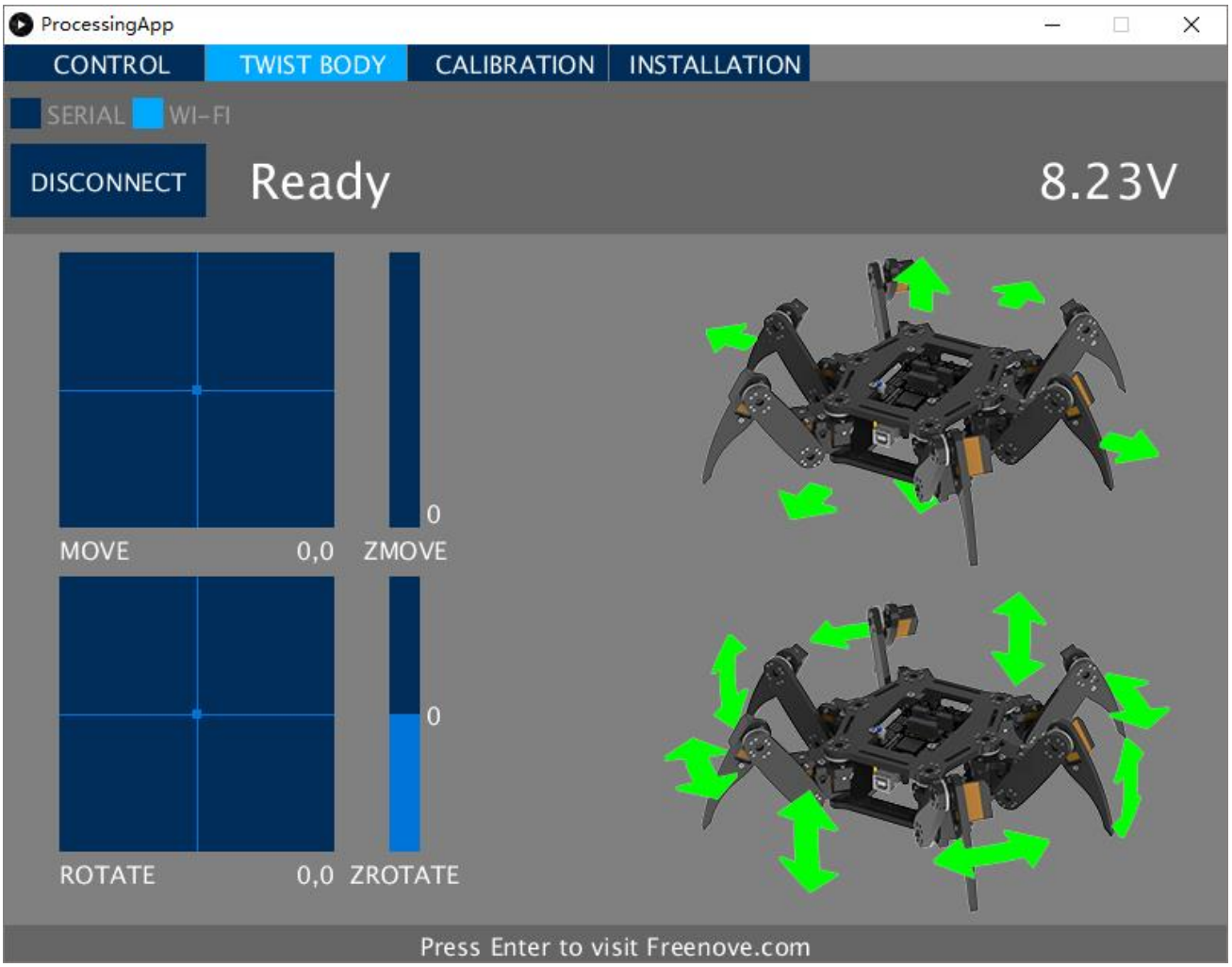


You can execute the following operation:

- Forward, backward, left, right, turn left, turn right and change body's height.
- Switch active mode and sleep mode. Sleep mode can help to save the power of batteries.
- Switch output state of IO ports. You can connect and control some output modules.

You can use keyboard to move the leg. The key is marked in brackets on the button.

In the "TWIST BODY" page, you can control the robot to move and rotate body in the place where it stays.



You can execute the following operation:

- Use mouse to click on the "MOVE" box and "ZMOVE" slider, the robot body will move to the corresponding location.
- Use mouse to click on the “ROTATE" box and "ZROTATE" slider, the robot body will rotate to the corresponding posture.

If there is no action command for about 10 seconds, the robot will switch into sleep mode automatically to save power. Any command can activate the robot again.

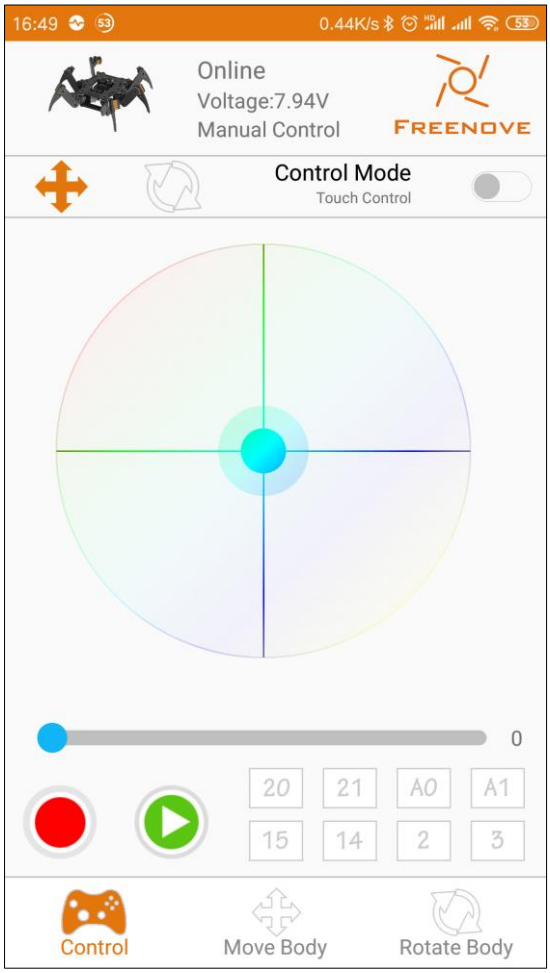
Use Android Devices or iPhone

You can use Android phone or tablet or iPhone to control this robot.

First, install Freenove App for your device:

- For Android, search and install “Freenove” on Google Play. You can also download the APK file directly: https://github.com/Freenove/Freenove_App_for_Android/raw/master/freenove.apk
- For iPhone, search and install “Freenove” on App store.

After the installation is completed, connect your device to the Wi-Fi hotspot of the robot.
The name of Wi-Fi hotspot is "Freenove Hexapod Robot" and the password is "Freenove" (case sensitive).
Open Freenove App and select “Freenove Hexapod Robot Kit”. The following interface will be displayed.



The App will connect the robot automatically. The online state will appear on the top. If the offline state appears, you can touch the robot logo on the top left corner to reconnect.

This APP is similar to the Processing App. You can explore it by yourself. There is also a manual about it:
https://github.com/Freenove/Freenove_App_for_Android/raw/master/Tutorial.pdf

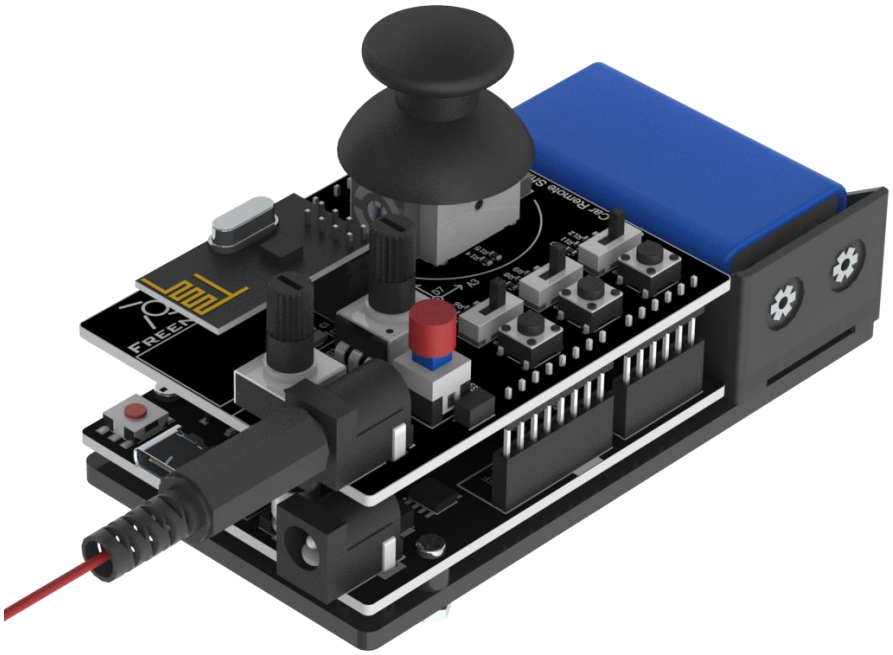
Having problems? Contact us for help! Send mail to: support@freenove.com

Use Remote

You can also use the remote to control this robot if you have purchased it.

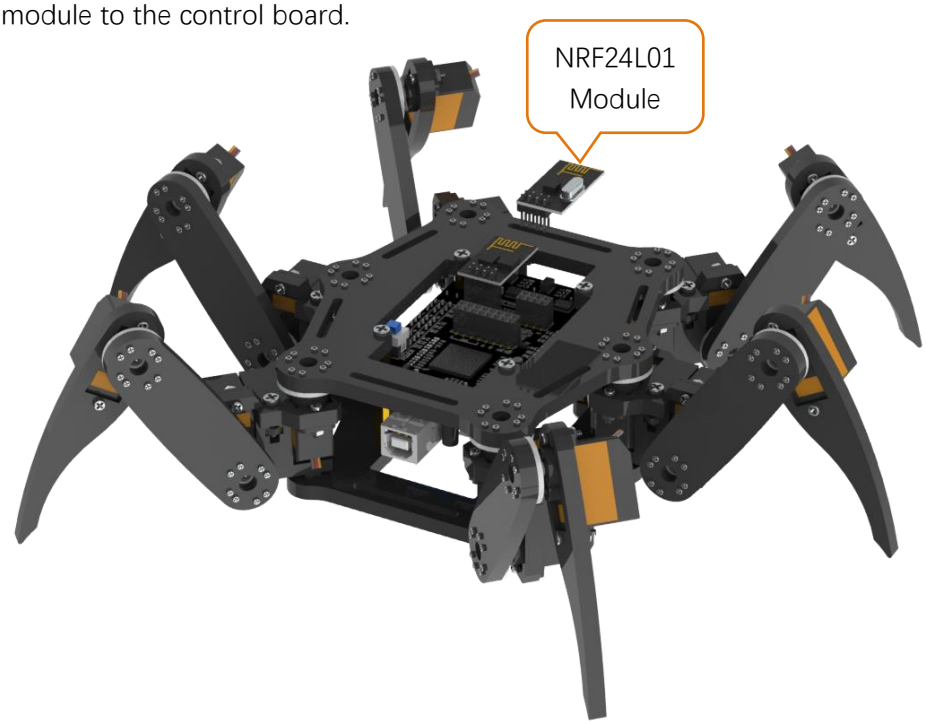
Please refer to tutorial (https://freenove.com/fnk0028) to assemble the remote first.

The assembled remote is shown below (the wires are not fully shown in the figure).
(The color of the board may be black or blue.)



There are two NRF24L01 modules packed with the remote. One has been installed on the remote. Turn off the power of the robot and then install the other one to it.

Fix NRF24L01 module to the control board.

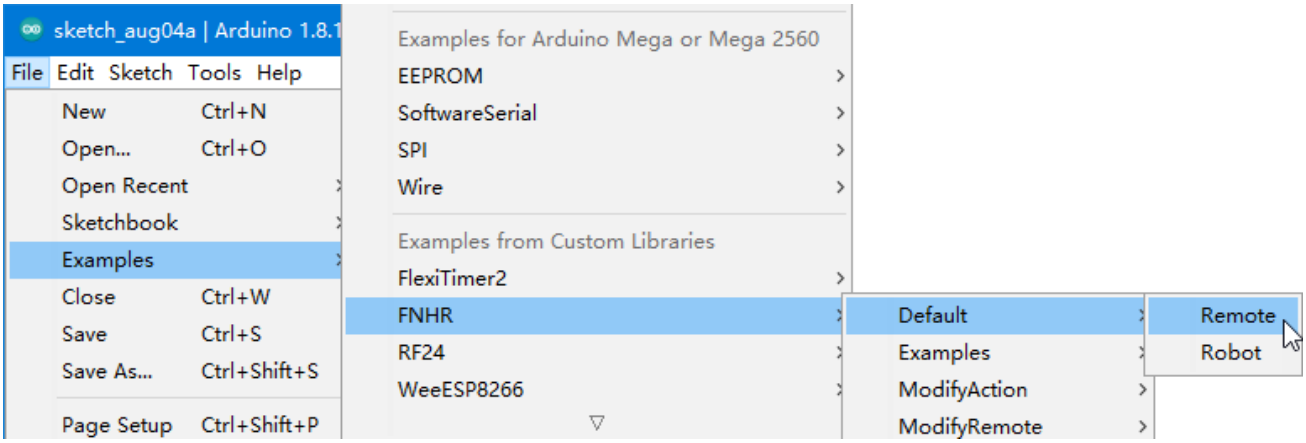


Fix it as below.

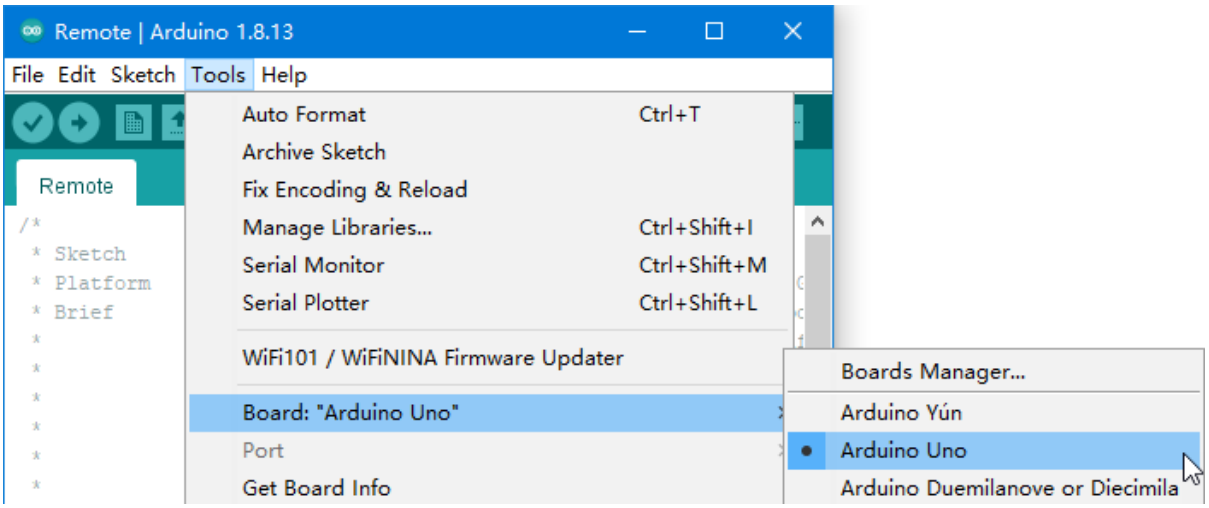


Now, upload sketch for remote.

Open "File" > "Examples" > "FNHR" > "Default" > "Remote".

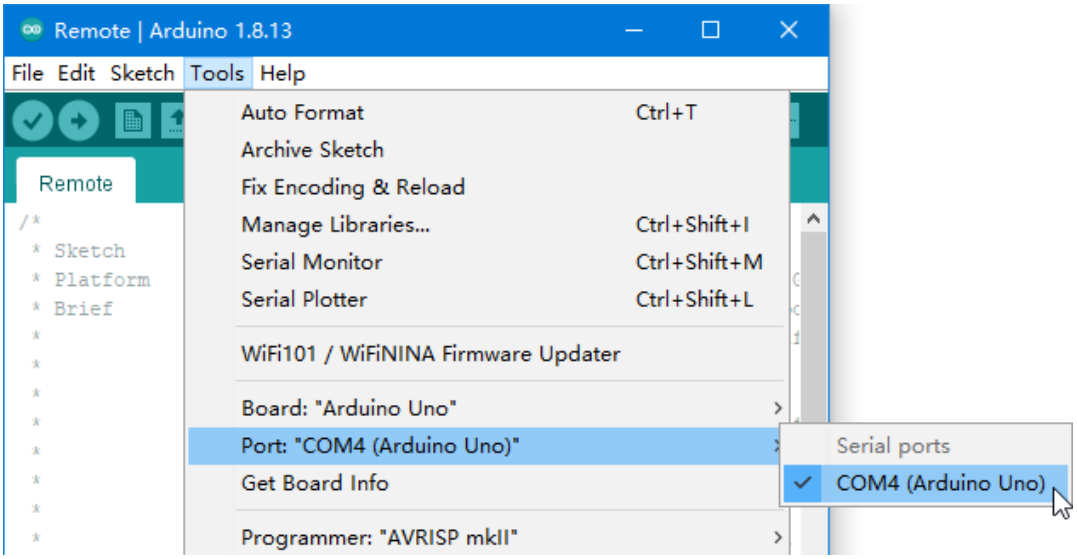


Select "Board" > "Arduino Uno". (The remote is compatible with this board.)



Connect the remote to your computer with a USB cable. Then select "Port".

! Your port may be different from that in the following figure.



Then upload it to the remote.

Install a 9V battery for the remote or connect it to any available USB port. Turn on the power switch of remote and robot. If a wireless connection is established between the remote and the robot, the LED3 on remote will light up or flash. Then you can use the remote to control the robot.

The remote has 3 toggle switches and 3 buttons. Each toggle switch is connected to the button closer to it. Turn on or turn off these switches or buttons to control the robot under different mode:

- Only turn on S1:
  You can use the joystick to control the robot to move. The robot will always face in one direction.
  Press the joystick to swich between active mode and sleep mode.

- Turn on S1 and S2:
  You can use the joystick to control the robot to move and turn.
  Press the joystick to swich between active mode and sleep mode.

- Only turn on S2:
  You can use the joystick to control the robot to move body in place.

- Only turn on S3:
  You can use the joystick and POT1 to control the robot to rotate body in place.

- Turn on S2 and S3:
  Move body when only S2 is turned on, and then turn on S3 to rotate body based on the moving body position.

In any case, you can rotate POT2 to adjust the height of robot body.

! If the remote cannot control the robot, please try the following:

1. Check if the NRF24L01 modules are installed correctly.
2. Fully charge the 14500 battery.
3. Upload the default sketch for the remote again. Only turn on S1.
4. Go back to “Step 01” and upload the default sketch for the robot again.

Having problems? Contact us for help! Send mail to: support@freenove.com

Programming

It is easy to reprogram this robot.

Modify Default Sketch

If you just want to modify the parameters of the default functions, it is very simple.

! In this case, all previous functions will not be affected except the parameters you want to modify.

Just add the corresponding functions under the following line in the default sketch.

```
1   robot.Start(true);
```

! Only the functions mentioned in this section can be added.
! Other codes of default sketch cannot be modified or deleted.

You can modify the Wi-Fi hotspot name and password by calling the following function.

```
1   void FNHR::SetWiFi(String name, String password)
```

Please open "File" > "Examples" > "FNHR" > "ModifyWiFi" > "Robot" to see how to use.

When there are many Wi-Fi signals nearby, you may not be able to connect to the robot or the signal will be poor. Then you can try to modify the channel by calling the following function.

```
1   void FNHR::SetWiFiChannel(byte channel)
```

Please open "File" > "Examples" > "FNHR" > "ModifyWiFiChannel" > "Robot" to see how to use.

You can modify the wireless communication address between robot and remote.
To modify the robot, call the following function.

```
1   void FNHR::SetRemote(byte byte0, byte byte1, byte byte2, byte byte3, byte byte4)
```

To modify the remote, call the following function.

```
1   void FNHRRemote::Set(byte byte0, byte byte1, byte byte2, byte byte3, byte byte4)
```

You must set them to the same address to control robot with the remote.
Please open "File" > "Examples" > "FNHR" > "ModifyRemote" to see how to use.

You can also modify the wireless communication channel between robot and remote.
To modify the robot, call the following function.

```
1   void FNHR::SetRemoteChannel(byte byte0, byte byte1, byte byte2, byte byte3, byte byte4)
```

To modify the remote, call the following function.

```
1   void FNHRRemote::SetChannel(byte byte0, byte byte1, byte byte2, byte byte3, byte byte4)
```

You must set them to the same channel to control robot with the remote.
Please open "File" > "Examples" > "FNHR" > "ModifyRemoteChannel" to see how to use.

You can modify the action speed by calling the following function.

```
1  void FNHR::SetActionSpeed(float speed)
```

Please open "File" > "Examples" > "FNHR" > "ModifySpeed" > "Robot" to see how to use.

You can modify the action group by calling the following function.

```
1  void FNHR::SetActionGroup(int group)
```

There are three different action groups, which determine the way robot moves and turns.

Please open "File" > "Examples" > "FNHR" > "ModifyAction" > "Robot" to see how to use.

Custom Programming

You can also write a new sketch to control the robot by including FNHR library.

! In this case, the robot is controlled only by your code.

Processing App, Android App and remote will no longer work.

! You can add any code you need, not just the functions mentioned in this section.

! You can add sensors and other modules, and the P3 I/O port on the control board is also available.

Create a new blank Arduino sketch, including FNHR library at the beginning.

```
1  #include <FNHR.h>
```

Then define a robot object.

```
2  FNHR robot;
```

In function setup(), start the robot as follows.

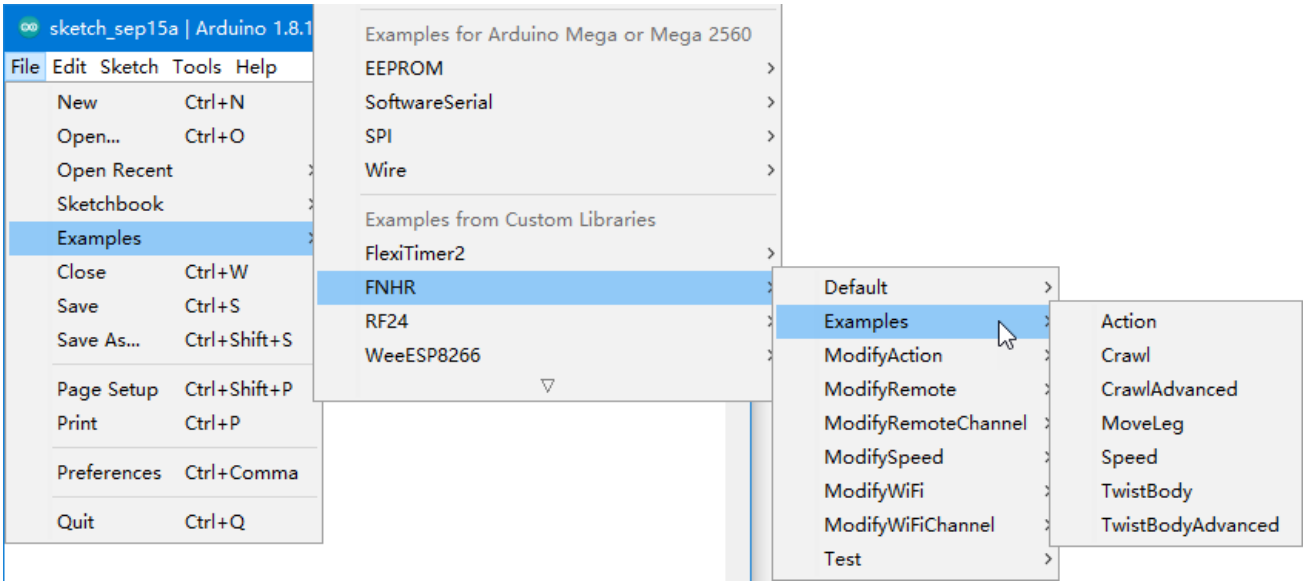
```
3  void setup() {
4    robot.Start();
5  }
```

Now, you can directly use the following code in function loop() to control the robot.

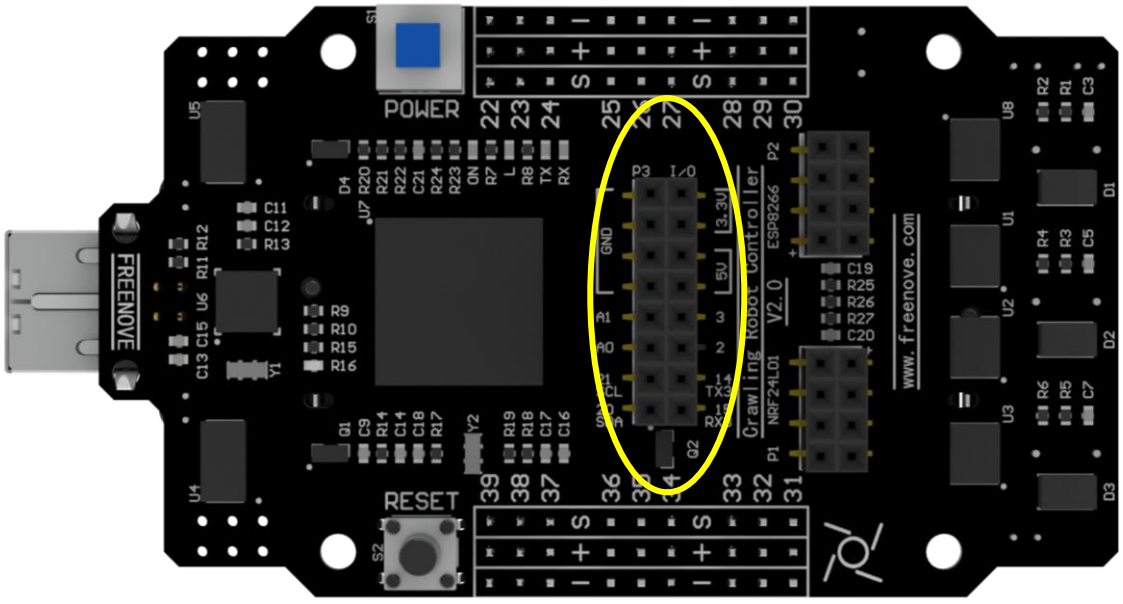
```
6    robot.ActiveMode();
7    robot.SleepMode();
8    robot.SwitchMode();
9    robot.CrawlForward();
10   robot.CrawlBackward();
11   robot.CrawlLeft();
12   robot.CrawlRight();
13   robot.TurnLeft();
14   robot.TurnRight();
15   robot.Crawl(float x, float y, float angle);
16   robot.ChangeBodyHeight(float height);
17   robot.MoveBody(float x, float y, float z);
18   robot.RotateBody(float x, float y, float z);
19   robot.TwistBody(float xMove, float yMove, float zMove, float xRotate, float yRotate, float zRotate);
```

```
20  robot.LegMoveToRelatively(int leg, float x, float y, float z);
21  robot.SetActionSpeed(float speed);
22  robot.SetActionGroup(int group);
```

There are some examples in"File" > "Examples" > "FNHR" > "Examples ". You can open and upload them to learn how to use FNHR library to control the robot.



The control board also provide some entension ports to use. They are not used by this robot in default.



If you want to add other parts for this robot. Please refer to "File" > "Examples" > "FNHR" > "Examples" for to build your own programming.

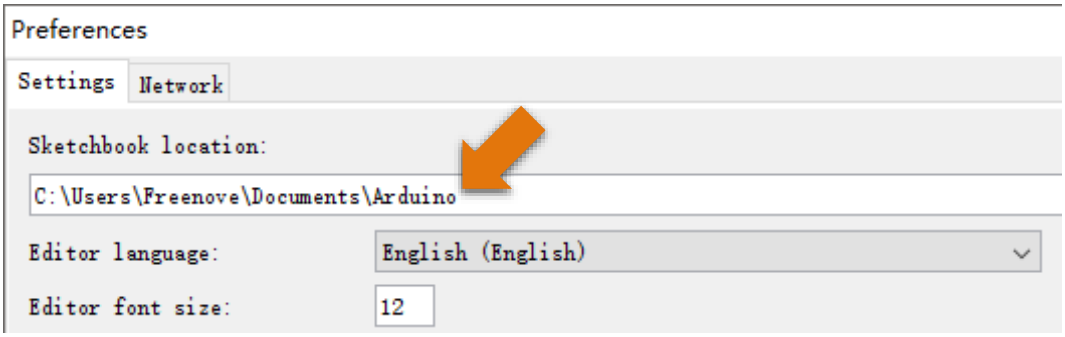
In the default robot code, these ports cannot be programmed.

Complete Reprogramming

It is NOT recommended that you use your own code to control every servo, which is more difficult and it may easily damage the servos.

If you want to learn the details of the code, you can view the FNHR library source code.

All the library files already added to Arduino software are in the "libraries" folder under "Sketchbook location" in the “File” > ”Preferences” window.



And if you want to learn the details about the control board, please find the schematic in the folder.

If you have any questions, please contact our support for help.

Hardware

Please find the circuit diagrams of the boards in the “Hardware” folder.

If FNHR library is used, the reference voltage of analog input may be switched to an external.

- On V2 board: the reference voltage is 2.094V.
- On other versions of boards: the reference voltage is 5V by default.

If using a port as an analog input, the voltage that can be measured ranges from 0V to reference voltage.
If the voltage to be measured is higher than the reference voltage, use two resistors to divide the voltage.

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 this 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.

After completing this robot, you can try to modify this robot, including purchasing and installing other electronic modules, or improving the code to achieve different functions you want. You can also try other Freenove projects.

If you want to learn more about Arduino, Raspberry Pi, micro:bit, robots, smart cars and other interesting products, please visit our website:

http://www.freenove.com

Thank you again for choosing Freenove products.