Important Information

Thank you for choosing Freenove products!

Getting Started

If you have not yet downloaded the zip file, associated with this kit, please do so now and unzip it.
https://github.com/Freenove/Freenove_Robot_Ant_Kit

Get Support and Offer Input

Freenove provides free and responsive product and technical su pport, 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

sale@freenove.com

Copyright

FREENOVE™

Contents

Chapter 0 Software Installation and Assembly

If you haven't downloaded the sources for the robot ant, you can download them via the link below:
https://github.com/Freenove/Freenove_Robot_Ant_Kit

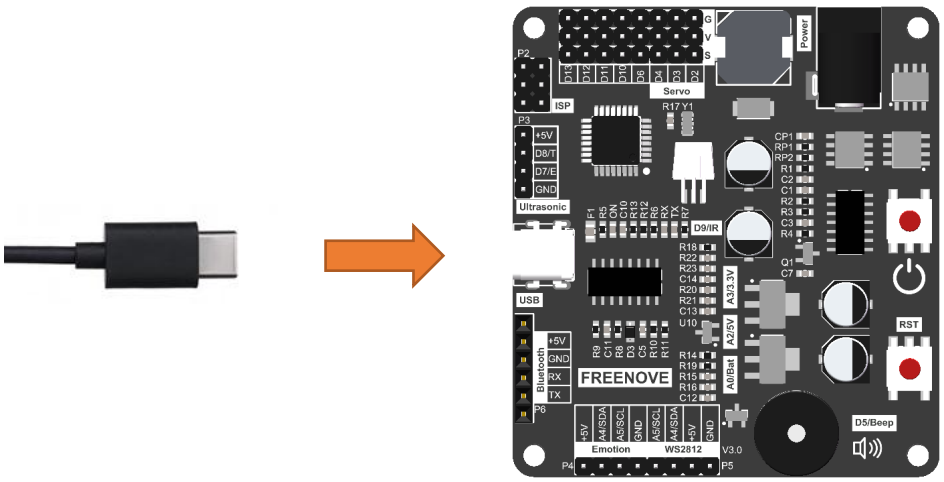
01 Installation of CH340

We upload code to the control board through CH340. Therefore, we need to install the driver for CH340 first.

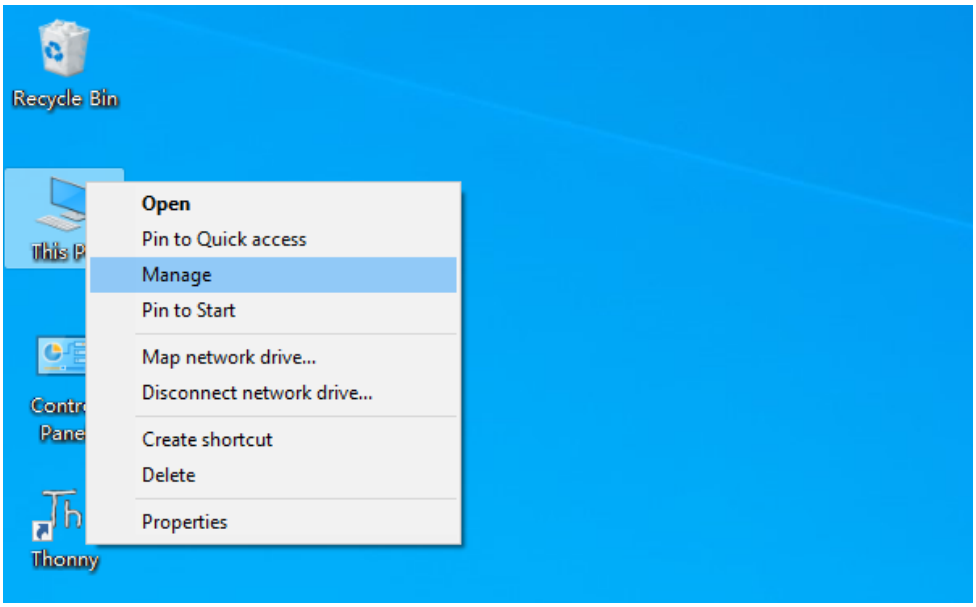
Windows

Check whether CH340 has been installed to your computer.

1. Connect the control board with a Type-C cable.



2. Back to the computer homepage, right-click on "This PC" and select "Manage".

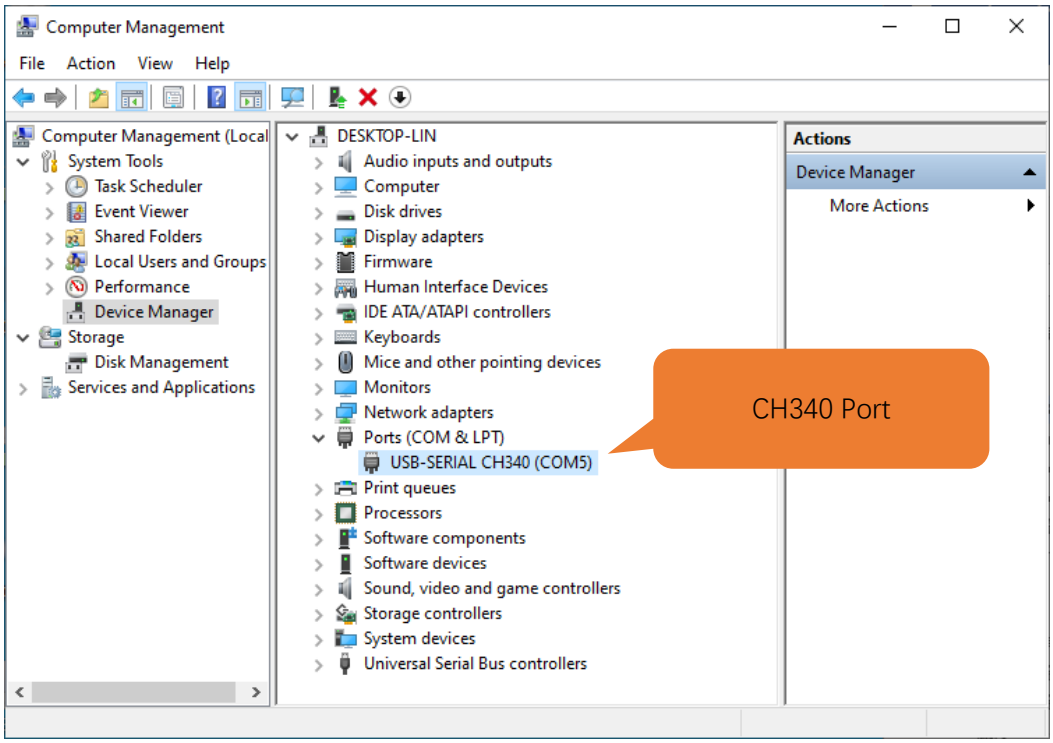


3. Click “Device Manage” on the pop-up window. If CH340 has been installed to your computer, you can see “USB-SERIAL CH340 (COMx)”.

Note: Only when the control board has connected with computer will “USB-SERIAL CH340 (COMx)” show up.

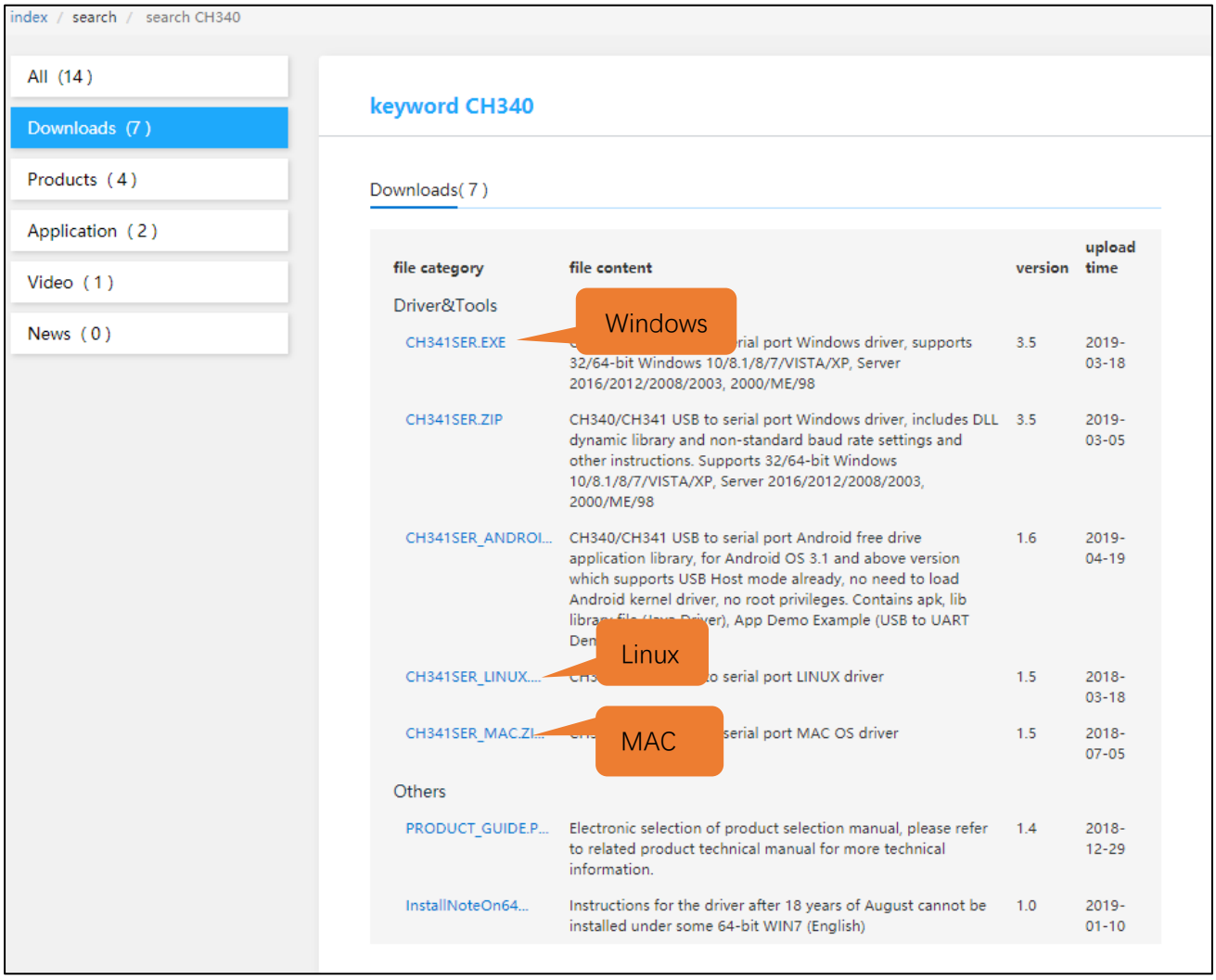
If you have installed CH340, you can skip to next step.

If you haven’t, please install it as follows.

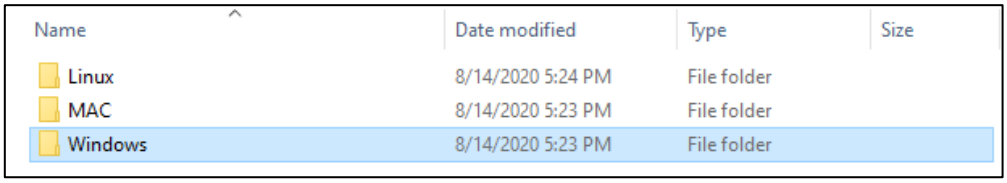


Install CH340 Driver

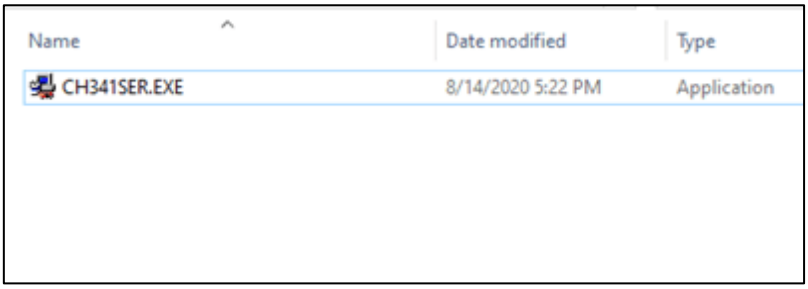
1. Click http://www.wch-ic.com/search?q=CH340&t=downloads to go to the downloading website of CH340. Choose a proper CH340 driver based on your operating system.



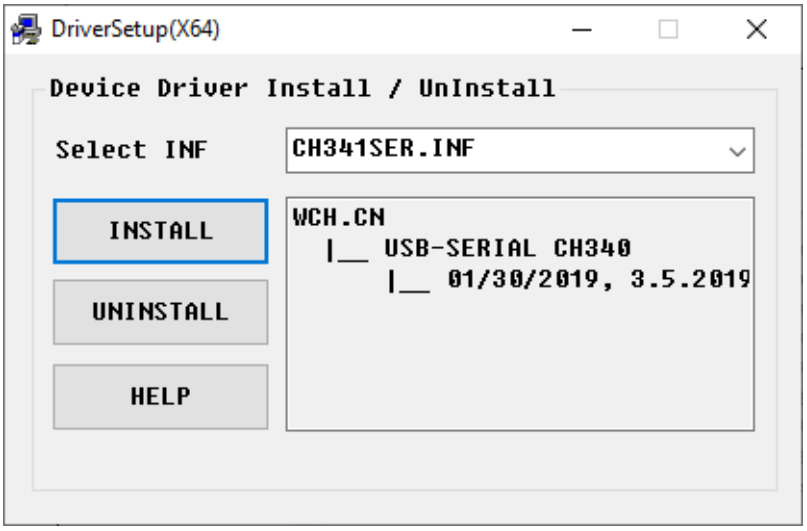
If you don't feel like downloading CH340 driver from the official website, you can also open the folder "Freenove_Robot_Ant_Kit/CH340". We've prepared it for you in advance.



2. Open the folder "Freenove_Robot_Ant_Kit**/CH340/Windows/**".

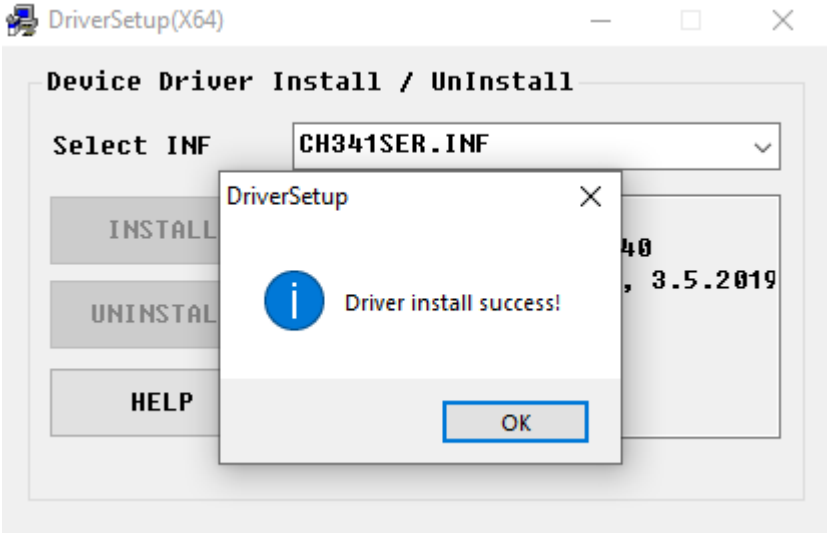


3. Double click to open "**CH341SER.EXE**".

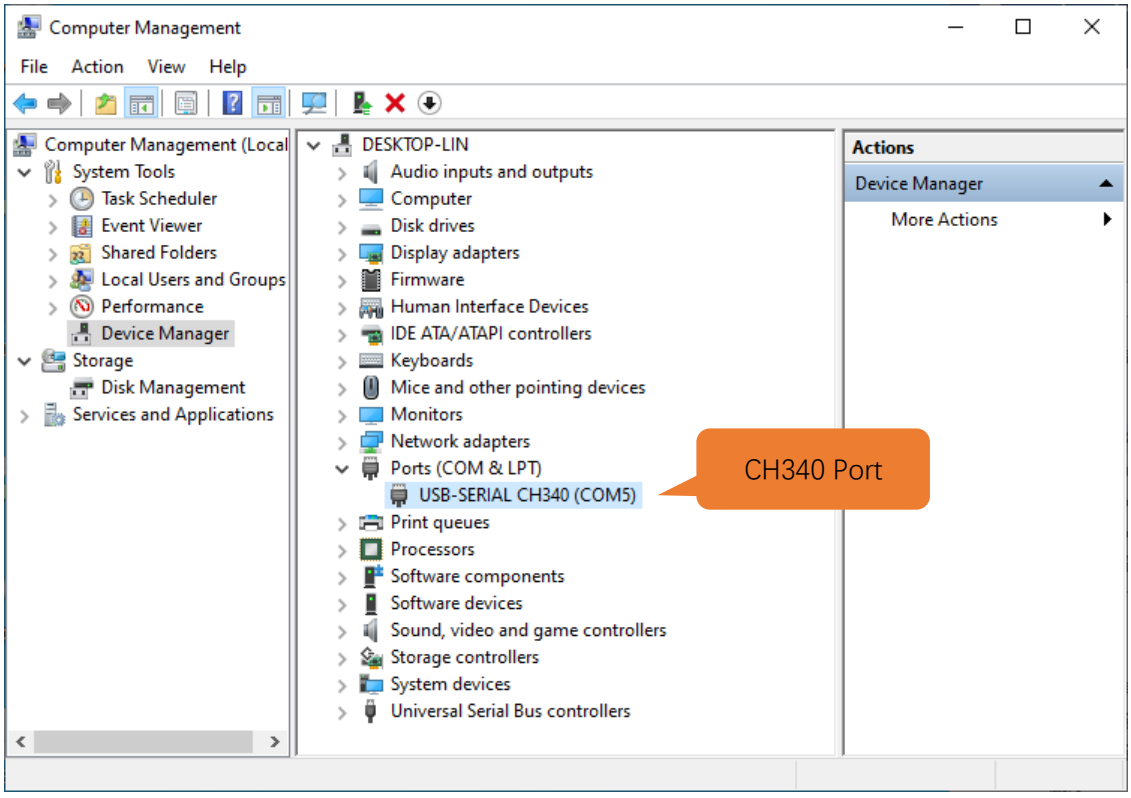


4. Click "INSTALL" and wait for the installation to finish.

5. When the following interface appears, it means the installation is successful. You can close it.



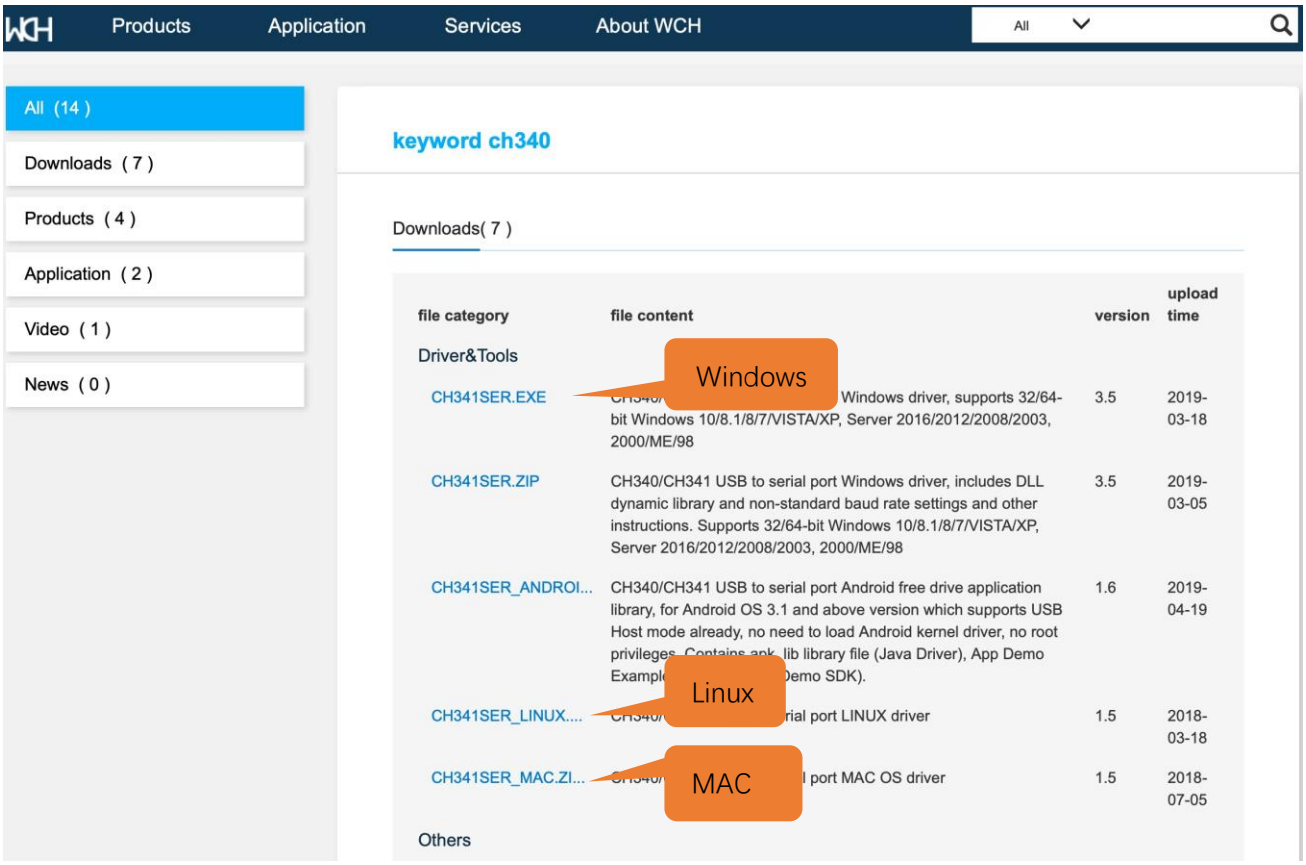
6. Connect the control board and computer with a type-C cable, when clicking "Device Manager" again, you will see "USB-SERIAL CH340 (COMx)" under "Ports (COM & LPT)". Click here to skip to next step.



7. So far, CH340 has been installed. You can close all windows.

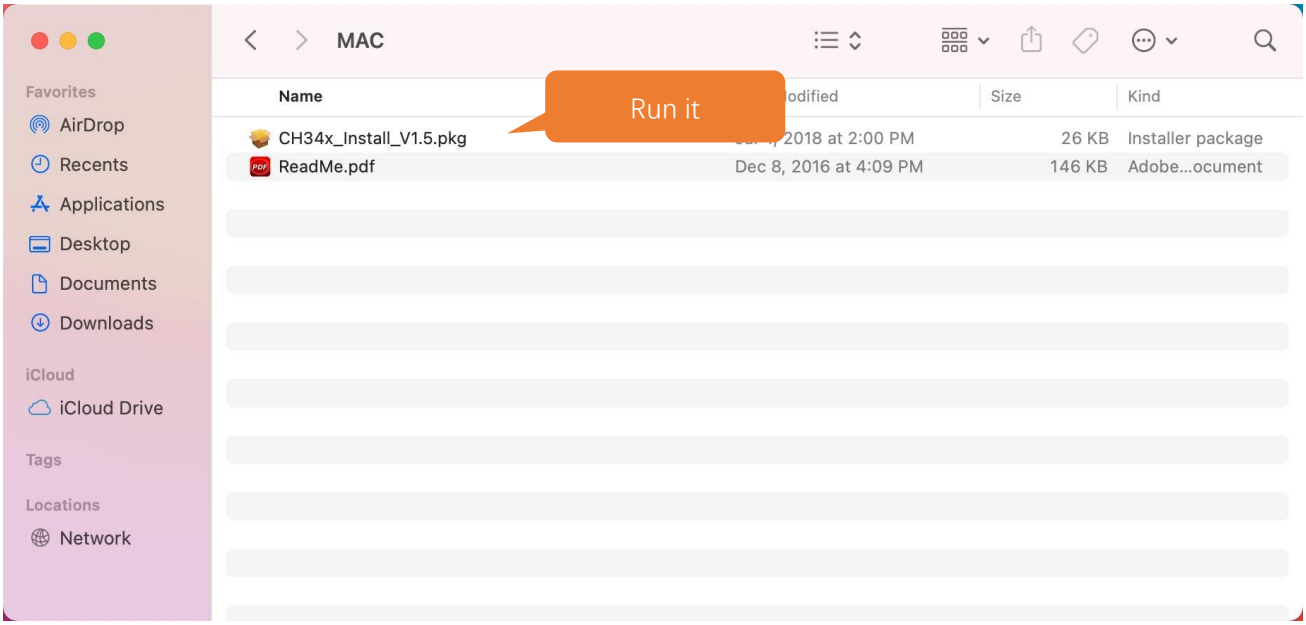
Mac

1. Click http://www.wch-ic.com/search?q=CH340&t=downloads to go to the downloading website of CH340. Choose a proper CH340 driver based on your operating system.

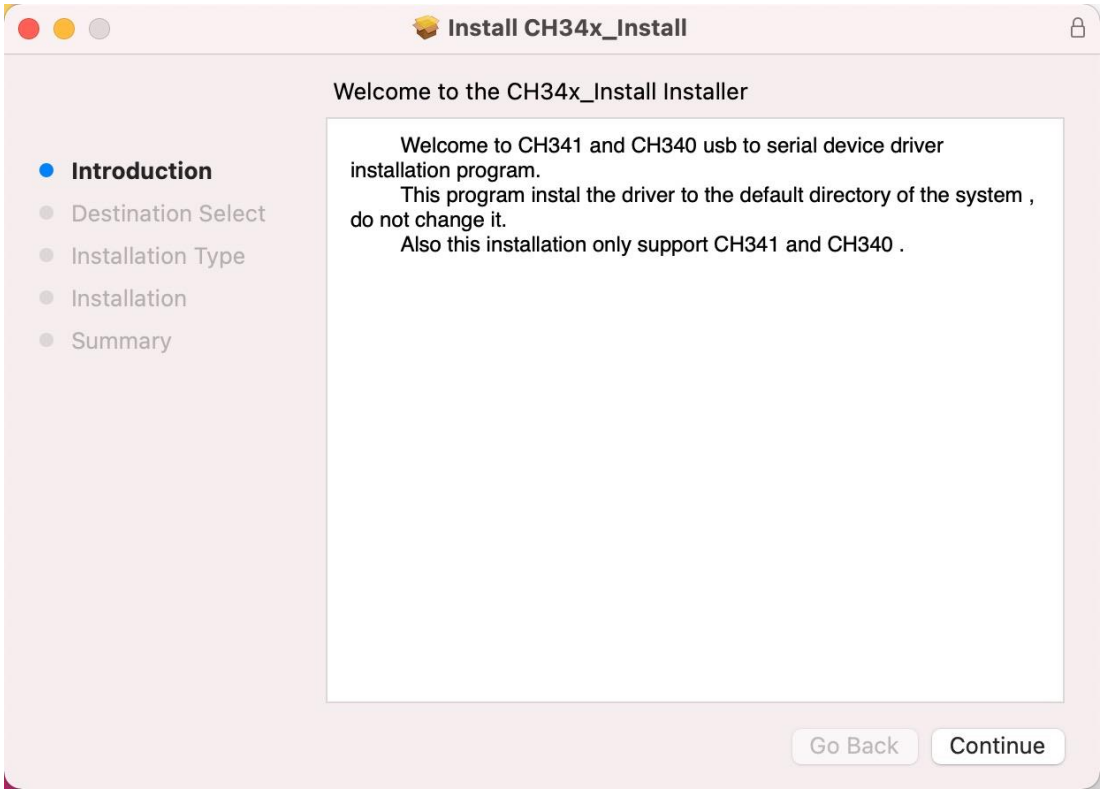


If you don't feel like downloading CH340 driver from the official website, you can also open the folder "Freenove_Robot_Ant_Kit/CH340". We've prepared it for you in advance.

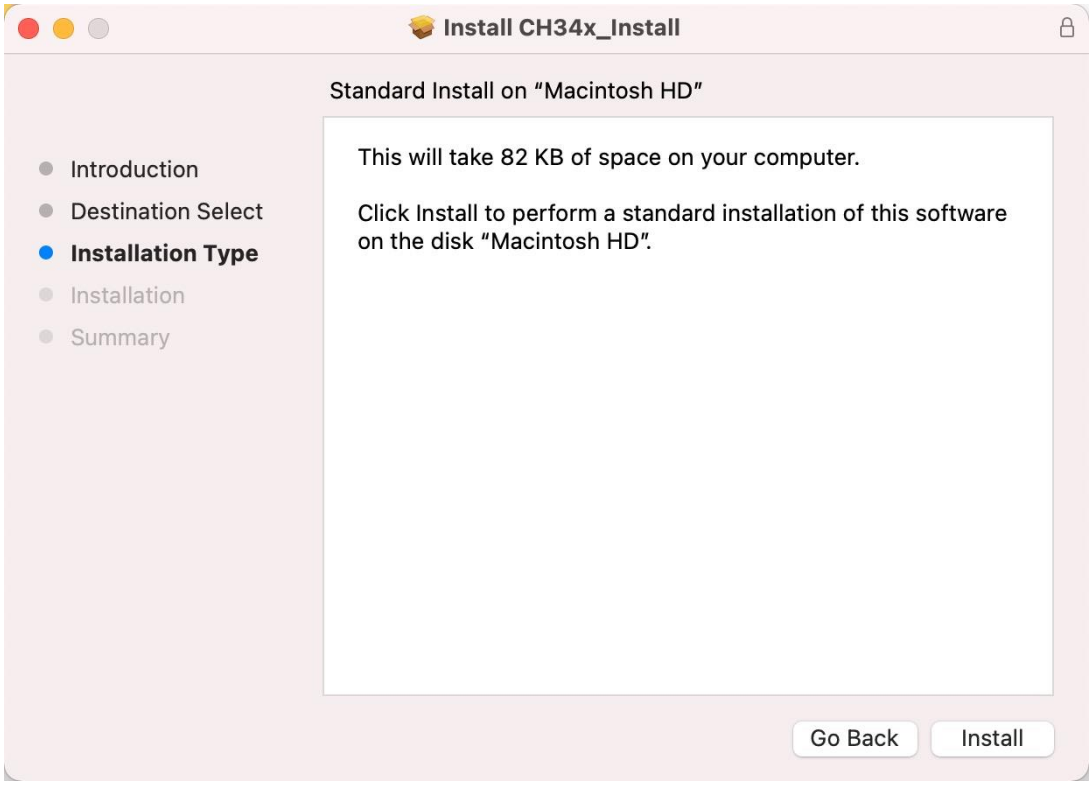
2. Open "Freenove_Ant_Kit/CH340/MAC/".



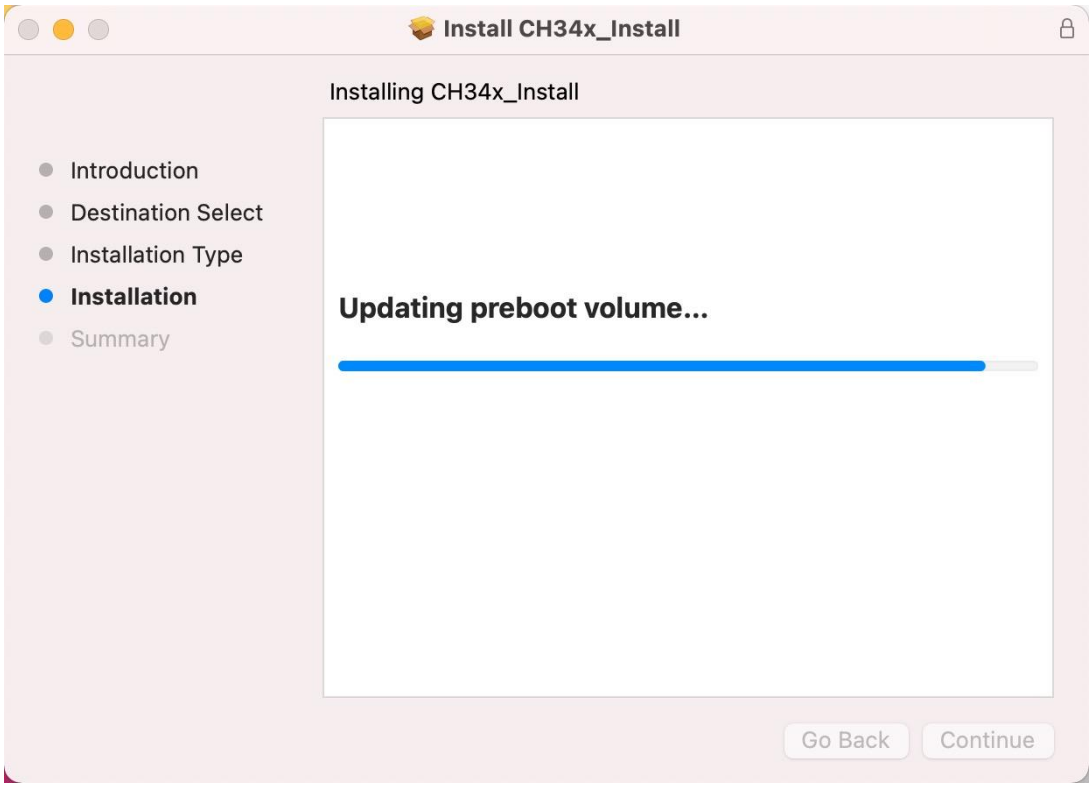
3. Click on Continue.



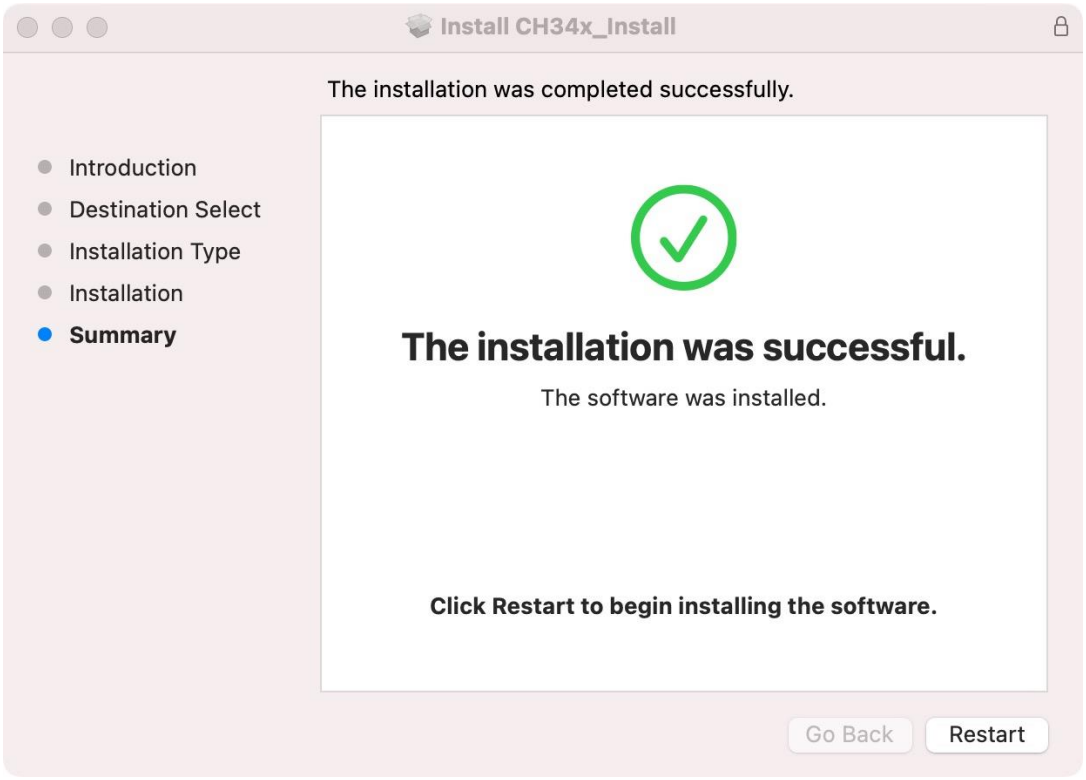
4. Click on Install.



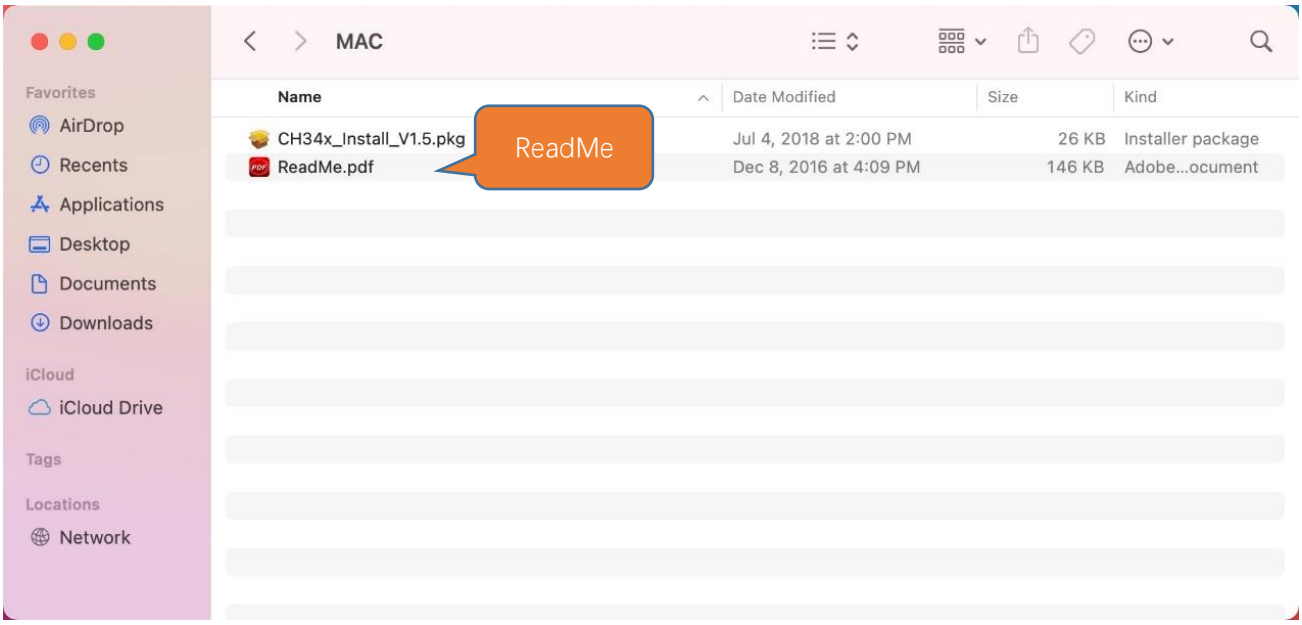
5. Wait for the installation to finish.



6. Restart your computer.



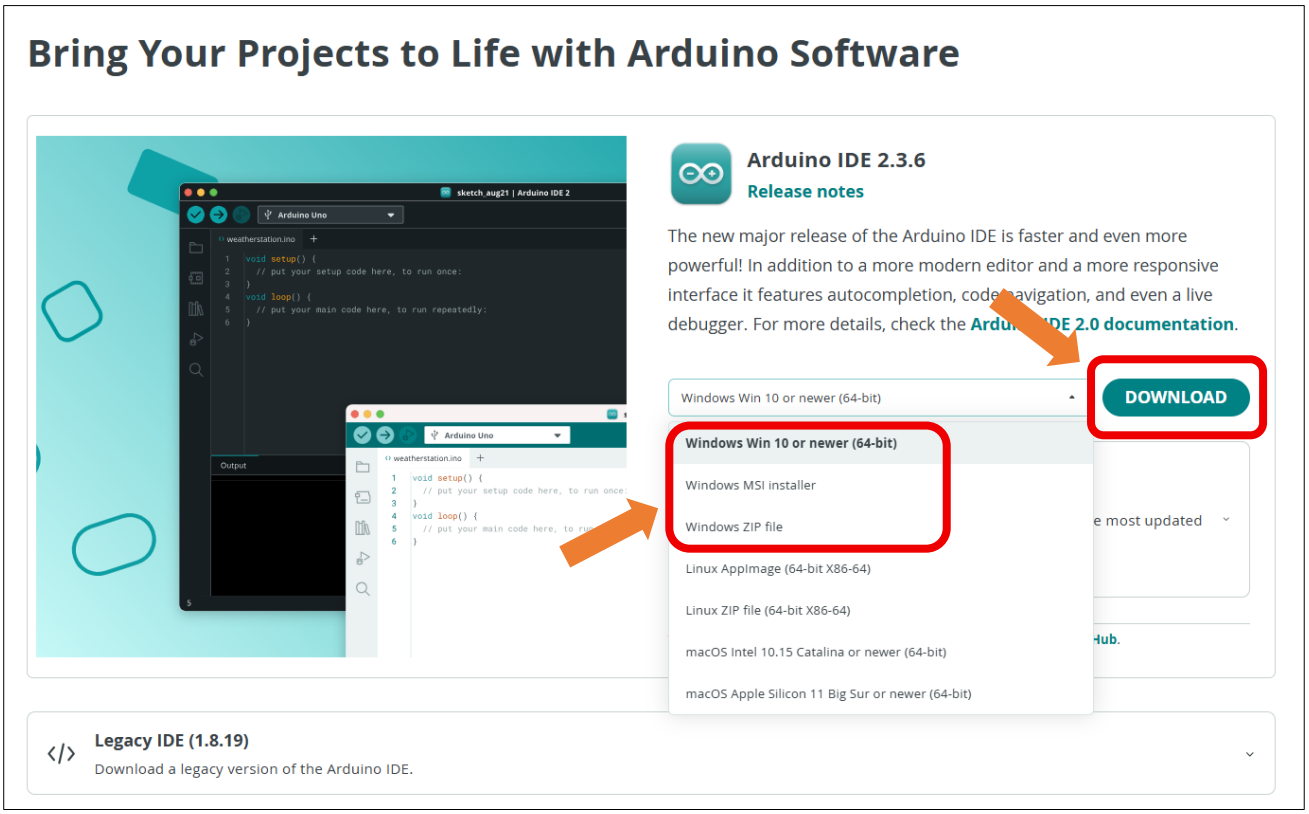
If you fail to install CH340 follwing the steps above, please refer to ReadMe.pdf.



02 Installation of Arduino IDE

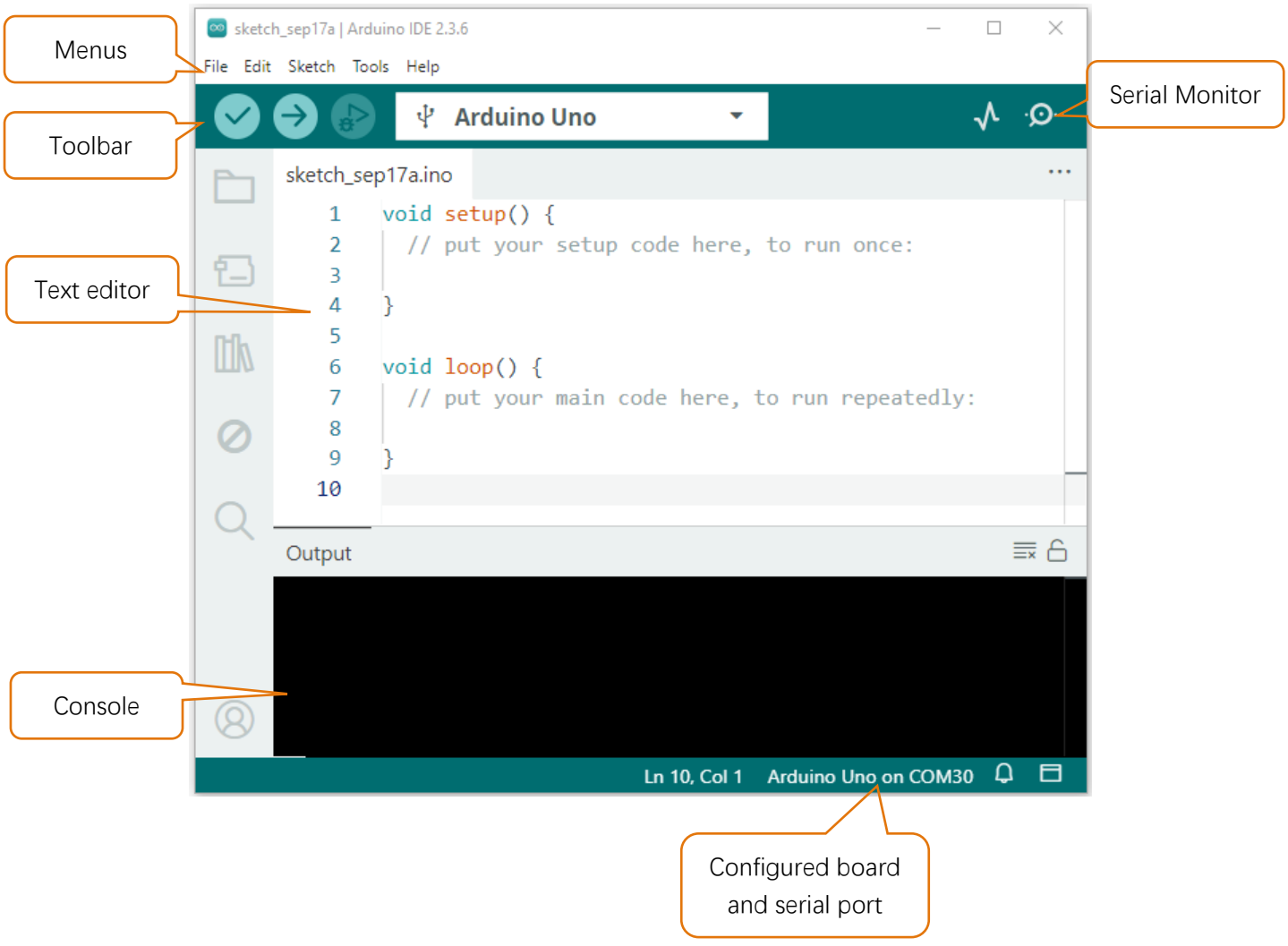
Arduino Software (IDE) is used to write and upload the code for Arduino Board.
First, install Arduino Software (IDE): visit https://www.arduino.cc/en/software/

Select and download corresponding installer based on your operating system. If you are a Windows user, please select the "Windows" to download and install the driver correctly.



After the downloading completes, run the installer. For Windows users, there may pop up an installation dialog box of 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.

Run it. The interface of the software is as follows:



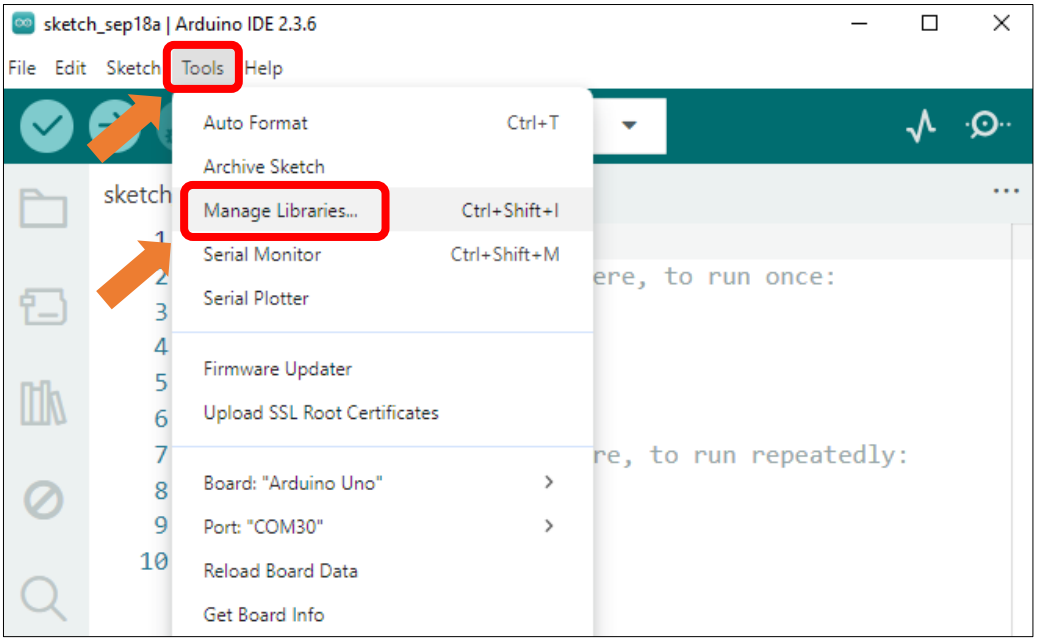
Programs written with Arduino IDE are called sketches. These sketches are written in a text editor and are saved with the file extension.ino. The editor has features for cutting/pasting and for searching/replacing text. The console displays text output by the Arduino IDE, including complete error messages 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, open the serial monitor, and access the serial plotter.

	Verify Checks your code for errors compiling it.
	Upload Compiles your code and uploads it to the configured board.
	Debug Troubleshoot code errors and monitor program running status.
	Serial Plotter Real-time plotting of serial port data charts.
	Serial Monitor Used for debugging and communication between devices and computers.

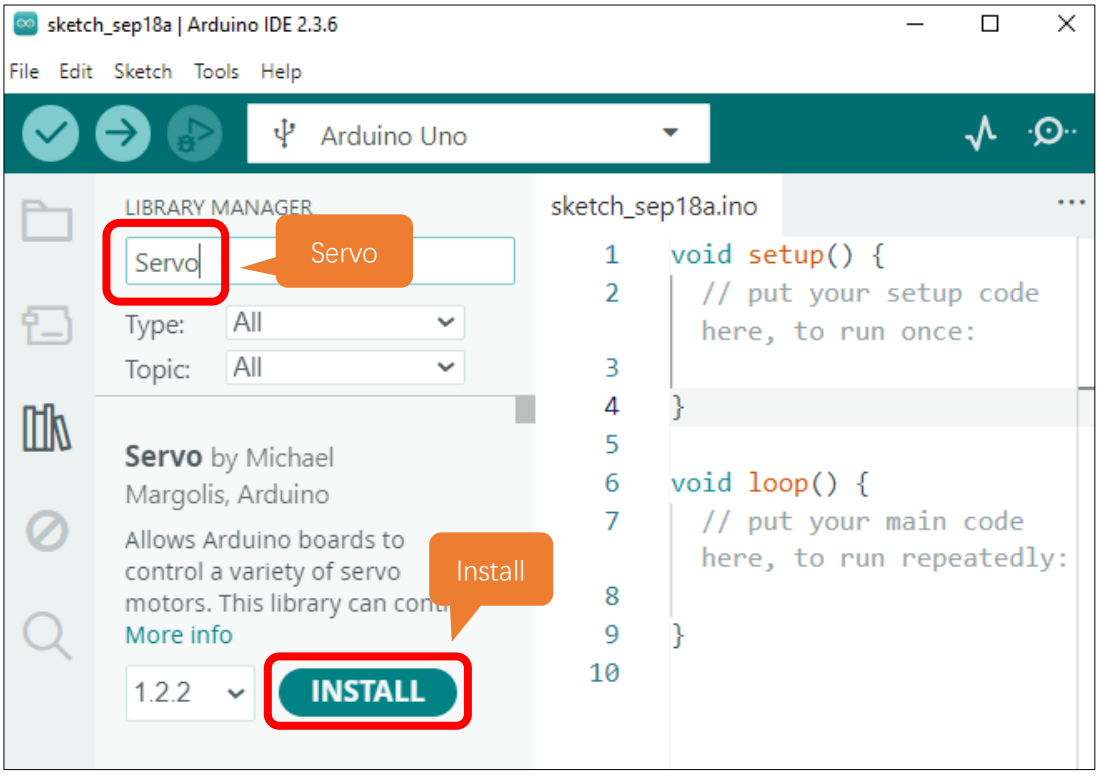
03 Installation of Libraries

In this tutorial, we use serveral libraries: Servo, UltrasonicSensor, Freenove_VK16K33_Lib and Freenove_WS2812_RGBLED_Controller respectively. Before running the sketches we provide, please make sure all the libraries have been installed. Otherewise, they may fail to run.

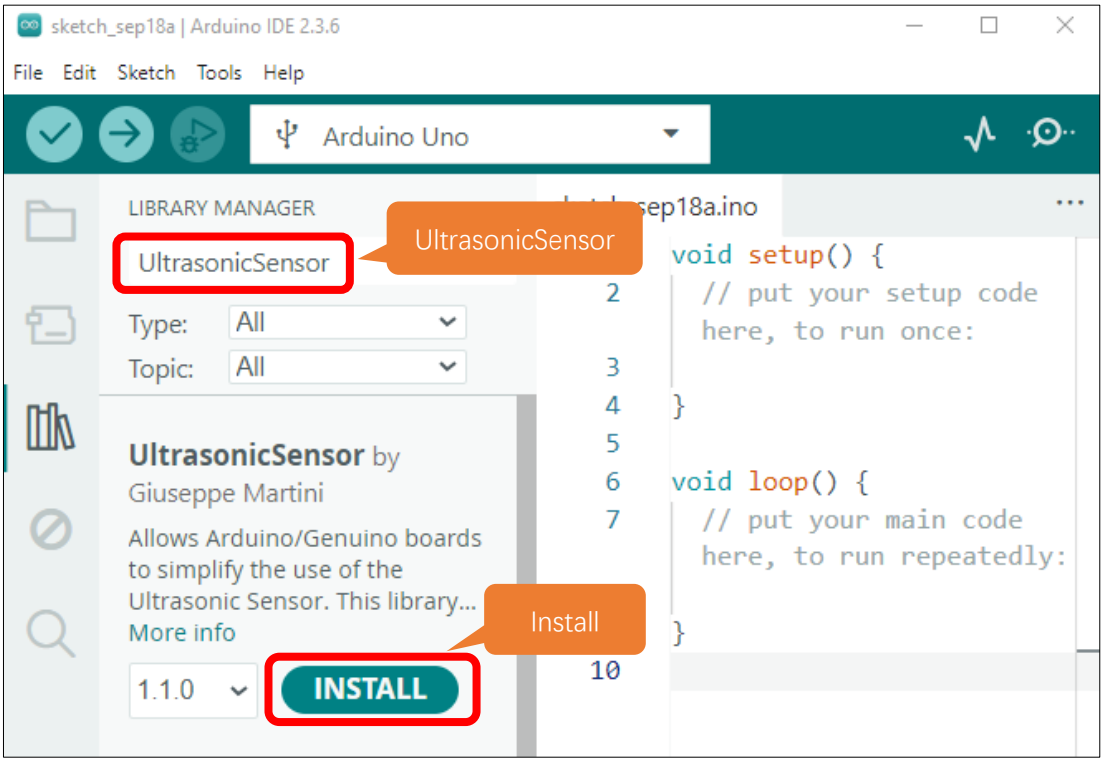
1. Open Arduino IDE, click on Sketch on Menus, select Include Library and then click on Manage Libraries….



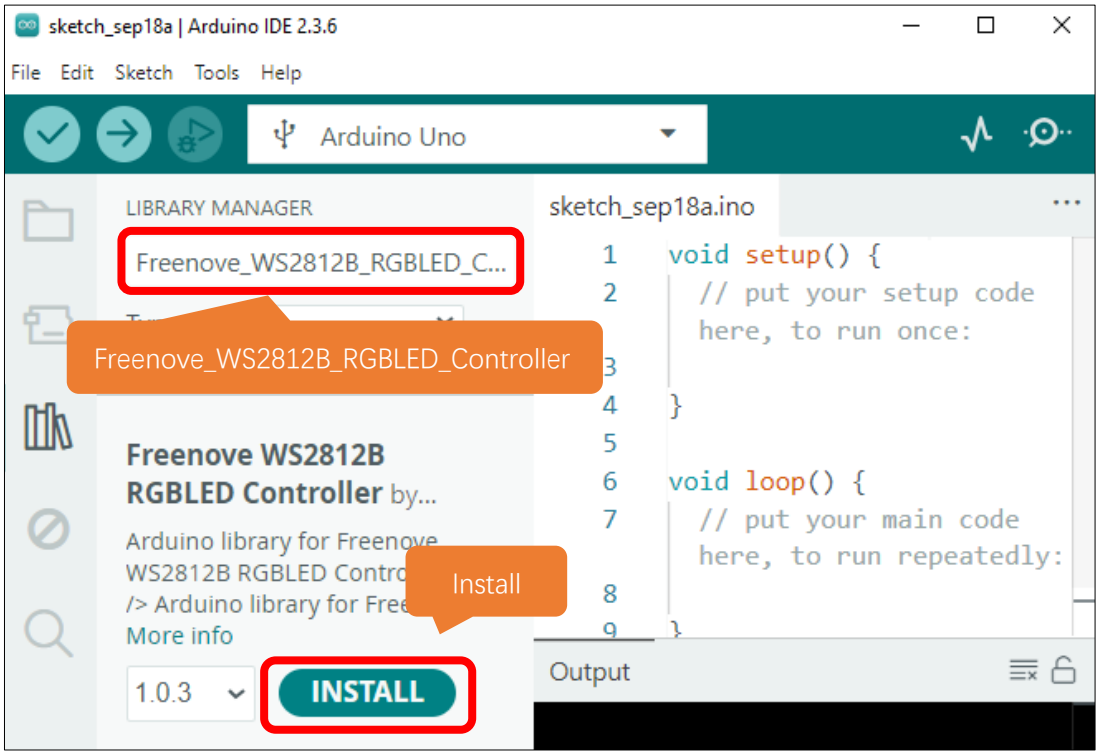
2. On the pop-up window, input **Servo** and press Enter. Select the Servo library as marked below and click to install.



3. After Servo library installs successfully, go on to input the name of the next library, that is, **UltrasonicSensor** and then install it.

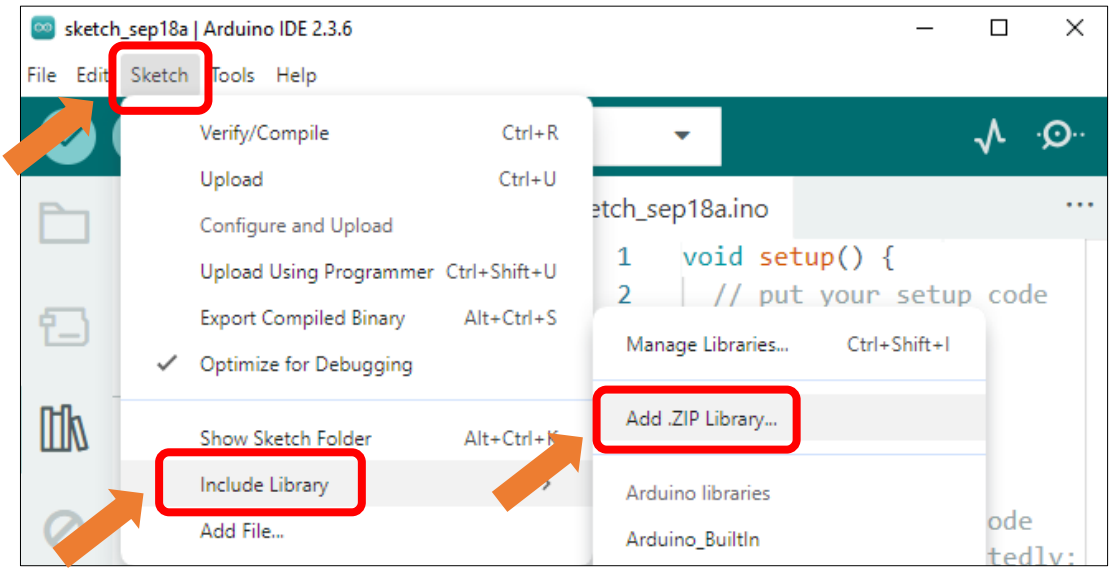


4. After finishing installation, install the next library **Freenove_WS2812B_RGBLED_Controller** in the same way.

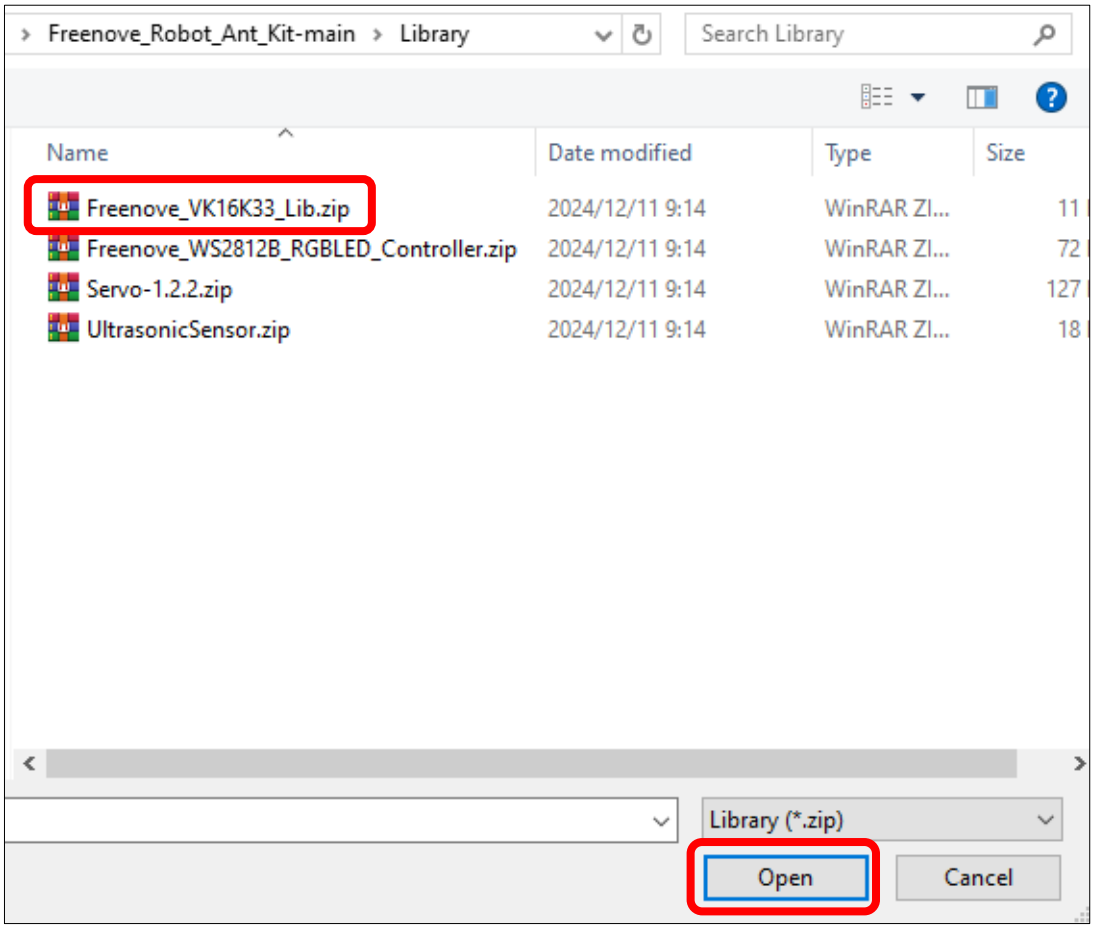


There is also another way to install libraries.

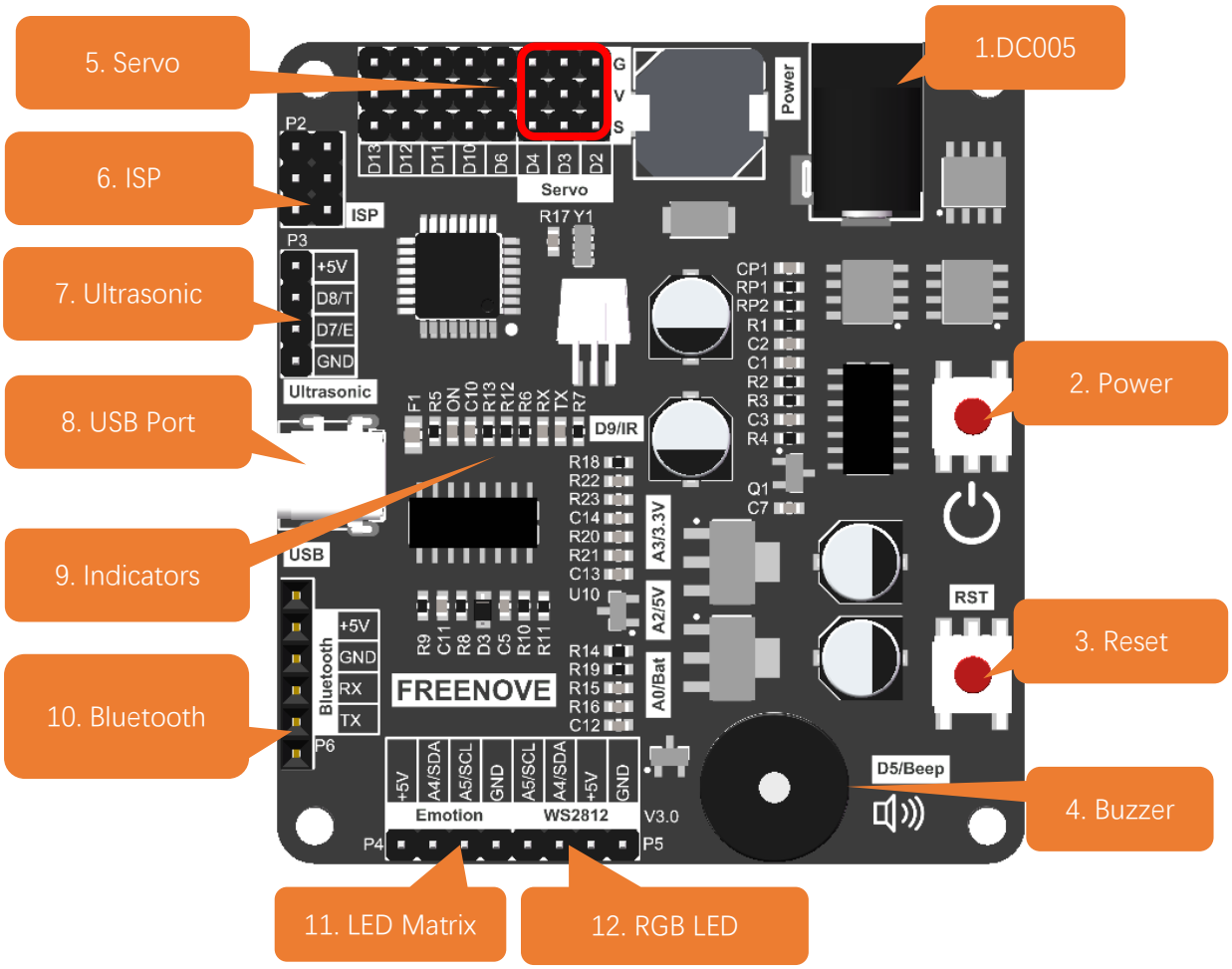
5. Click on Sketch on Menus, select Include Library, and then click on Add .ZIP Libraries···.



6. On the pop-up window, select the source pakage **Freenove_Robot_Ant_Kit/Library/Freenove_VK16K33_Lib.zip** and click on **Open**.



04 Control board



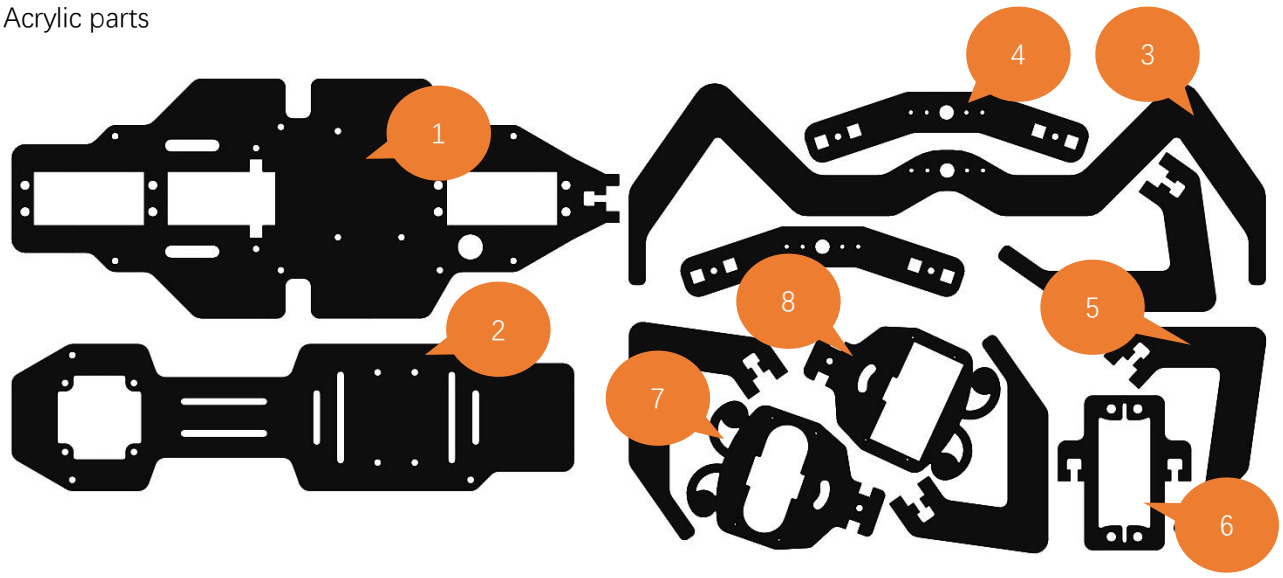
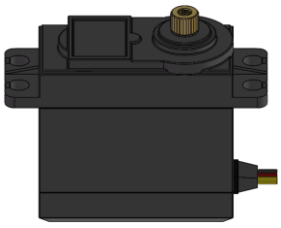
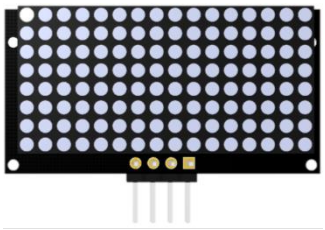
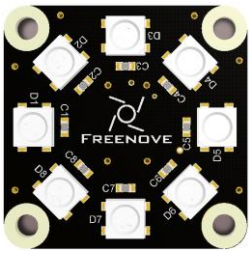
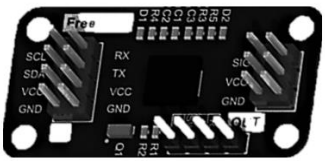
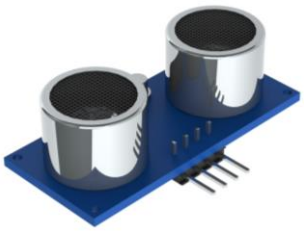
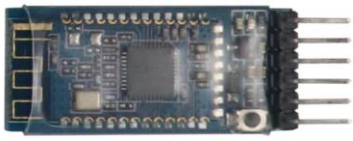
1. DC005: Powered by 2 18650 batteries. Supports 7-12V power supply.
2. Power button: Uses digital chip circuits to control the power's ON and OFF. It's more durable than traditional switches.
3. Reset button: Reset the control board.
4. Passive buzzer: Controlled by D5 pin on ArduiNo.
5. Servo: Controlled by D2, D3 and D4 on Arduino with D2 connecting to Servo1, D3 connecting to Servo2 and D4 connecting to Servo3.
6. ISP connector: Uses ISP to download programmer to download code.
7. Ultrasonic connector: If you use ultrasonic module for the ant's head, please connect it to this port. Connect D8 of the Arduino to Trig pin of ultrasonic module and D7 to Echo.
8. USB port: Connect computer and control board with a type-C cable to download programs.
9. Indicators: Used to indicates whether the board is powered and the status of the serial port.
10. Bluetooth connector: Plug the Bluetooth module HC-05 to this port. Note: The Bluetooth module should orient to the control board.
11. LED matrix connector: If you use LED matrix for the ant's head, please connect it to this port.
12. RGB LED module: the IIC port to connect to RGB LED module.

The pinout of the control board is as below:

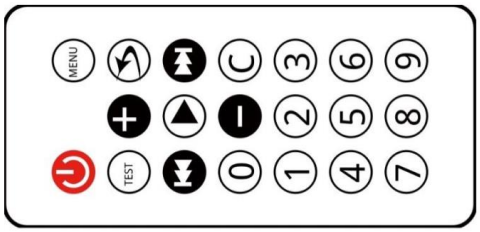
Pins	Functions	Introduction
0	Uart-RX	Bluetooth module. Please remove it when uploading code.
1	Uart-TX	
2	Servo1	Servo motors
3	Servo2	
4	Servo3	
5	Buzzer	Buzzer
6		Extension IO
7	Ultrasonic-Echo	Ultrasonic module
8	Ultrasonic-Trig	
9	Infrared receiving pin	Infrared module
10		Extension IO
11		ISP/Extension IO
12		ISP/Extension IO
13		ISP/Extension IO
A0	Battery Voltage Pin	Detect voltage of batteries (1/4)
A1	AREF Pin	Detect voltage of AREF pin
A2	5V Voltage Pin	Detect 5V voltage (1/4)
A3	3.3V Voltage Pin	Detect 3.3V Voltage (1/4)
A4	IIC-SDA	WS2812 RGB LED module/LED Matrix (Expression module)
A5	IIC-SCL	

05 Component List

Before assembly, please compare the list with the kit you receive to make sure that no item is missed or damaged. Should this happens, please send emails to us: support@freenove.com, we will offer solution.

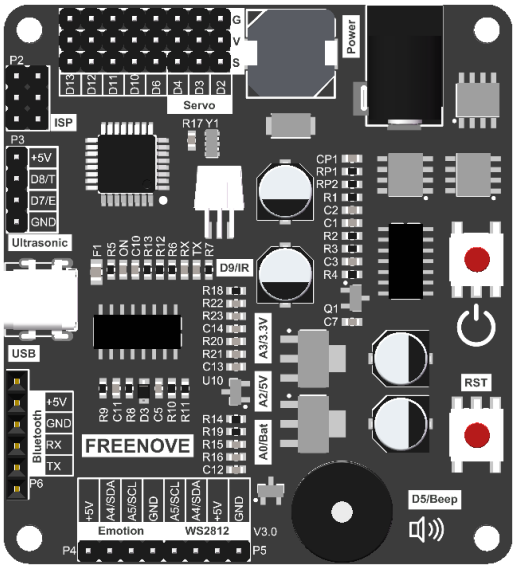
<table>
<tr><td colspan="2">Acrylic parts
  </td></tr>
<tr><td>Servo *3
  </td><td>Expression Module *1
  </td></tr>
<tr><td>8-digit RGB LED Module *1
  </td><td>I2C RGB LED Control Module *1
  </td></tr>
<tr><td>Ultrasonic Module *1
  </td><td>Bluetooth Module *1
  </td></tr>
</table>

Infrared Remote Controller *1



Battery Holder *1

Control board *1



4P F-F Jumper Wires 20cm*3

3P F-F Jumper Wires 20cm*1

Tidy Cable 15cm *1

Type-C USB Cable *1

Metal cross sleeve*1

Machinery Parts

Cross Screwdriver (3mm) ×1

Cross Screwdriver (2mm) ×1

PVC rubber sheath ×8

Required but NOT Contained Parts

2 x 3.7V 18650 lithium **rechargeable** batteries with continuous discharge current >3A.

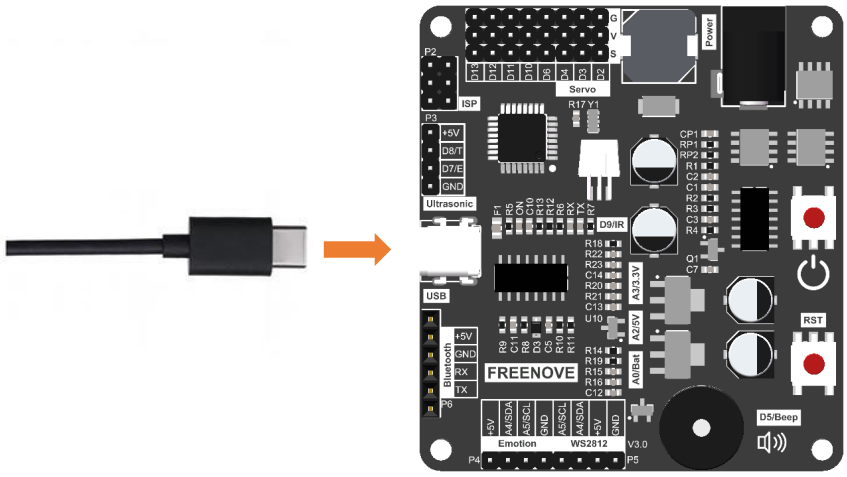
Please refer to **AboutBattery.pdf** to purchase the batteries.

06 Assembly

Set Servo Gear to 90°

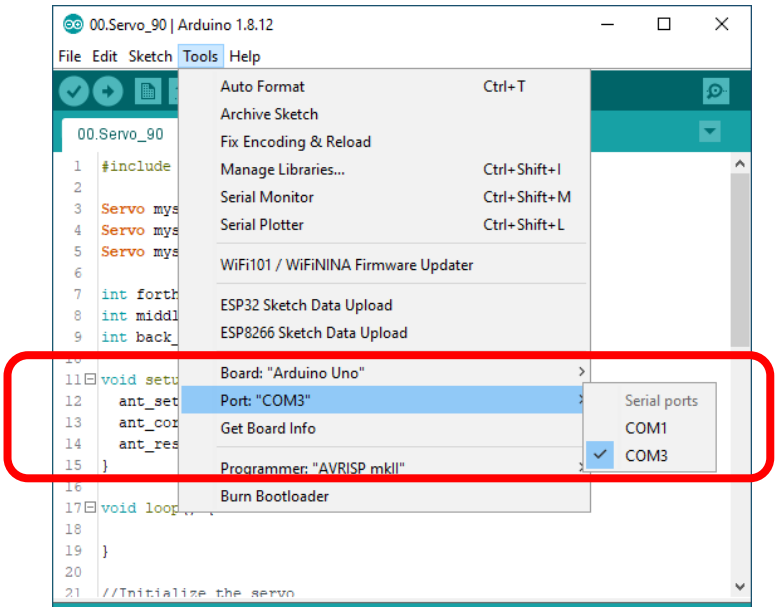
Before installing the legs, please set the servos to 90°. Only after doing this can you assemble the robot ant correctly.

Step 1: Connect the control board and computer with a type-C cable.



Step 2: Open the file 00.Servo_90.ino in **Freenove_Robot_Ant_Kit\Sketches\00.Servo_90**.

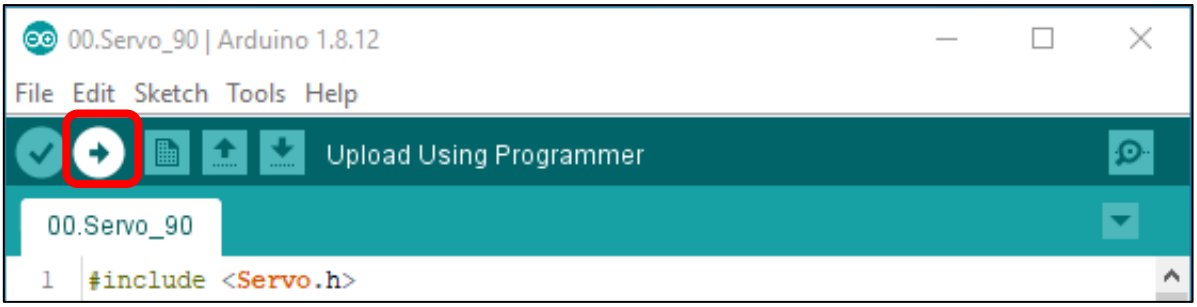
Step 3: Click on Tools and then select "Arduino Uno" for Board and port COMx for port. In our computer, the port is COM3.



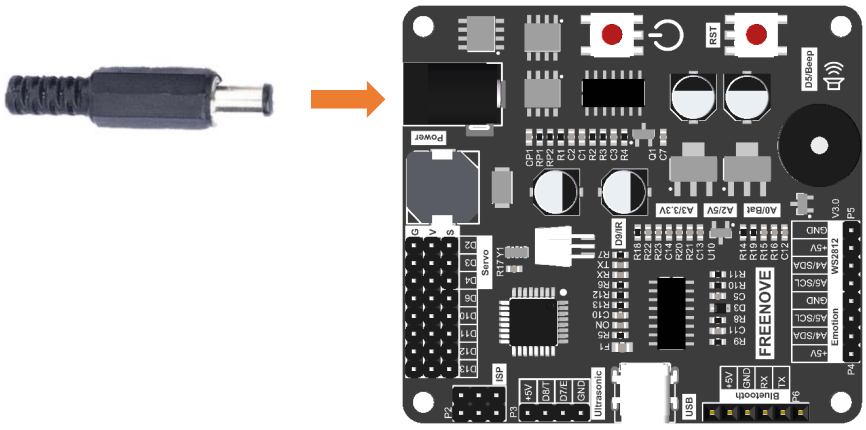
Note:

1. Generally, COM1 is not the port of development board, so please do NOT choose it.
2. The x of COMx varifies among different computers. If you cannot find your port, please check whether CH340 has been installed or whether the board has connected to PC.

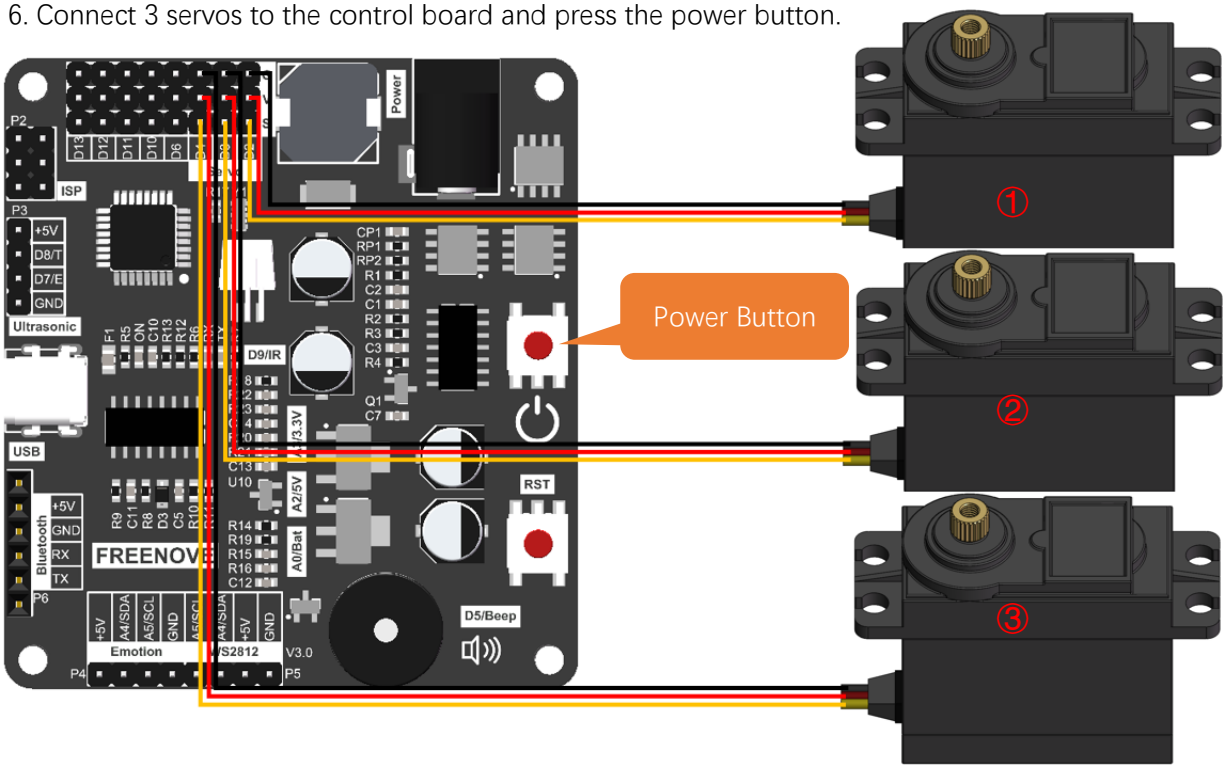
Step 4: Click to download Code (Upload Using Programmer).



Step 5. Plug the power cord from the battery holder into control board.



Step 6. Connect 3 servos to the control board and press the power button.

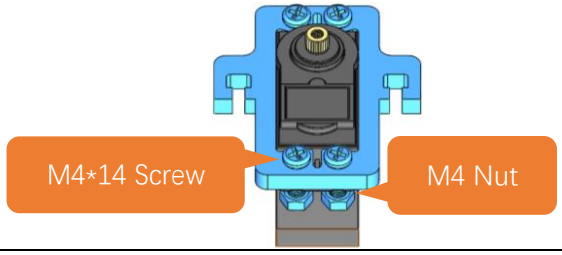


Step 7: When you see the power indicator on the board light up, and all the 3 servos rotate to a specific position and remain still, it means you have set the servos to the middle position. At this point, you can assemble the legs.

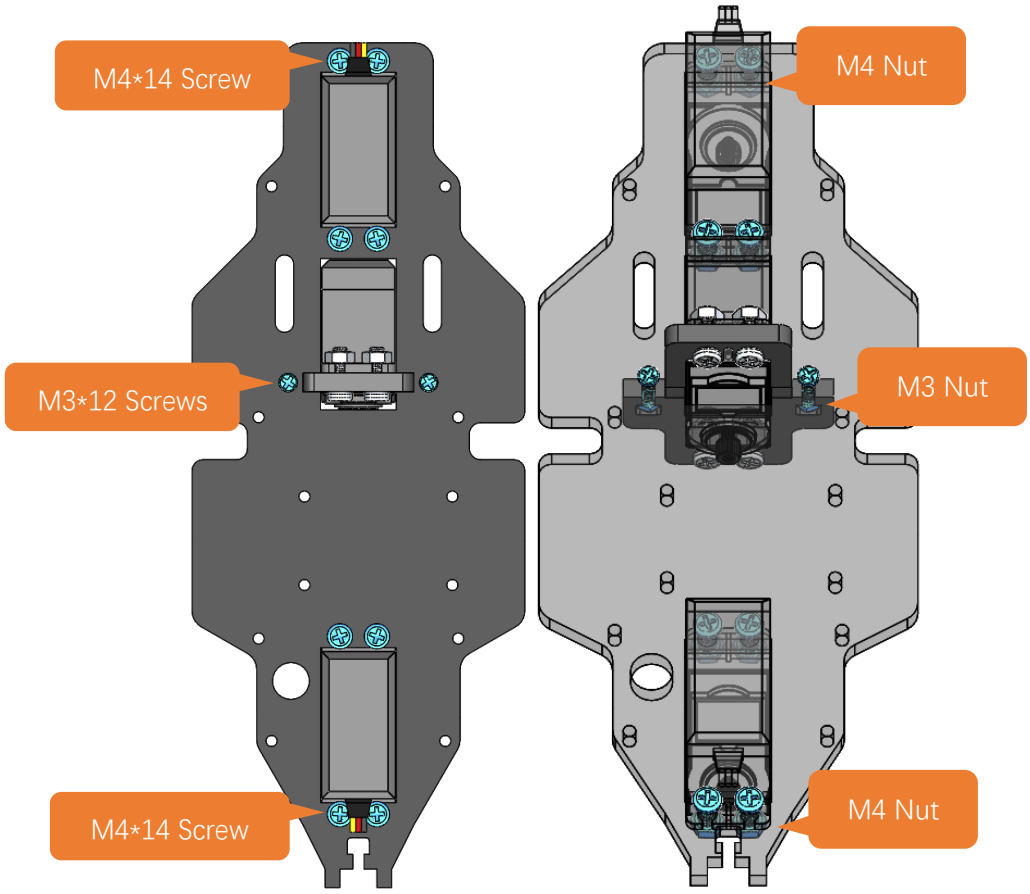
If the servos have been at that position, you won't observe anything.

Assembly of Legs

Use 4 M4*14 screws and 4 M4 nuts to fix a servo to No.6 acylic part.

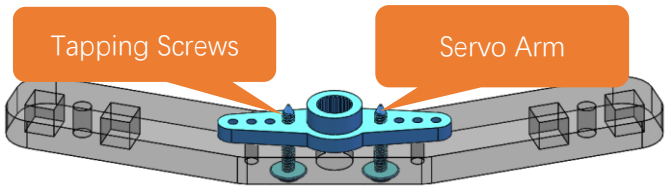


Fix 3 servos to No.1 acrylic part. (8 M4*14 screws, 8 M4 nuts, 2 M3*12 screws and 2 M3 nuts)



On the left is the plan view of the acrylic part.
On the right is its perspective view.

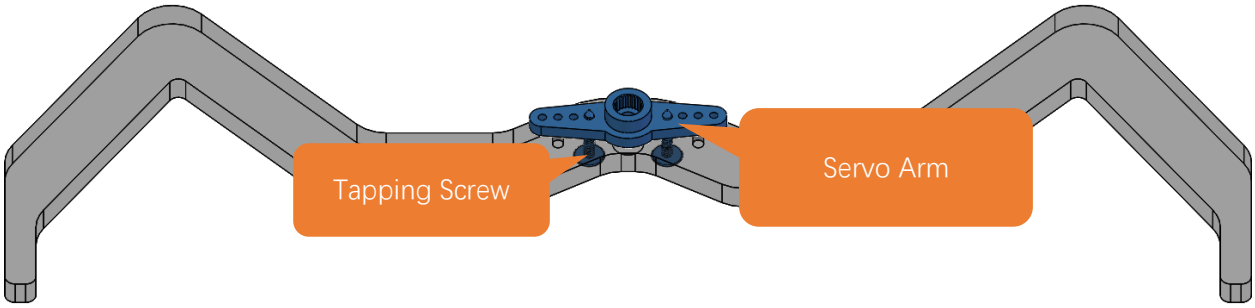
Use 4 tappping screws to fix the disc servo arms to two No.4 acrylic parts.
Note: Tapping screws, disc servo arms and servos are packed in the servo package, please don't use wrong ones.
It is a bit strenuous to make the disc servo arm fix tightly, which is normal.



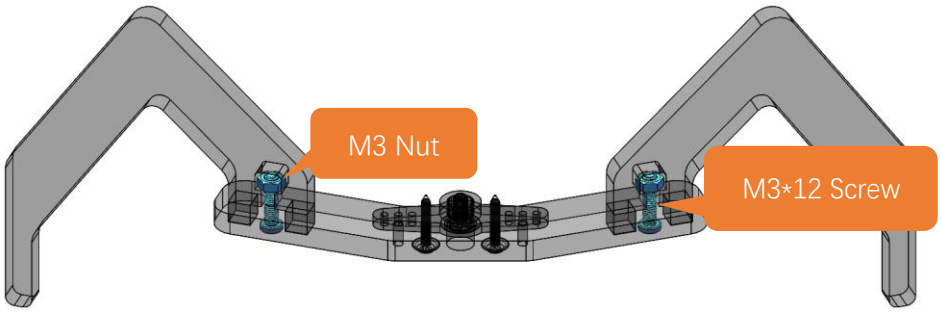
Use 2 tapping screws to fix the disc servo arms to No.3 acrylic part.

Note: Note: Tapping screws, disc servo arms and servos are packed in the servo package, please don't use wrong ones.

It is a bit strenuous to make the disc servo arm fix tightly, which is normal.

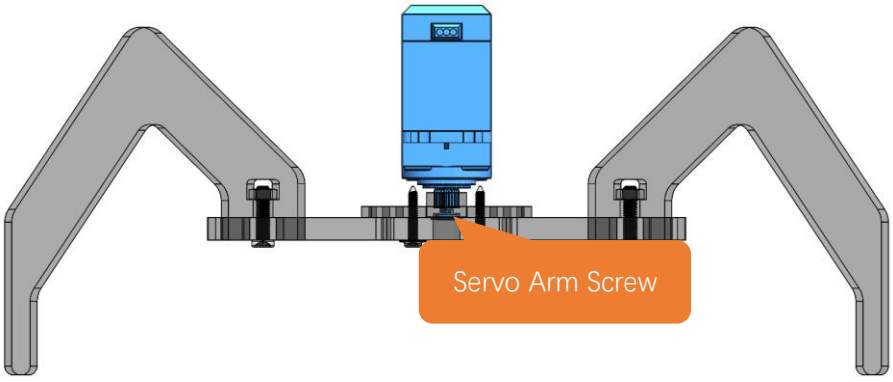


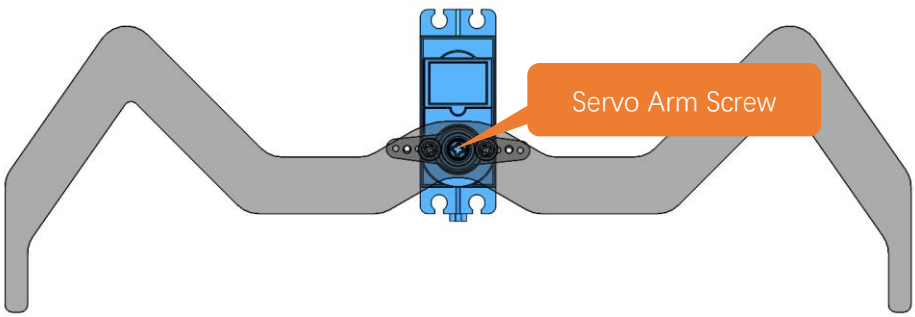
Use 4 M3*12 screws and 4 M3 nuts to fix 4 No.5 acrylic parts to 2 No.4 acrylic parts.



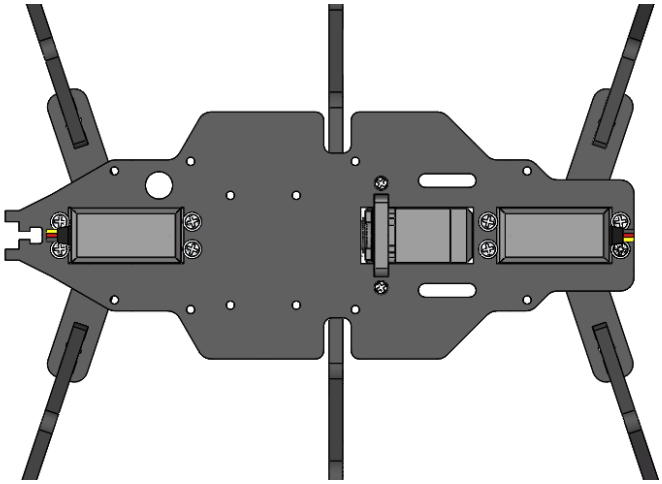
Use 3 servo arm screw to fix 3 servos to No.3 acrylic part and 2 No.4 acrylic parts respectively.

Note: servo arm screws are packed with the servos. Don't use wrong ones.



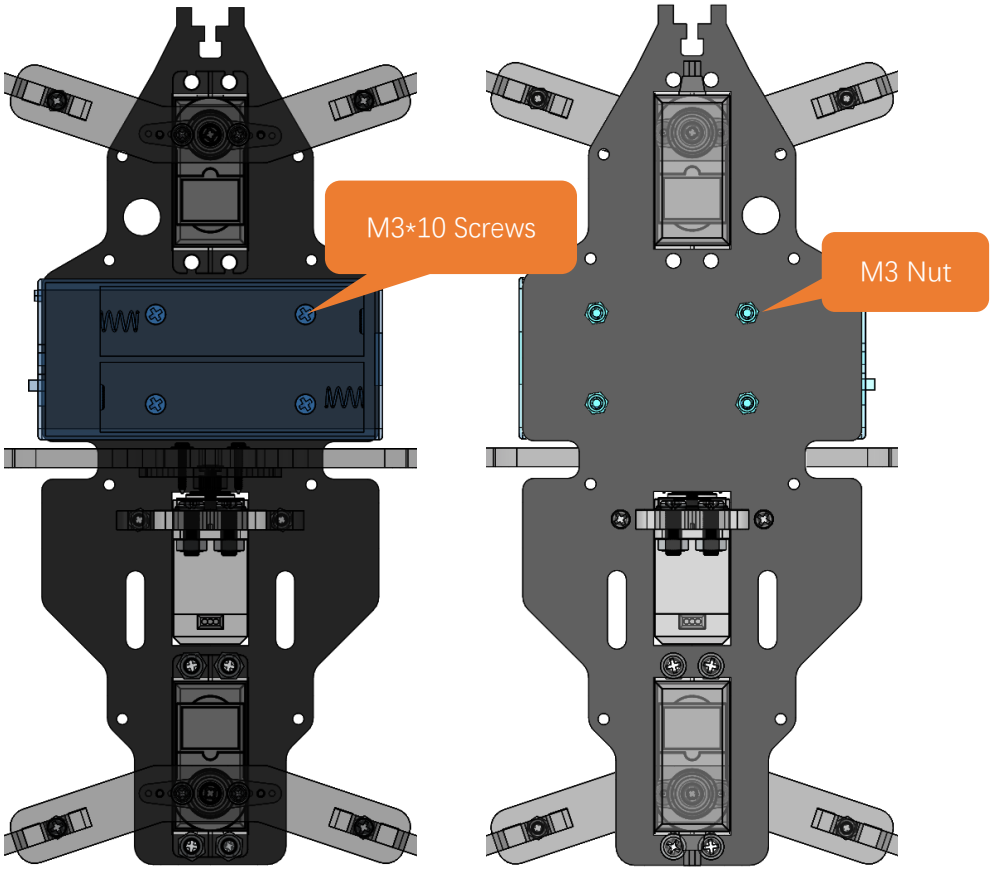


When finish assembly, from the top view, it looks as below:



Assembly of Battery Holder

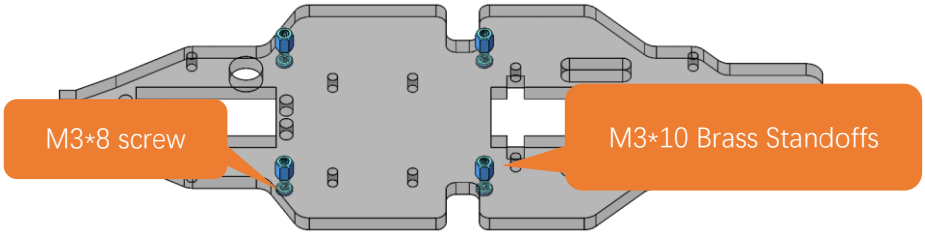
Use 4 M3*10 screws and 4 M3 nuts to fix the 18650 battery holder to the back of No.1 acrylic part.



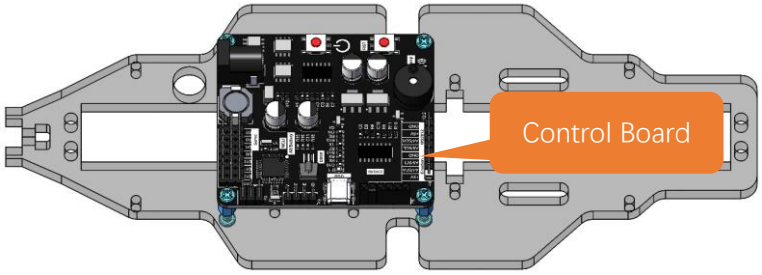
The left is the bottom view and the right is the top view

Assemby of the Control board

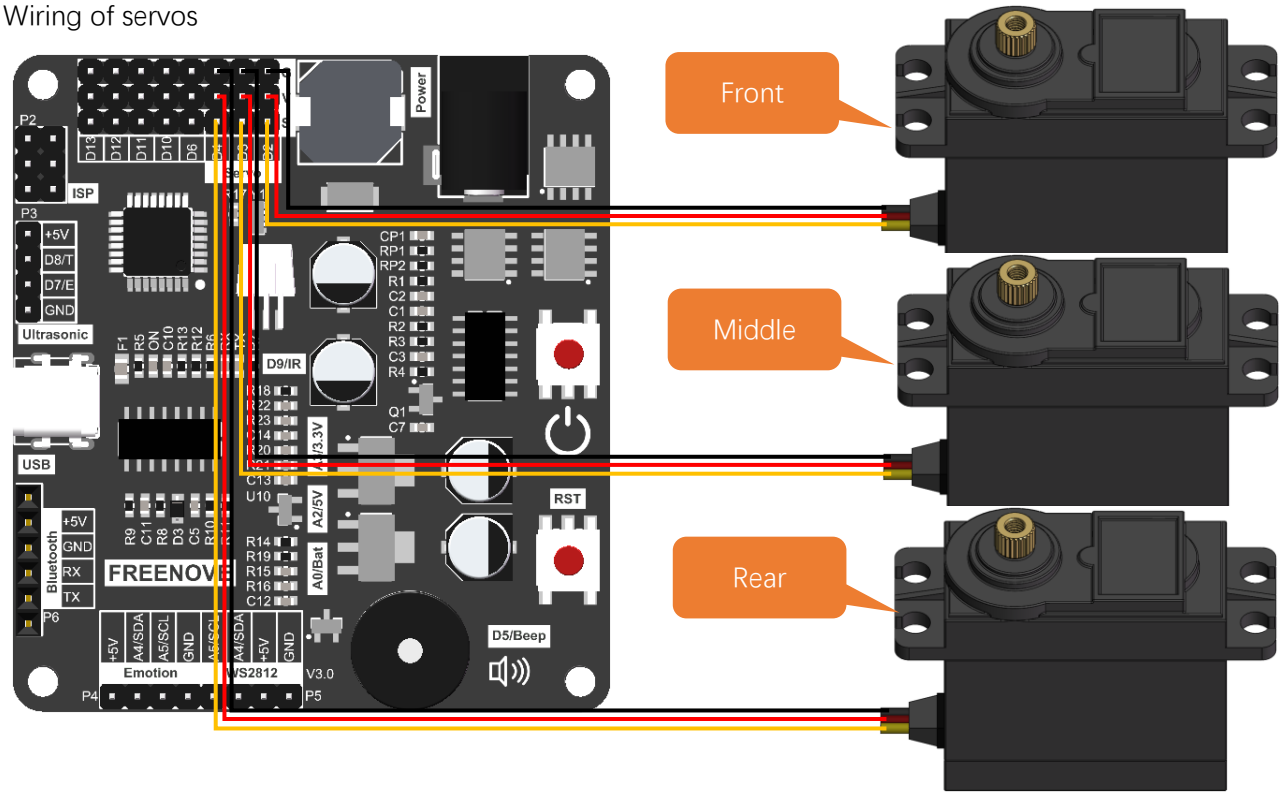
Use 4 M3*8 screws to fix 4 M3*10 brass standoffs to No.1 acrylic part. (Top view)



Use 4 M3*8 screws to fix the control board to the brass standoffs. Pay attention to the orientation of the control board. (Top view)



Wiring of servos

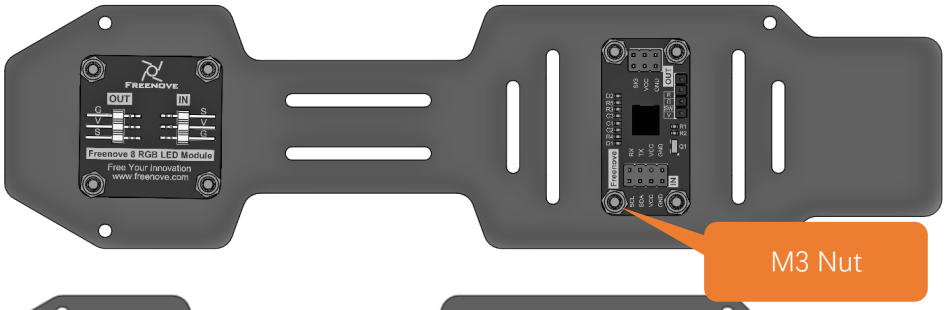


Control board（Servo）	Servo1	Servo2	Servo3
S	orange-D2	orange-D3	orange-D4
V	red-VCC	red-VCC	red-VCC
G	black-GND	black-GND	black-GND

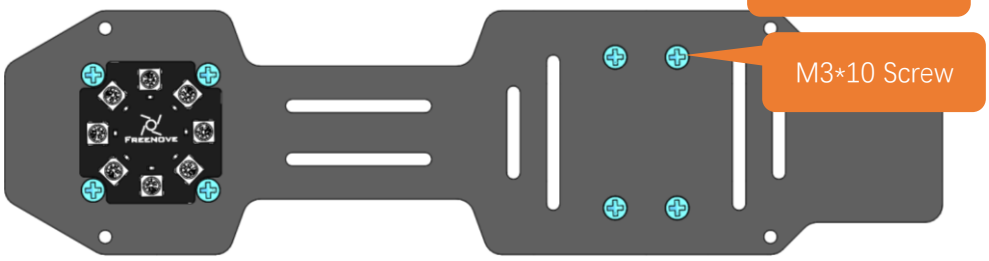
Assembly of the WS2812 LED Module

Use 8 M3*10 screws and 8 M3 nuts to fix the LED module and LED control module to No.2 acrylic parts.

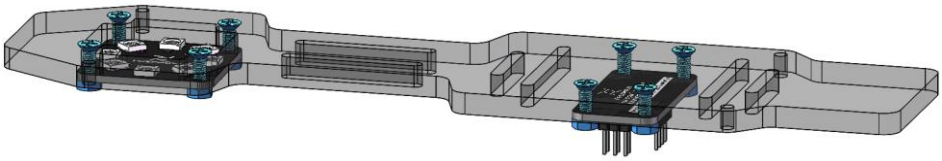
Bottom view:



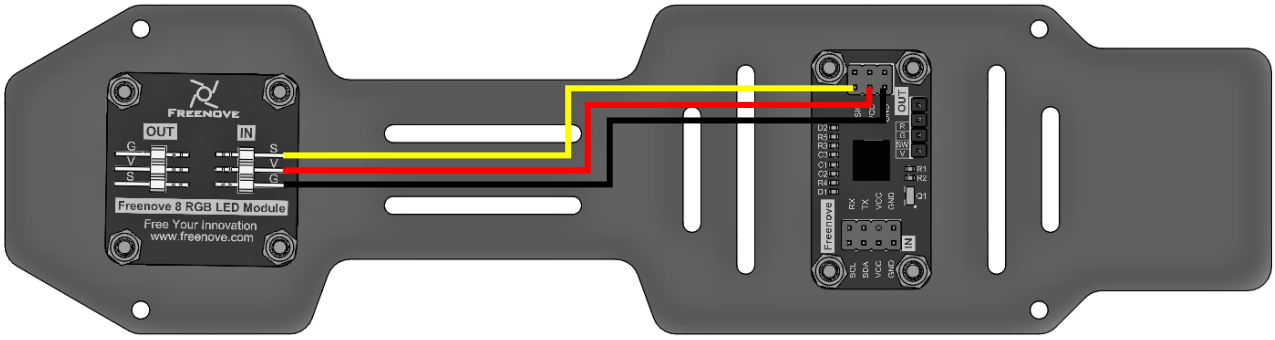
Top view:



Perspective:

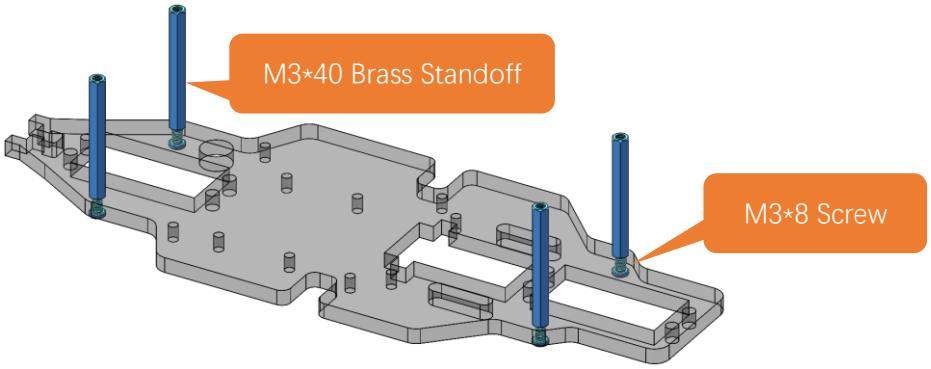


Wirng of RGB LED module to its control module



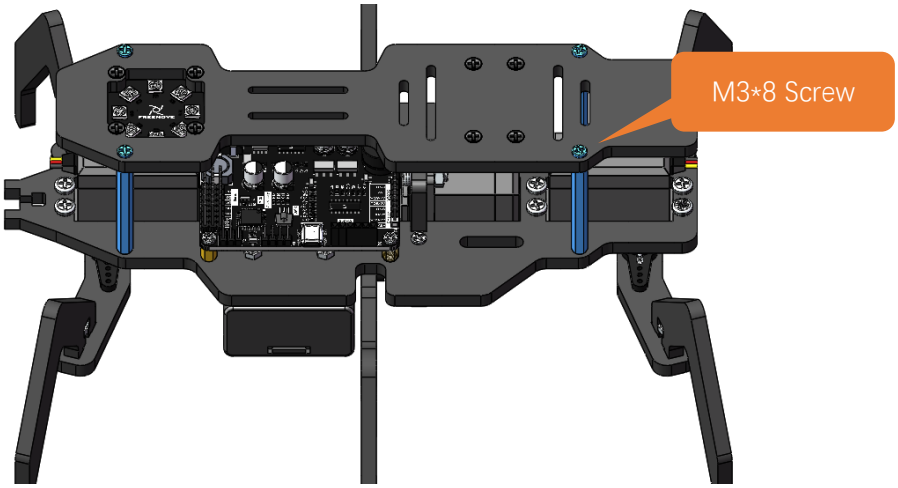
Assembly of the Body

Use 4 M3*8 screws to fix 4 M3*40 brass standoff to No.1 acrylic part. (Top view)



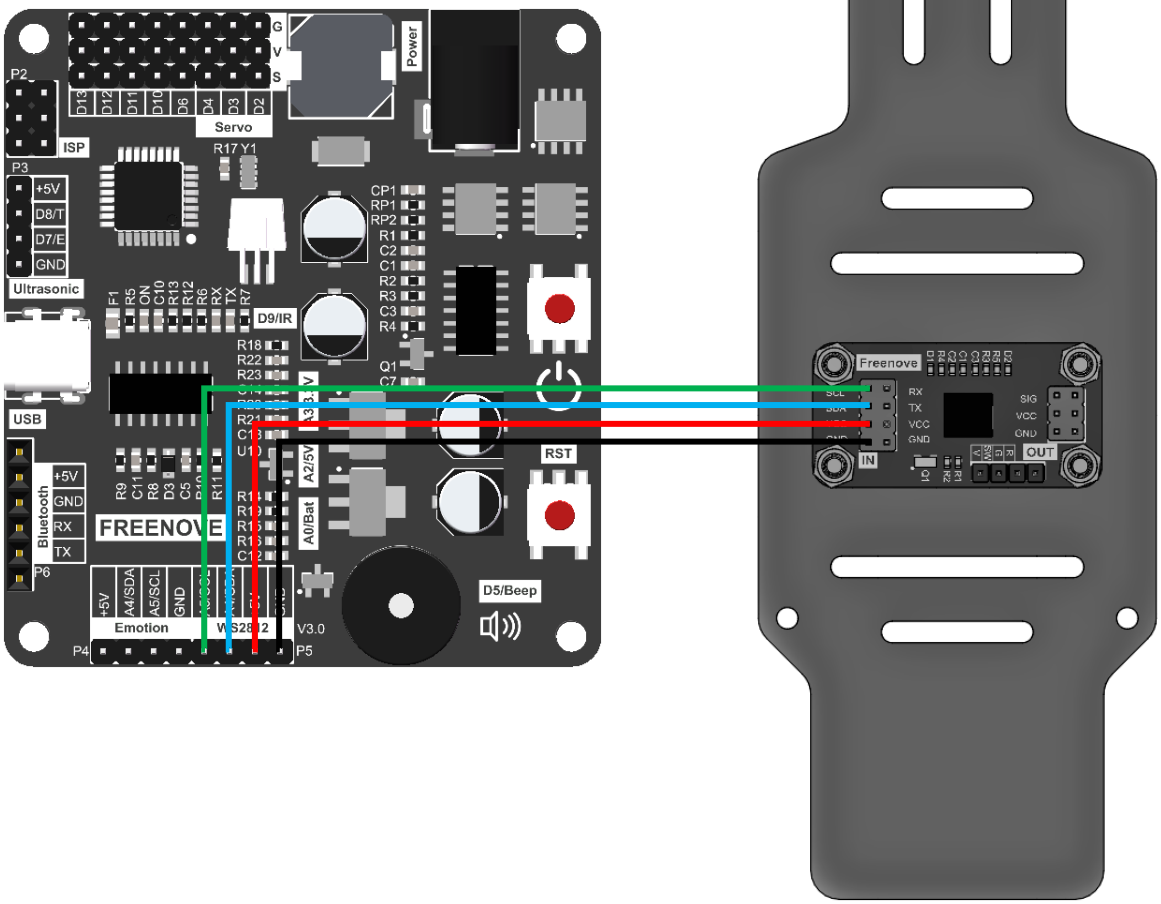
Use 4 M3*8 screws to fix No.2 acrylic part to the standoffs. (Top view)

Pay attention to the orientation of No.2 acrylic parts.



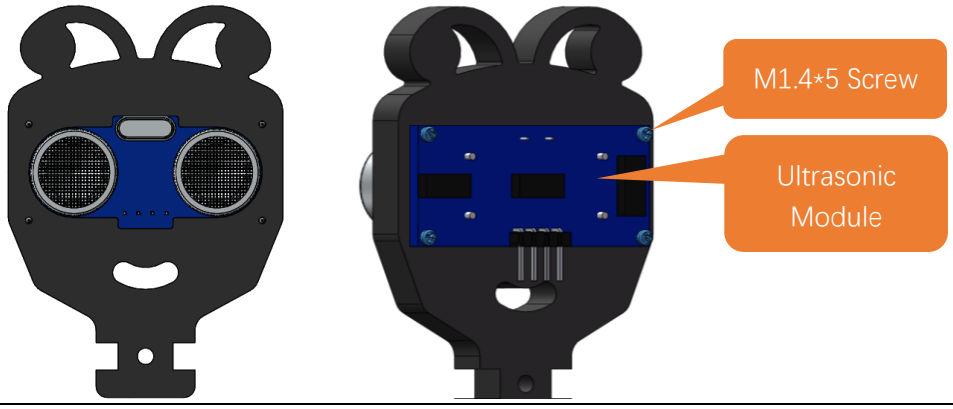
Wirng of the LED control module to control board

Control board (WS2812)	LED control module
A5/SCL	SCL
A4/SDA	SDA
+5V	VCC
GND	GND

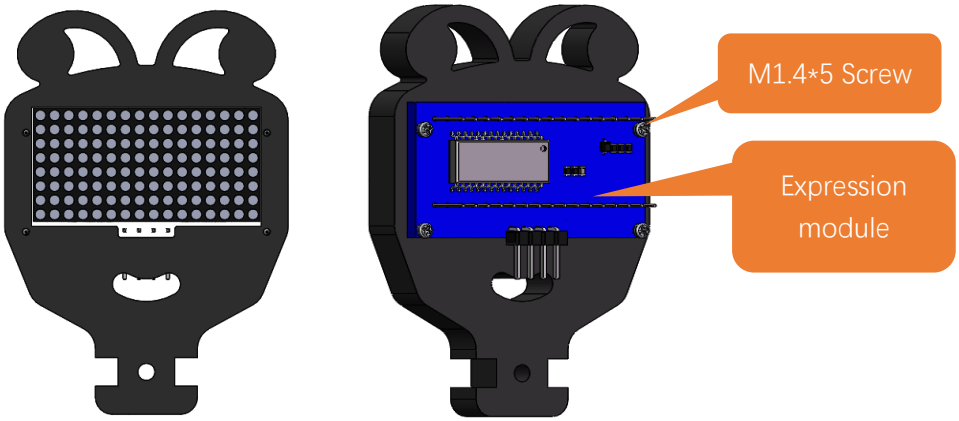


Assembly of the Head

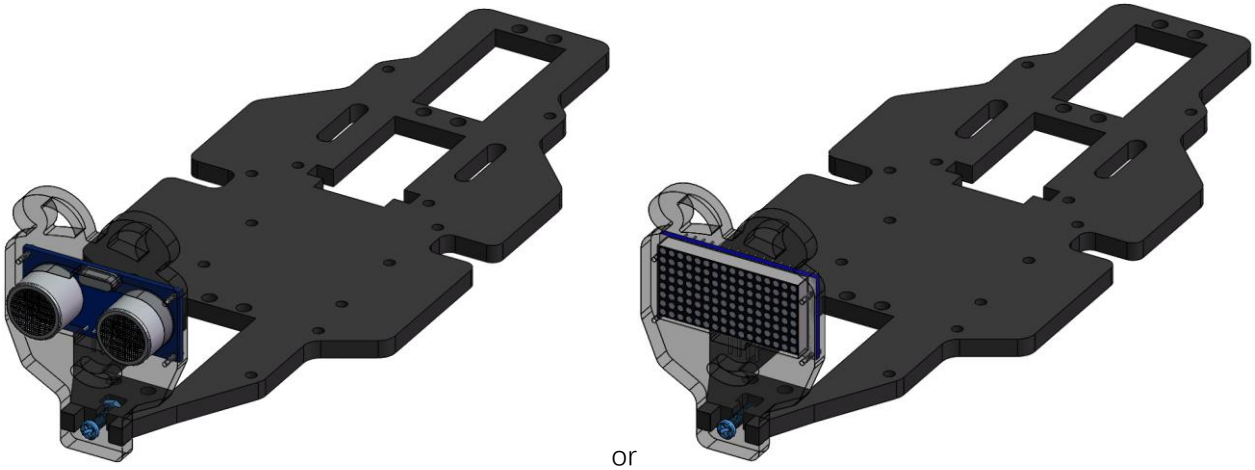
Use 4 M1.4*5 tapping screws to fix the ultrasonic module to No.7 acylic part.



Use 4 M1.4*5 tapping screws to fix the expression module to No.8 acrylic part.

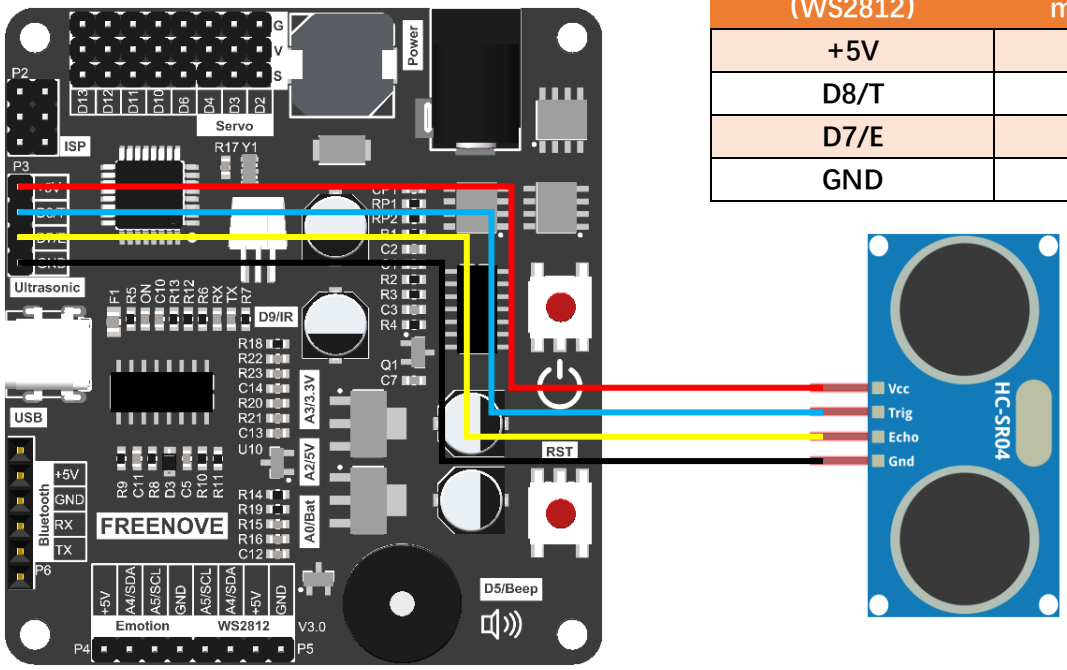


Use a M3*12 screw and a M3 nut to fix No.7 or No.8 acrylic part to No.1 acrylic part.



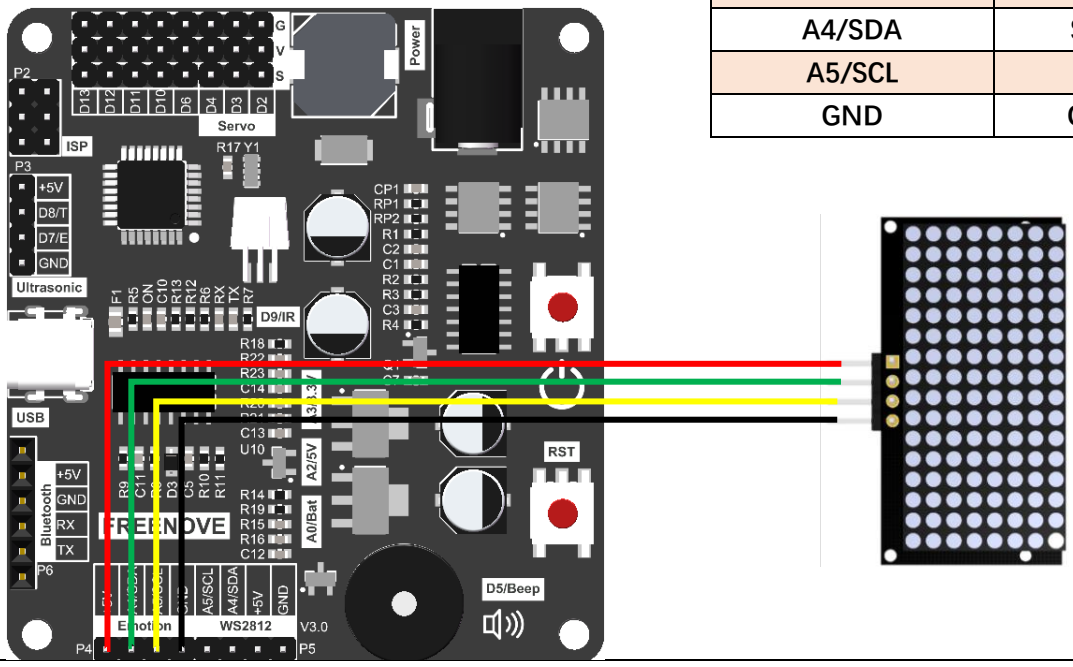
Wiring of ultrasonic module to control board

Control board (WS2812)	Ultrasonic module
+5V	Vcc
D8/T	Trig
D7/E	Echo
GND	GND



Wiring of the expression module to control board.

Control board (WS2812)	Expression module
+5V	VCC
A4/SDA	SDA
A5/SCL	SCL
GND	GND

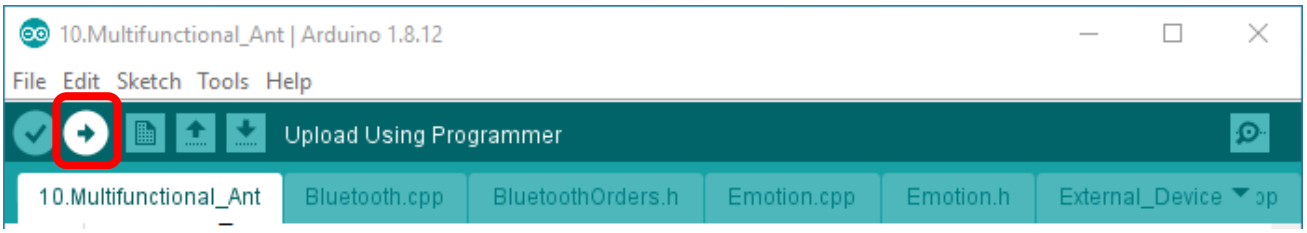


When finishing the assembly of the robot ant and make sure all the wirings are correct, you can use tidy cable to arrange the wires. If you have any questions during the assembly, please send emails to us: support@freenove.com.

07 Test

1, Connect the control board and computer with a type-C cable.

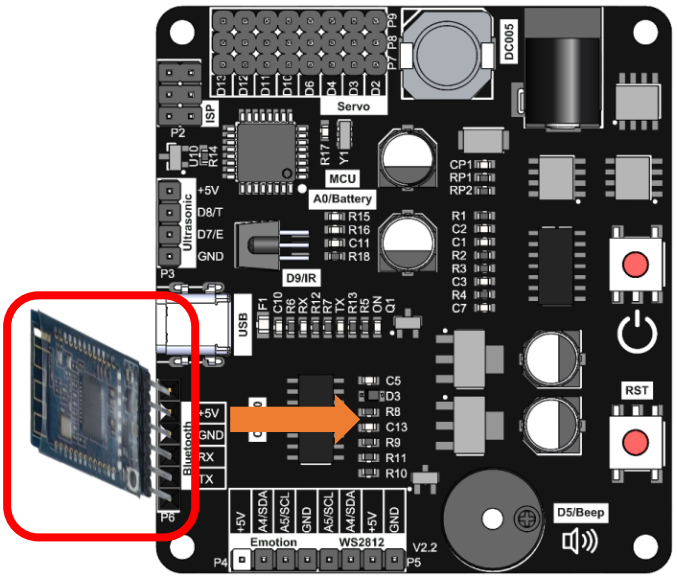
2, Open **10.Multifunctional_Ant.ino** in **Freenove_Robot_Ant_Kit\Sketches\10.Multifunctional_Ant**. Click to download the code to control board.



3, When the code is downloaded successfully, you can unplug the cable.

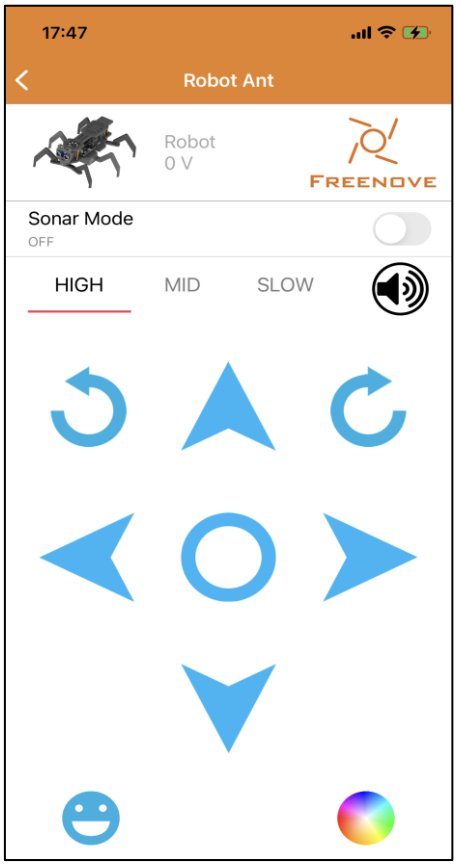
Note: Remember to remove Bluetooth module every time when you upload code; Otherwise the uploading will fail.

4, Plug in the Bluetooth module. **Please pay attention to the orientation of the Bluetooth module.**



5, Turn ON the power. When you hear a beep from buzzer, it means that the robot ant is ready. You can control it through the phone APP.

App download address: https://github.com/Freenove/Freenove_app_for_Android



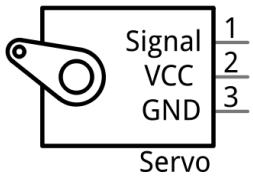
You can also control the robot with Infrared remote controller.

		Reset			MENU	Buzzer ON/OFF
	TEST	Spot Turn to Left	+	Forward		Spot Turn to Right
	⏮	Forward Left	▶	Speed Adjustment	⏭	Forward Right
	0	Obstacle Avoidance	−	Backward	C	Obstacle Avoidance Mode OFF
	1	Red of RGB LED ON/OFF	2	Green of RGB LED ON/OFF	3	Blue of RGB LED ON/OFF
	4	Modes of WS2812	5	Modes of Dynamic Expressions	6	Random Display of Static Expressions
	7	Custom	8	Custom	9	Custom

Chapter1 Servo Test(Importance)

Component Knowledge

Servo is an auto-control system, consisting of DC motor, reduction gear, sensor and control circuit. Usually, it can rotate at a range of 180 degrees. Servo can output larger torque and is widely used in model airplane, robot and so on. It has three lines, including two for electric power line positive (2-VCC, red), negative (3-GND, brown), and the signal line (1-Signal, orange).



We use 50Hz PWM signal to drive the servo. The lasting time 0.5ms-2.5ms of PWM single cycle high level corresponds to the servo angle 0 degrees - 180 degrees linearly. Part of the corresponding values are as follows:

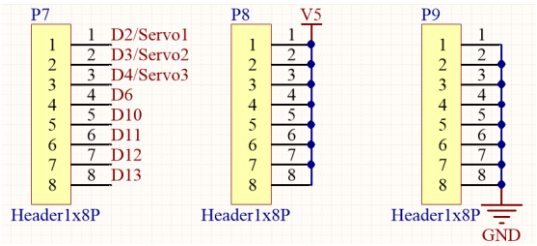
High level time	Servo angle
0.5ms	0 degree
1ms	45 degree
1.5ms	90 degree
2ms	135 degree
2.5ms	180 degree

When you change the servo signal, servo will rotate to the designated position.

Circuit

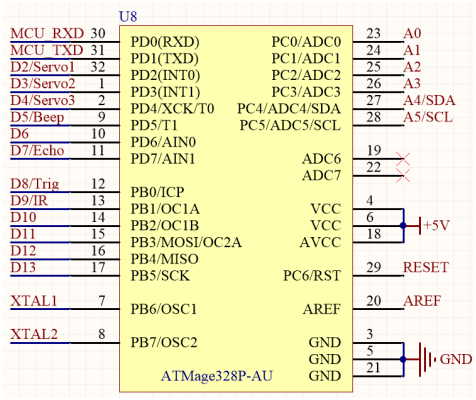
Schematic diagram

Servo



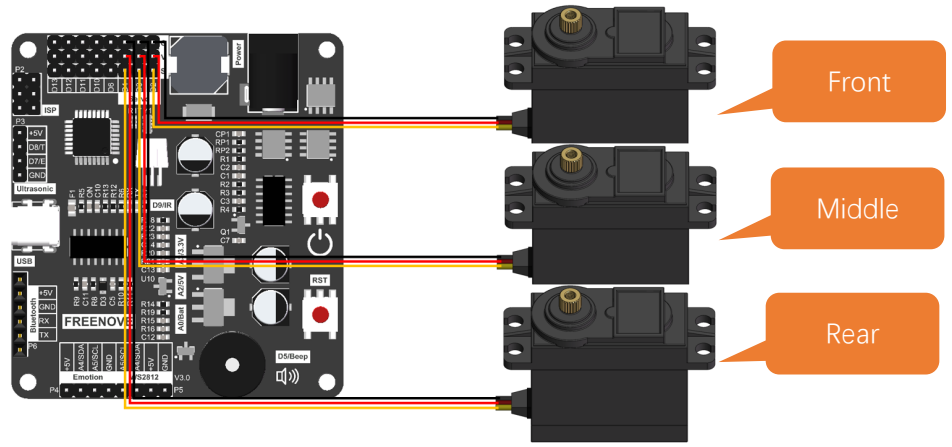
If you don't feel like using D2-D4, you can change the wiring and modify code to use D6, D10-D13

Main control chip pins



Hardware connection. If you need any support, please feel free to contact us via: support@freenove.com

Wiring of servo to mian board:

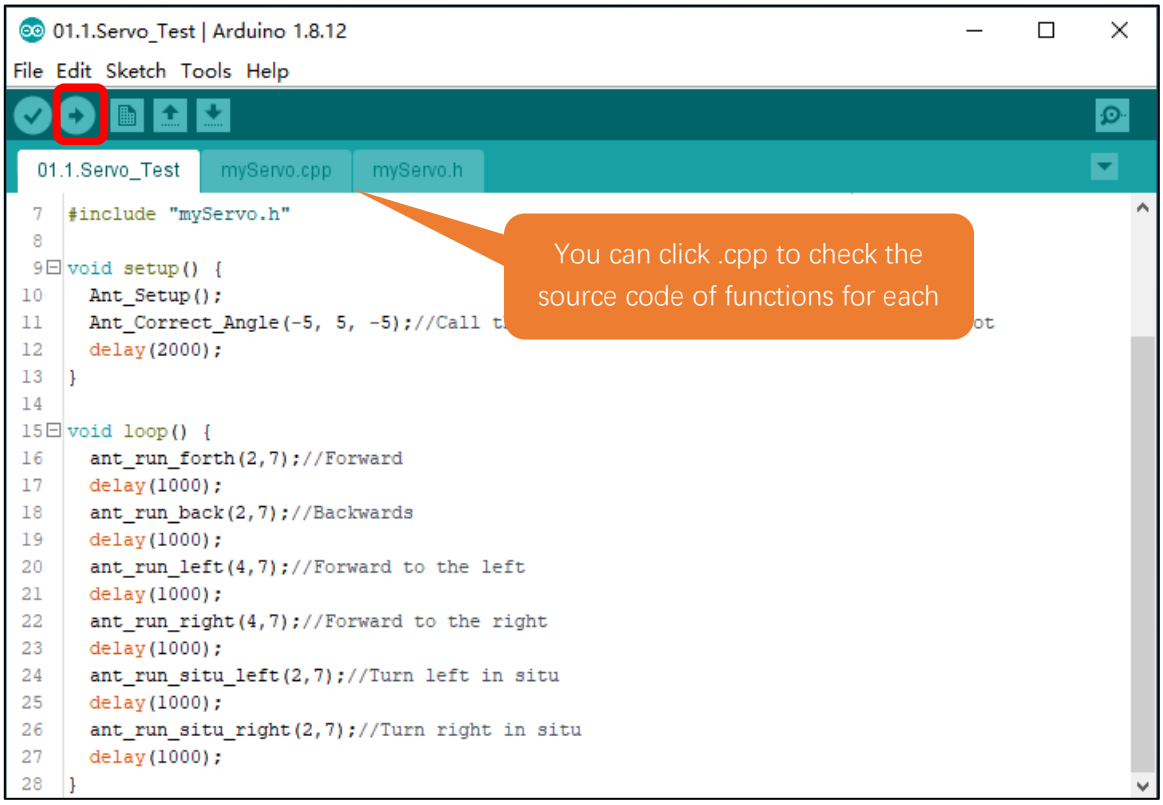


Sketch

Upload code to control board to control the robot ant.

Open the 01.1.Servo_Test.ino in **Freenove_Robot_Ant_Kit\Sketches\01.1.Servo_Test**.

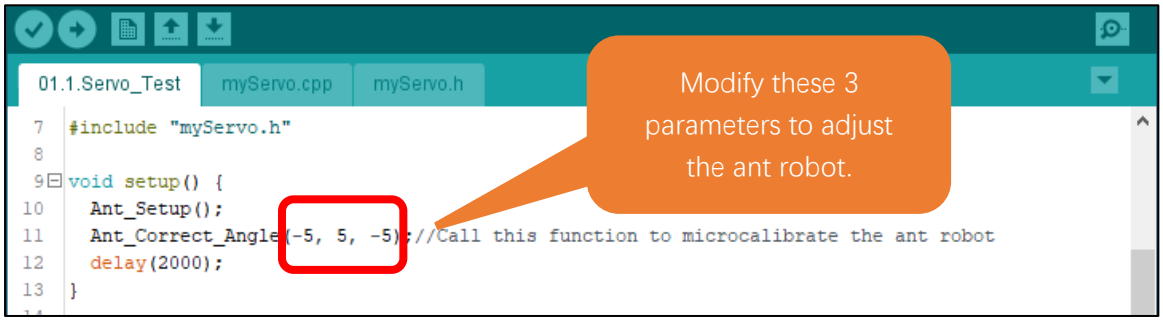
If you are interested in the realization of functions in myServo.h file, you can click on myServo.cpp to check.



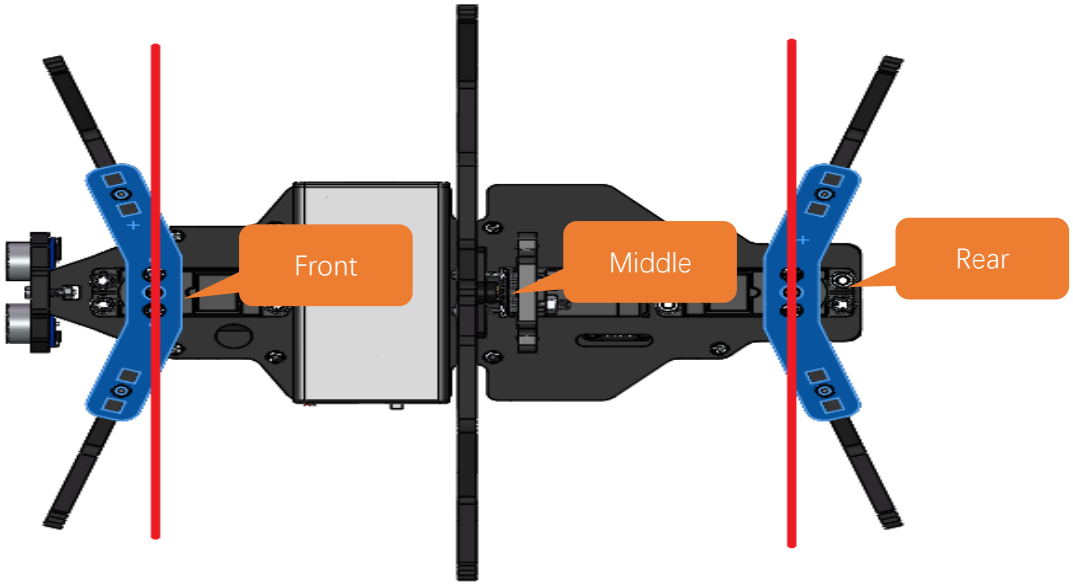

```
#include "myServo.h"

void setup() {
  Ant_Setup();
  Ant_Correct_Angle(-5, 5, -5);//Call t
  delay(2000);
}

void loop() {
  ant_run_forth(2,7);//Forward
  delay(1000);
  ant_run_back(2,7);//Backwards
  delay(1000);
  ant_run_left(4,7);//Forward to the left
  delay(1000);
  ant_run_right(4,7);//Forward to the right
  delay(1000);
  ant_run_situ_left(2,7);//Turn left in situ
  delay(1000);
  ant_run_situ_right(2,7);//Turn right in situ
  delay(1000);
}
```

Calibrate the joints of the ant robot

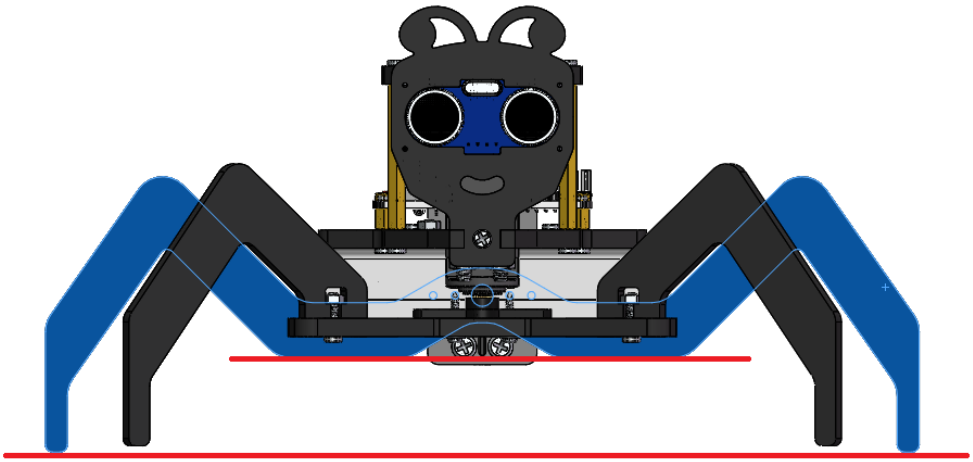
When robot ant is powered, robot legs may be not in ideal position. You can adjust the joint by modify parameters of function Ant_Correct_Angle(x1, x2, x3) to modify.



Modify the first and third parameters of the Ant_Correct_Angle(x1, x2, x3) function, to make the front and rear legs of the ant robot parallel to the red line.

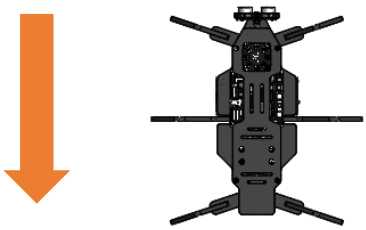


Modify the second parameter of the Ant_Correct_Angle(x1, x2, x3) function, to make the moddle leg of the ant robot parallel to the red line.



The joints in later projects may also need to be adjusted.

Compile and upload code to control board. The movement of the ant will be as follows:

1. Forward 	2. Backward 
3. Turn Left 	4. Turn Right 
5, Spot Turn to Left 	6, Spot Turn to Right 

Code:

```
#include "myServo.h"

void setup() {
  Ant_Setup();
  delay(2000);
}

void loop() {
  ant_run_forth(2,7);//Forward
  delay(1000);
  ant_run_back(2,7);//Backwards
  delay(1000);
  ant_run_left(4,7);//Forward to the left
  delay(1000);
  ant_run_right(4,7);//Forward to the right
  delay(1000);
  ant_run_situ_left(2,7);//Turn left in situ
```

```
18    delay(1000);
19    ant_run_situ_right(2,7);//Turn right in situ
20    delay(1000);
21  }
```

Explanation of Code

Include the header file of library function, which makes it easier to call the program.

```
1  #include "myServo.h"
```

In the Initialization function setup(), call Ant_Setup() function to initialize the servos. Delay for 2s after initialization.

```
3  void setup() {
4    Ant_Setup();
5    delay(2000);
6  }
```

In the loop() function, the motion function of the robot is constantly called to control it to make different actions.

```
8  void loop() {
9    ant_run_forth(2,7);//Forward
10   delay(1000);
11   ant_run_back(2,7);//Backwards
12   delay(1000);
13   ant_run_left(4,7);//Forward to the left
14   delay(1000);
15   ant_run_right(4,7);//Forward to the right
16   delay(1000);
17   ant_run_situ_left(2,7);//Turn left in situ
18   delay(1000);
19   ant_run_situ_right(2,7);//Turn right in situ
20   delay(1000);
21 }
```

To facilitate users to learn, we have written some driving functions for servos to help our users learn how to control robot ant more quickly.

Below are the contents of myServo.h.

Reference

`void Ant_Setup(void)`
Ant_Setup() function is used to initialize the pins of servos so that they can control the servos. When initializing control board, please include it to initialization code; Otherwise, it won't be able to control servos.
`void Ant_Correct_Angle(int angle1, int angle2, int angle3)`
Ant_Correct_Angle() function is used to correct the installation error of the servos. After we install the robot ant, its legs may not be exactly at the middle, so we can use this function to fine-tune the program. When initializing control board, please include it to initialization code. Angle1: Adjust Servo1. Recommended value: -5 to +5. Angle2: Adjust Servo2. Recommended value: -5 to +5. Angle3: Adjust Servo3. Recommended value: -5 to +5.

```
void ant_run_forth(int times, int mdelayms);
void ant_run_back(int times, int mdelayms);
void ant_run_left(int times, int mdelayms);
void ant_run_right(int times, int mdelayms);
void ant_run_situ_left(int times, int mdelayms);
void ant_run_situ_right(int times, int mdelayms);
```

These functions are used to control the robot's movement. They are blocking functions that can only be ended by interruption function.
ant_run_forth(): Controls the robot to crawl forward
ant_run_back(): Cpntrols the robot to crawl backward
ant_run_left(): Controls the robot to craw forward left
ant_run_left():Controls the robot to craw forward right
ant_run_situ_left(): Controls the robot to make spot turn to left.
ant_run_situ_right(): Controls the robot to make spot turn to left.
times: Indicates the times that the robot moves
mdelayms: Indicates the spped of the robot. The bigger the value is, the slower the robot moves.

```
void ant_reset_angle(void);
bool ant_move_forth(int times, int mdelayms, int state = 1);
bool ant_move_back(int times, int mdelayms, int state = 1);
bool ant_move_left(int times, int mdelayms, int state = 1);
bool ant_move_right(int times, int mdelayms, int state = 1);
bool ant_situ_left(int times, int mdelayms, int state = 1);
bool ant_situ_right(int times, int mdelayms, int state = 1);
```

These functions are also used to control the robot's movement. But they are non-blocking functions that can only be ended at any time.
ant_move_forth(): Controls the robot to crawl forward
ant_move_back (): Cpntrols the robot to crawl backward
ant_move_left(): Controls the robot to craw forward left
ant_move_right ():Controls the robot to craw forward right
ant_situ_left (): Controls the robot to make spot turn to left.
ant_situ_right (): Controls the robot to make spot turn to left.
times: Indicates the times that the robot moves
mdelayms: Indicates the spped of the robot. The bigger the value is, the slower the robot moves.
state: If state=1, then the robot keeps crawling and times is invalid. If state=0, then the robot will crawl for "times" times and then stops.

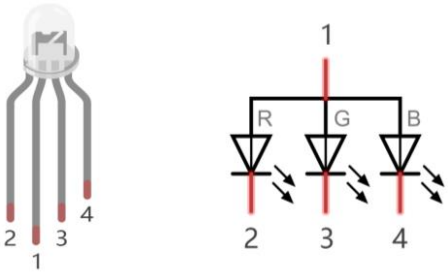
```
void Ant_Servo_Mode(int mode, int speed=1, bool state=1);     //Set the movement mode of the ant
```

Ant_Servo_Mode() function is a further package of the above serven non-blocking functions.
mode: 0-ant_reset_angle(), 1-ant_move_forth(), 2-ant_move_back(), 3-ant_move_left(), 4-ant_move_right(), 5-ant_situ_left(), 6-ant_situ_right()
speed: 0-fast, 1-intermediate, 2-slow
state: If state=1, then the robot keeps crawling and times is invalid. If state=0, then the robot will crawl for "times" times and then stops.

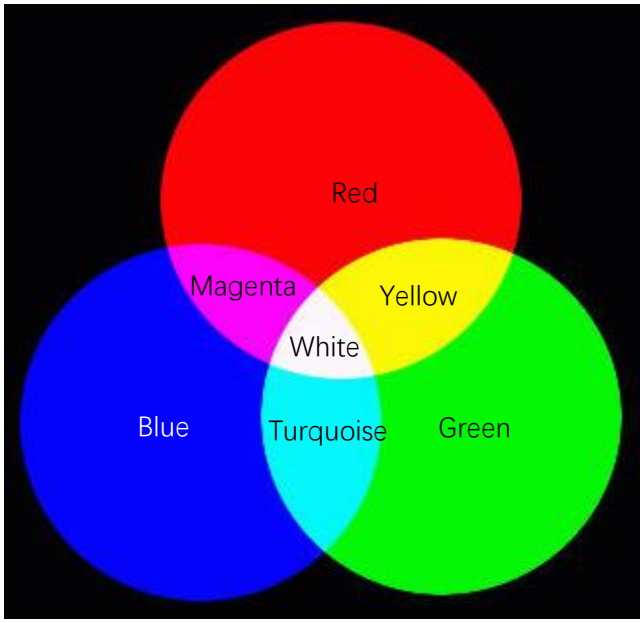
Chapter2 WS2812 Module Test

Component Knowledge

An RGB LED has 3 LEDs integrated into one LED component. It can respectively emit Red, Green and Blue light. In order to do this, it requires 4 pins (this is also how you identify it). The long pin (1) is the common which is the Anode (+) or positive lead, the other 3 are the Cathodes (-) or negative leads. A rendering of an RGB LED and its electronic symbol are shown below. We can make RGB LED emit various colors of light and brightness by controlling the 3 Cathodes (2, 3 & 4) of the RGB LED.



Red, Green, and Blue light are called 3 Primary Colors when discussing light (Note: for pigments such as paints, the 3 Primary Colors are Red, Blue and Yellow). When you combine these three Primary Colors of light with varied brightness, they can produce almost any color of visible light. Computer screens, single pixels of cell phone screens, neon lamps, etc. can all produce millions of colors due to this phenomenon.

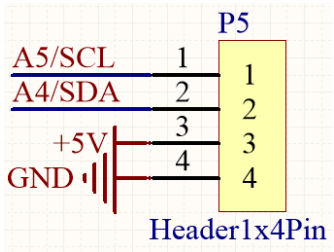


We know from previous section that, control board controls LEDs to emit a total of 256(0-255) different brightness. So, through the combination of three different colors of LEDs, RGB LED can emit 256^3=16777216 Colors, 16Million colors.

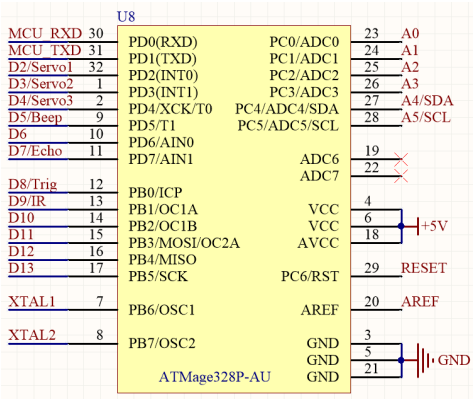
Circuit

Schematic diagram

RGB LED Control Module pins



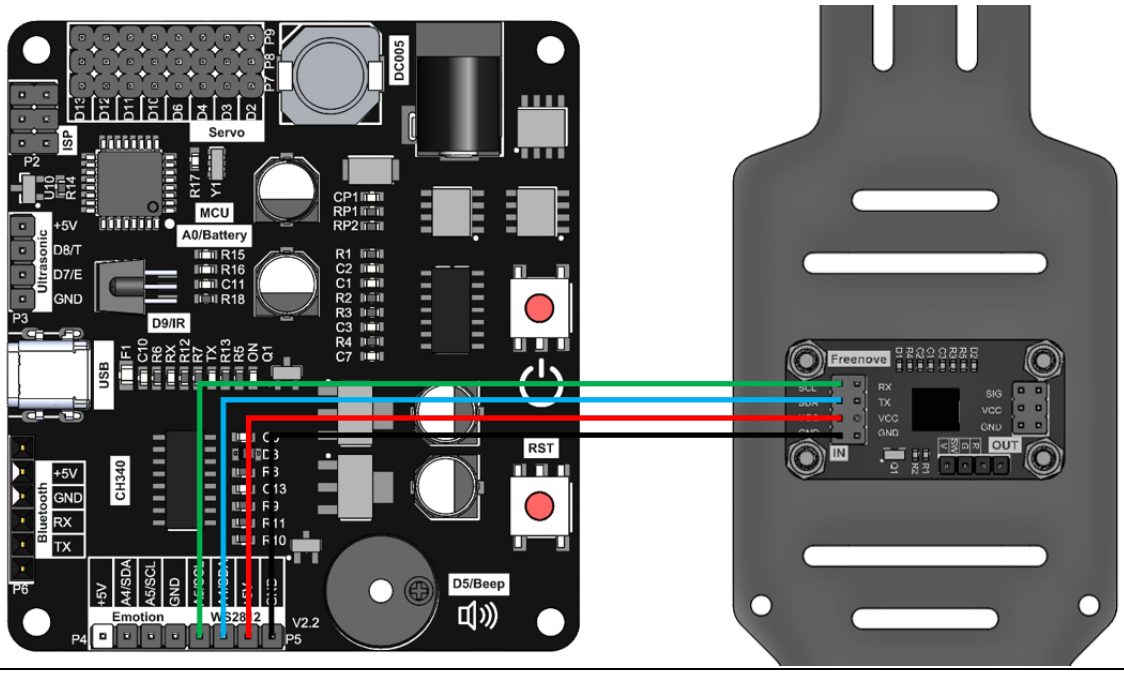
Main control chip pins

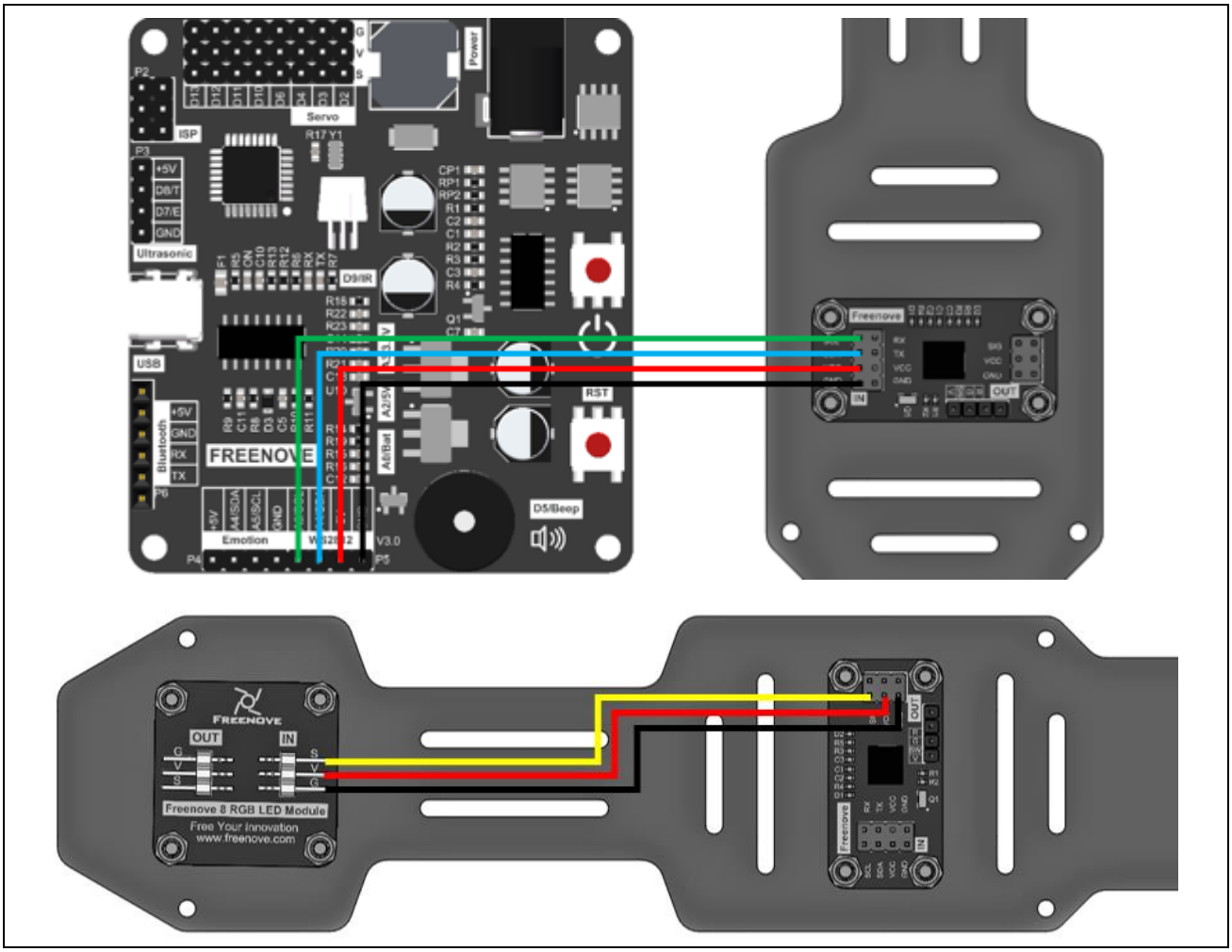


Hardware connection.

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

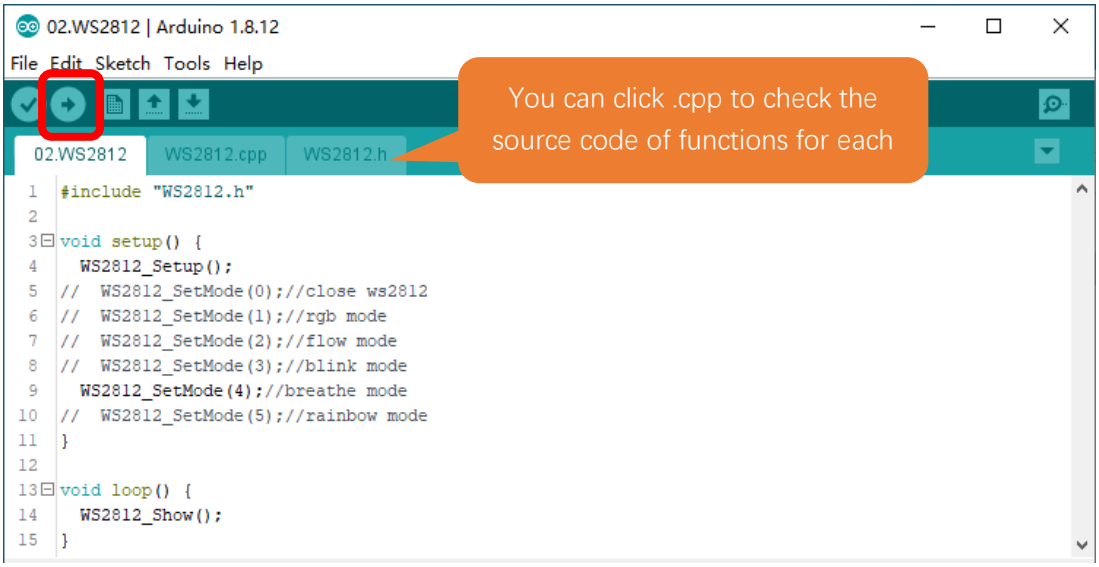
Wiring of RGB LED module to the control board



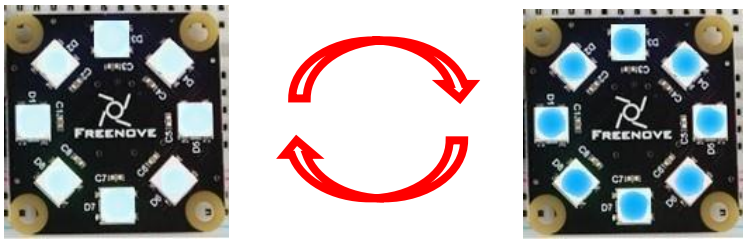

FREENOVE
Servo
Power
Ultrasonic
Bluetooth
USB
RST
D5/Beep
Emotion
V3.0
OUT
IN
Freenove 8 RGB LED Module
Free Your Innovation
www.freenove.com

Sketch

Open the 02.WS2812.ino in **Freenove_Robot_Ant_Kit\Sketches\02.WS2812**.
If you are interested in the realization of functions in WS2812.h file, you can click on WS2812.cpp to check.



Compile and upload code and the WS2812 LED module will gradually emit blue light and then OFF gradually. This process will repeat over and over again.



Code:

```
#include "WS2812.h"

void setup() {
  WS2812_Setup();
//  WS2812_SetMode(0);//close ws2812
//  WS2812_SetMode(1);//rgb mode
//  WS2812_SetMode(2);//flow mode
//  WS2812_SetMode(3);//blink mode
  WS2812_SetMode(4);//breathe mode
//  WS2812_SetMode(5);//rainbow mode
}
void loop() {
  WS2812_Show();
}
```

Explanation of Code

Include the header file of library function, which makes it easier to call the program.

```
1  #include "WS2812.h"
```

WS2812_Setup() function is called to initialize the LED control module and set the default color to blue.

```
4    WS2812_Setup();
```

WS2812_SetMode() function is called to set the display mode to breathing light mode.

```
9    WS2812_SetMode(4);
```

In the main loop, WS2812_Show() is called constantly to make the module work.

```
13   WS2812_Show();
```

Reference

```
void WS2812_Setup(void)
```

WS2812_Setup() function is used to initialize RGB LED moduel. When initializing control board, please include it to the initialization code; Otherwise, it will fail to have the module display any color.

```
void WS2812_Set_Color(unsigned char color_1,unsigned char color_2,unsigned char color_3);
```

WS2812_Ser_Color() function is used to set the color of RGB LED module.
color_1: Brightness of red. Range: 0-255.
color_2: Brightness of green. Range: 0-255.
color_3: Brightness of blue. Range: 0-255.

```
void WS2812_Set_LED(bool red=0,bool green=0,bool blue=0,int brightness=20);
```

WS2812_Set_LED() function is used to set the color of the LED module.
red: If red=1, emits red light; if red=0, red light OFF.
green: If green=1, emits green light; if green=0, green light OFF.
blue: If blue-1, emits blue light; if blue=0, blue light OFF.
Brightness: Set brightness of the LED. Range: 0-255.

```
void ws2812_close(void);
void ws2812_flowing(void);
void ws2812_rgb(void);
void ws2812_blink(void);
void ws2812_breathe(void);
void ws2812_rainbow(void);
```

Above are 6 non-blcoking function controlling the LED moduel, which are called through WS2812_Show(). And we use WS2812_SetMode() to determine the mode and use WS2812_Set_Color() to set the display color.
ws2812_close(): Turn OFF the LED module.
ws2812_flowing(): Flowing Water Light Mode
ws2812_rgb(): Light Always-ON Mode
ws2812_blink(): Blinking Light Mode
ws2812_breathe(): Breathing Light Mode
ws2812_rainbow(): Rainbow Light Mode

```
void WS2812_Show(void);
```

WS2812_Show() function is used to send command to LED control module to control the LED module to display colors.

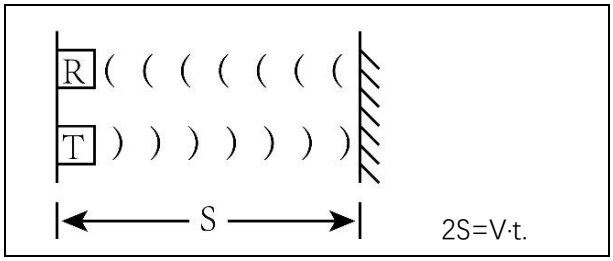
```
void WS2812_SetMode(int mode);
```

The function to set the display mode of the LED module. Based on different parameter, the LED module can run on different mode.
Mode:0-LED OFF; 1-Light Always-ON; 2-Flowing Water Light; 3- Blinking; 4- Breathing; 5- Rainbow Light

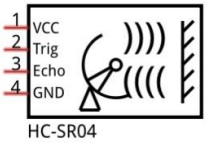
Chapter3 Ultrasonic Module Test

Component Knowledge

The ultrasonic ranging module uses the principle that ultrasonic waves will be sent back when it detects obstacles. We can measure the distance by counting the time interval between sending and receiving of the ultrasonic waves, and the time difference is the total time of the ultrasonic wave's journey from being transmitted to being received. Because the speed of sound in air is a constant, about v=340m/s, we can calculate the distance between the ultrasonic ranging module and the obstacle: s=vt/2.



The HC-SR04 ultrasonic ranging module integrates both an ultrasonic transmitter and a receiver. The transmitter is used to convert electrical signals (electrical energy) into high frequency (beyond human hearing) sound waves (mechanical energy) and the function of the receiver is opposite of this. The picture and the diagram of the HC SR04 ultrasonic ranging module are shown below:



Pin description:

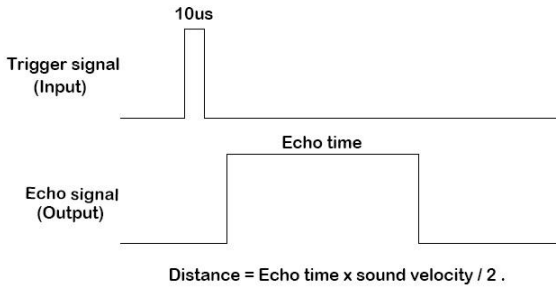
Pin	Description
VCC	power supply pin
Trig	trigger pin
Echo	Echo pin
GND	GND

Technical specs:

Working voltage: 5V Working current: 12mA

Minimum measured distance: 2cm Maximum measured distance: 200cm

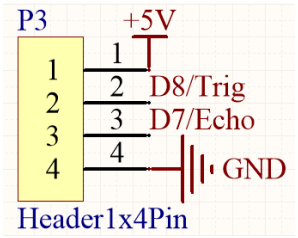
Instructions for use: output a high-level pulse in Trig pin lasting for at least 10us, the module begins to transmit ultrasonic waves. At the same time, the Echo pin is pulled up. When the module receives the returned ultrasonic waves from encountering an obstacle, the Echo pin will be pulled down. The duration of high level in the Echo pin is the total time of the ultrasonic wave from transmitting to receiving, s=vt/2.



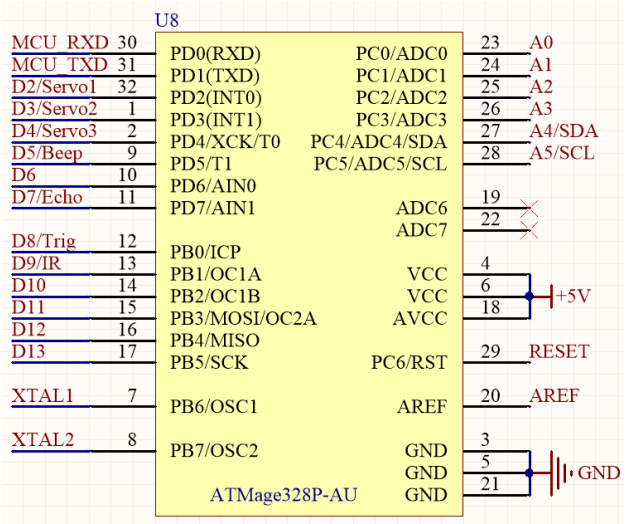
Circuit

Schematic diagram

Ultrasinnic Module Pins

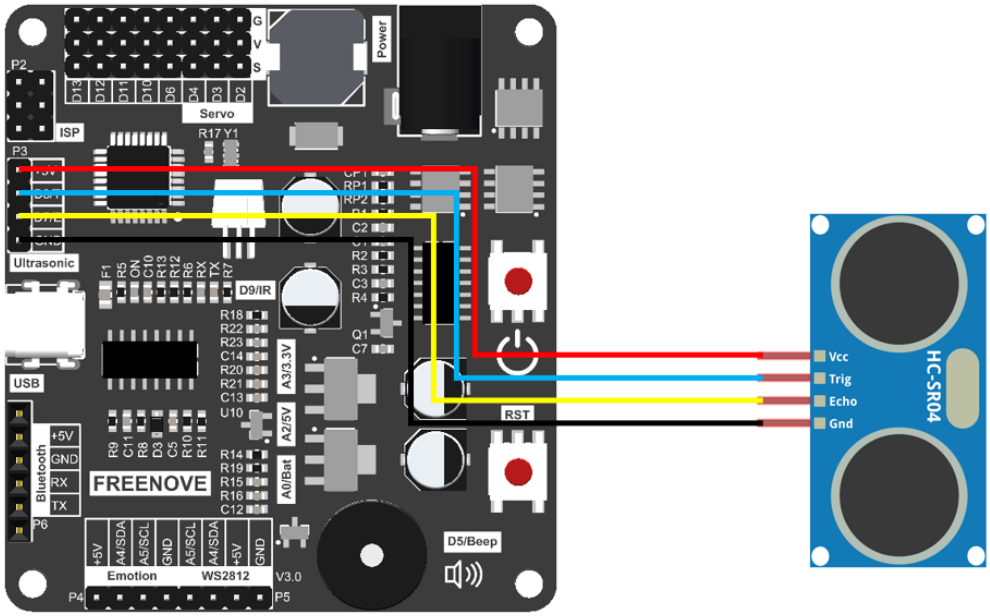


Main control chip pins



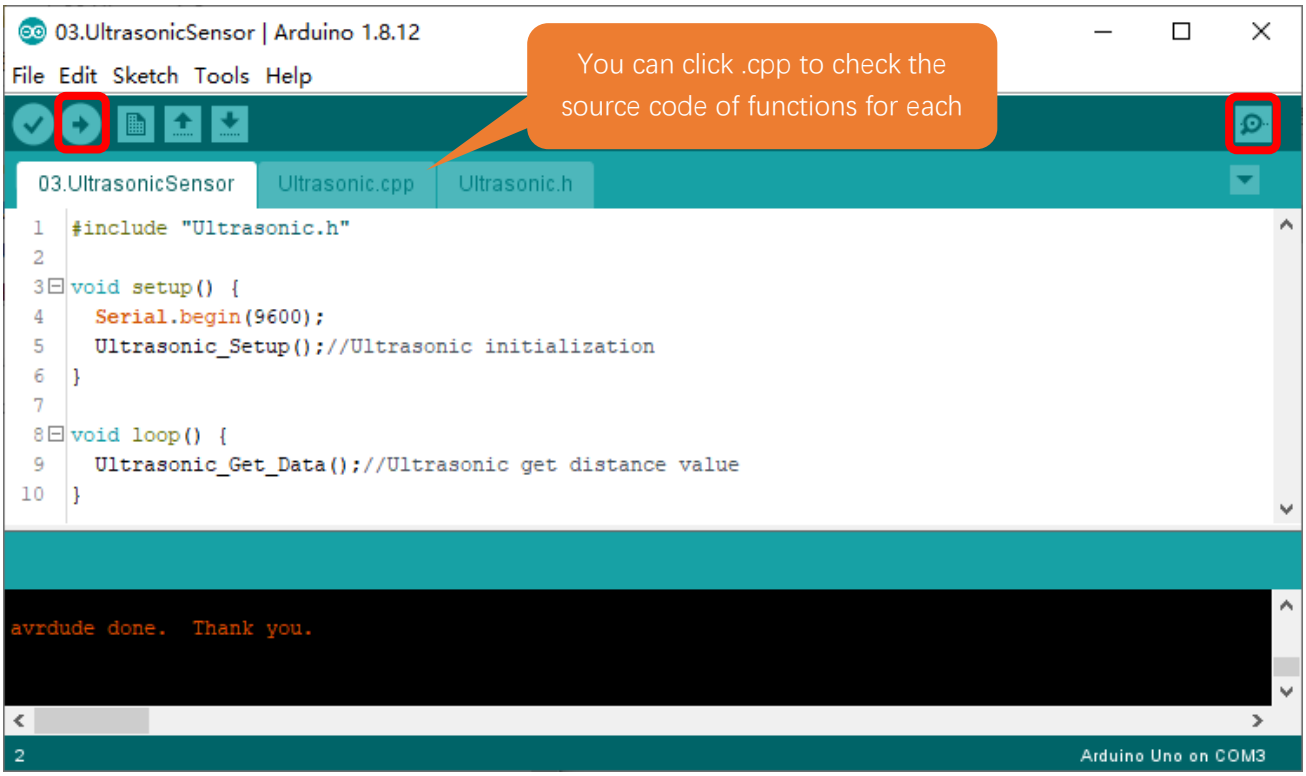
Hardware connection. If you need any support, please feel free to contact us via: support@freenove.com

Wiring of ultrasonic module to the control board

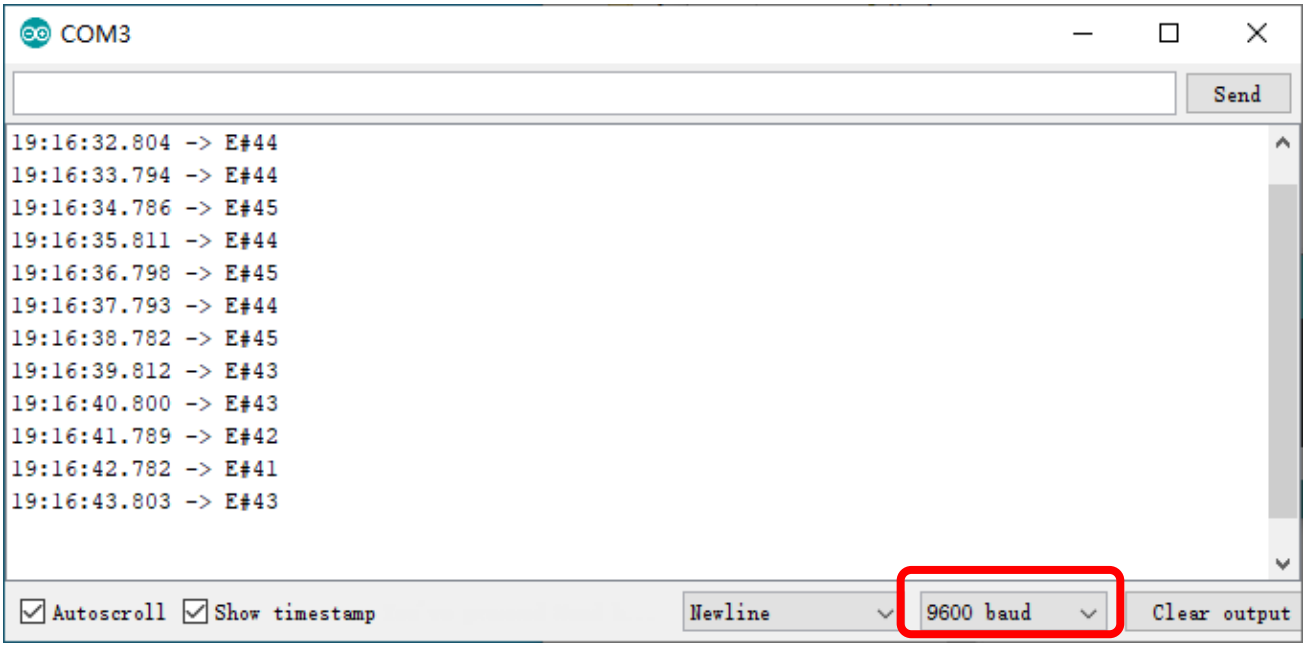


Sketch

Open 03.UltrasonicSensor.ino in **Freenove_Robot_Ant_Kit\Sketches\03.UltrasonicSensor.**
If you are interested in the realization of functions in Ultrasonic.h file, you can click on Ultrasonic.cpp to check.



Compile and upload the code. When the program is uploaded successfully, open the serial monitor, set baud rate to 9600, and you can observe that the control board receives distance messages from the ultrasonic module every 1s and print them on the screen in centimeter



Code:

```
#include "Ultrasonic.h"

void setup() {
  Serial.begin(9600);
  Ultrasonic_Setup();//Ultrasonic initialization
}

void loop() {
  Ultrasonic_Get_Data();//Ultrasonic get distance value
}
```

Explanation of Code

Include the header file of library function, which makes it easier to call the program.

```
#include "Ultrasonic.h"
```

Initialize the serial communication function of the control board and set baud rate to 9600.

```
  Serial.begin(9600);
```

Initialize the ultrasonic module.

```
  Ultrasonic_Setup();//Ultrasonic initialization
```

Obtain the distance messages from ultrasonic module every 1s and print them through serial port.每

```
  Ultrasonic_Get_Data();//Ultrasonic get distance value
```

Reference

```
void Ultrasonic_Setup(void);
```

Ultrasonic_Setup() function is used to initialize ultrasonic module.

```
int Ultrasonic_Get_Data(int delayms=1000);
```

By default, control board receives the distance messages from ultrasonic module every 1s and stores them to Ultrasonic_Value and print them through serial port.

Delayms: Every delayms millisecond, distance information is obtained from ultrasonic module. Range: 0-32767

```
void Ultrasonic_Bluetooth_Data(void)
```

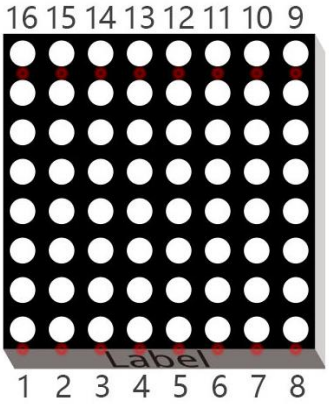
Obtain information from ultrasonic module and send it through serial port.(applied when receiving commands from Bluetooth module)

Chapter4 Expression module Test

Component Knowledge

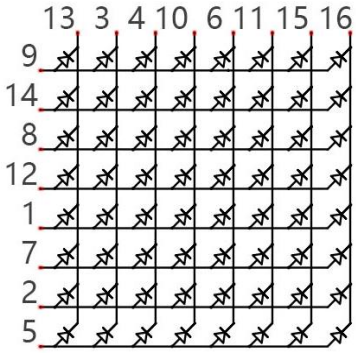
LED Matrix

An LED matrix is a rectangular display module that consists of a uniform grid of LEDs. The following is an 8X8 monochrome LED matrix containing 64 LEDs (8 rows by 8 columns).

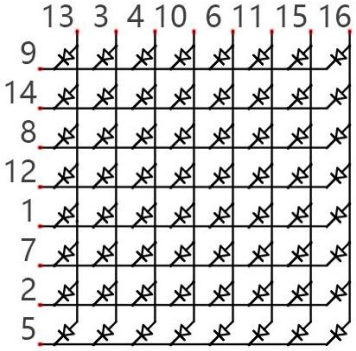


In order to facilitate the operation and reduce the number of ports required to drive this component, the positive poles of the LEDs in each row and negative poles of the LEDs in each column are respectively connected together inside the LED matrix module, which is called a common anode. There is another arrangement type. Negative poles of the LEDs in each row and the positive poles of the LEDs in each column are respectively connected together, which is called a common cathode.

Connection mode of common anode

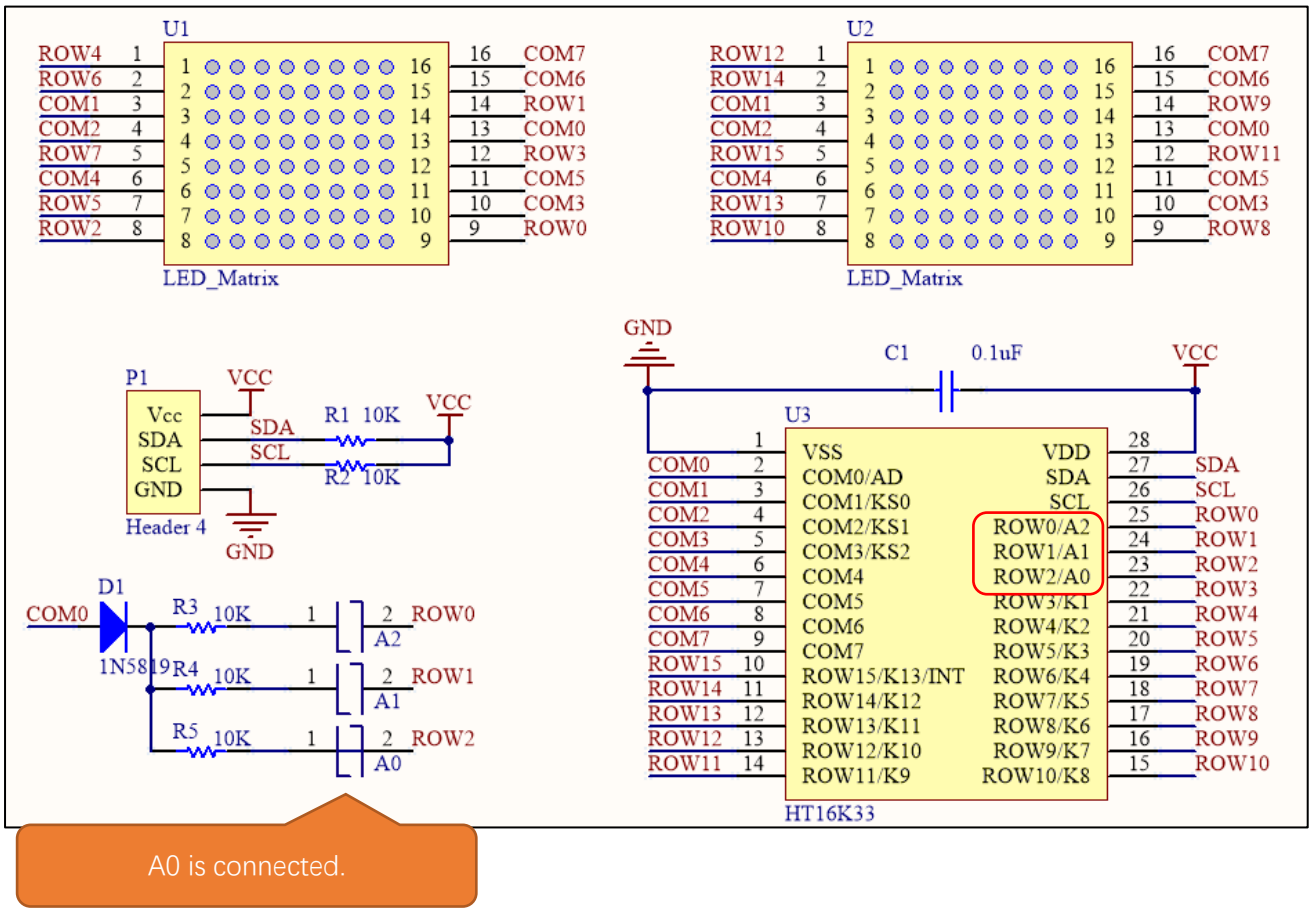


Connection mode of common cathode

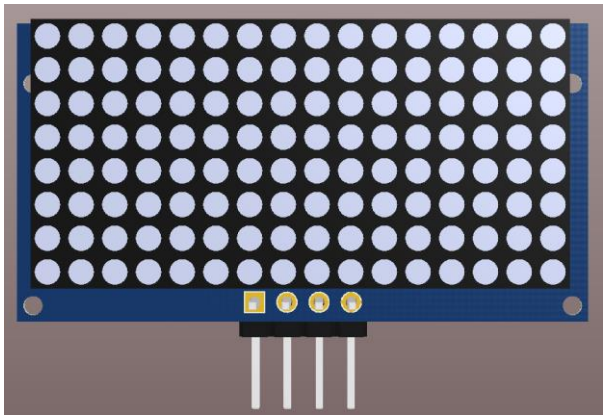
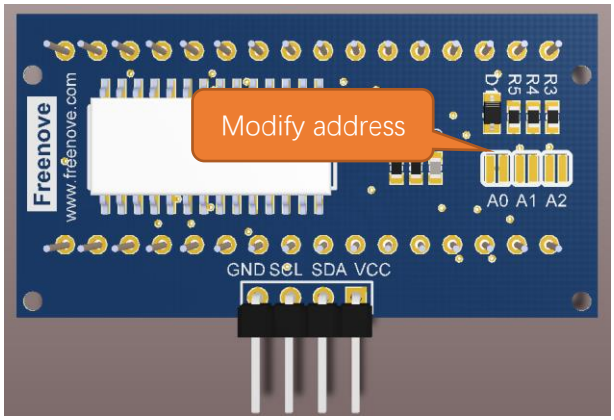


Schematic

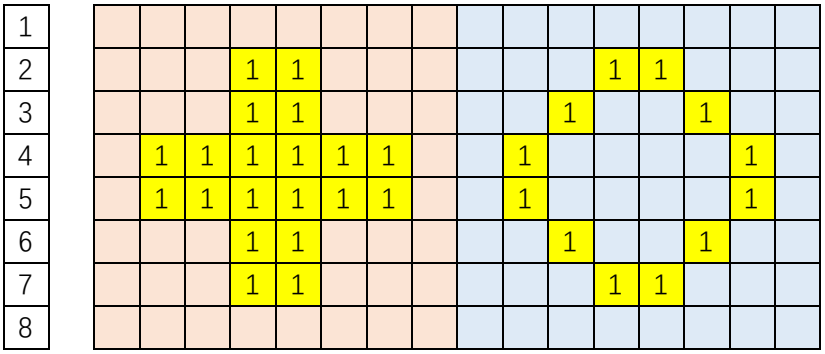
For this tutorial, the LED matrix module is individual and it is driven by IIC chip.



The LED matrix is common anode. As we can see from the schematic above, the anode of LED matrix is connected to ROWx of HT16K33 chip, and the cathode is connected to COMx. The address of HT16K33 chip is (0x70+[A2:A0]), and the default address of LED matrix is 0x71. If you want to change the address, you can use a knife to cut the connecting line in the middle of A0, or connect A1/A2.

Front of LED Matrix	Back of LED Matrix
	

We divide the LED matrix into two sides and display "+" on the left and "o" on the right. As shown below, yellow stands for lit LED while other colors reprensent the OFF LED.



Below, the table on the left corresponds to the "+" above, and the table on the right corresponds to the "o" above.

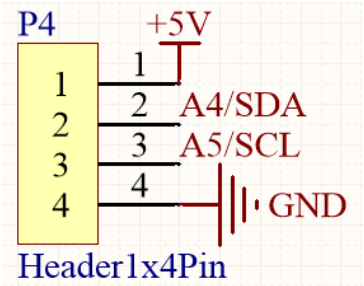
Row	Binary	Hexadecimal
1	0000 0000	0x00
2	0001 1000	0x18
3	0001 1000	0x18
4	0111 1110	0x7e
5	0111 1110	0x7e
6	0001 1000	0x18
7	0001 1000	0x18
8	0000 0000	0x00

Row	Binary	Hexadecimal
1	0000 0000	0x00
2	0001 1000	0x18
3	0010 0100	0x24
4	0100 0010	0x42
5	0100 0010	0x42
6	0010 0100	0x24
7	0001 1000	0x18
8	0000 0000	0x00

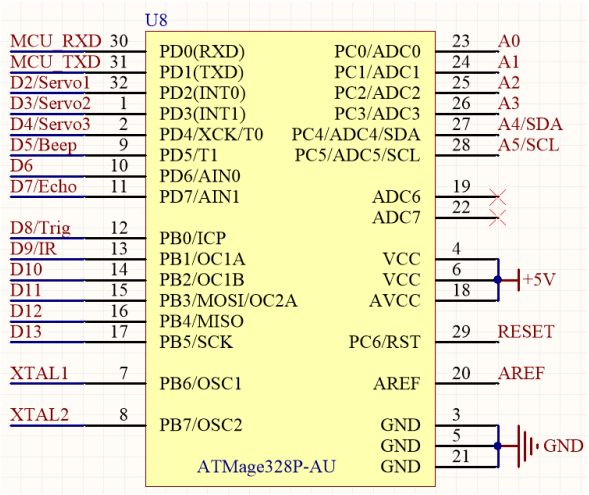
Circuit

Schematic diagram

Expression module Pins

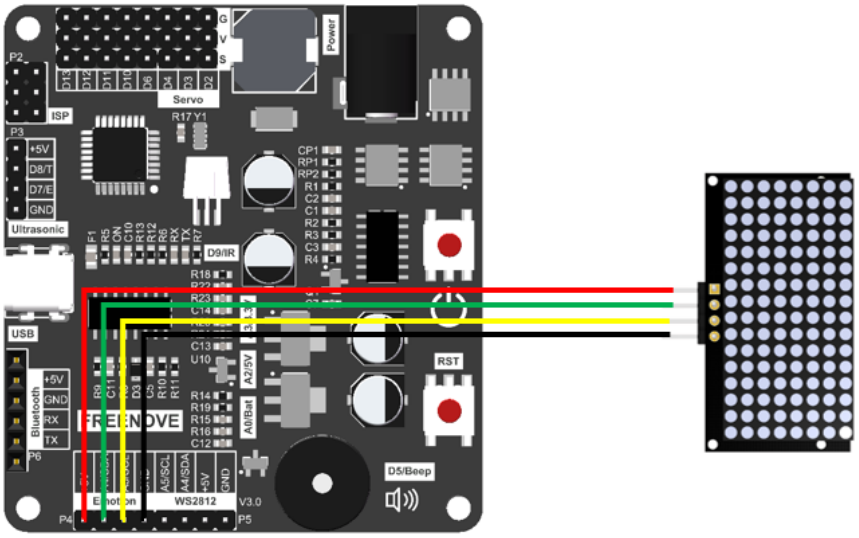


Main Control Chip Pins



Hardware connection. If you need any support, please feel free to contact us via: support@freenove.com

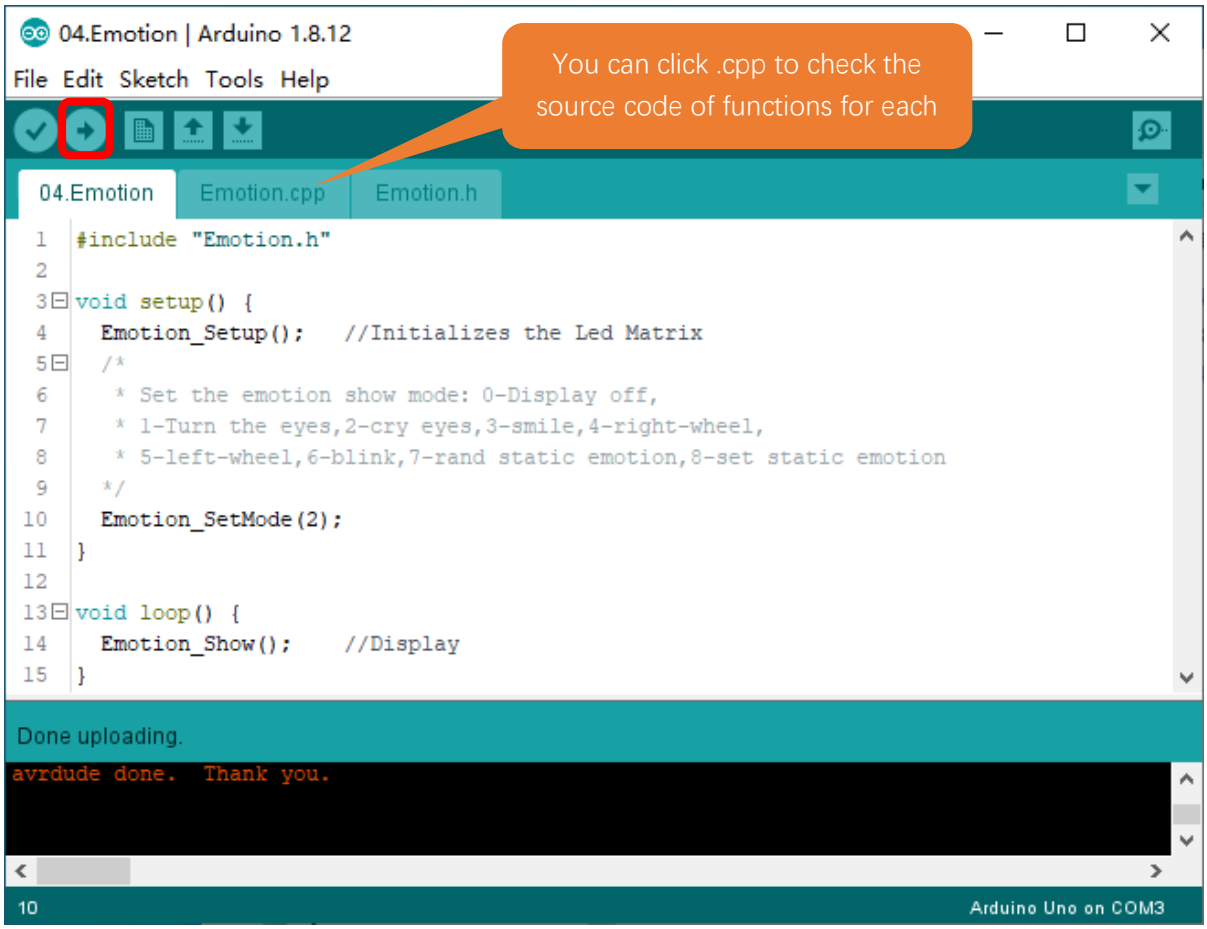
Wiring of expression module to control board



Sketch

Open 04.Emotion.ino in **Freenove_Robot_Ant_Kit\Sketches\04.Emotion.**

If you are interested in the realization of functions in Emotion.h file, you can click on Emotion.cpp to check.



Compile and upload the code, you will see the expression module dropping tears.


Code:

```
#include "Emotion.h"
void setup() {
  Emotion_Setup();   //Initializes the Led Matrix
  /*
   * Set the emotion show mode: 0-Display off,
   * 1-Turn the eyes,2-cry eyes,3-smile,4-right-wheel,
   * 5-left-wheel,6-blink,7-rand static emotion,8-set static emotion
  */
  Emotion_SetMode(2);
}
void loop() {
  Emotion_Show();    //Display
}
```

Explanation of Code

Include the header file of library function, which makes it easier to call the program.

```
#include "Emotion.h"
```

Emotion_Setup() function is used to initialize expression module.

```
  Emotion_Setup();   //Initializes the Led Matrix
```

Emotion_SetMode() is called to setup exression module to display expressions.

```
  Emotion_SetMode(2);
```

In main loop, Emotion_Show() is constantly called to get expression module work.

```
  Emotion_Show();
```

Reference

void Emotion_Setup(int address = 0x71);

Emotion_Setup() function is used to initialize expression module. When initializing expression module, include it to initialization code; Otherwise, the module will fail to display expressions

void Emotion_Show(void);

Emotion_Show() function is used to send data to expression module so that the control board can control it to display expressions.

```
void Emotion_SetMode(int mode, int static_emotion = 0);
```

Set expression mode.
Mode: 0- Expression module OFF; 1-Eyeballs rotating; 2-Dropping tears; 3- smiling; 4-Clockwise Windmill; 5-Counterclockwise Windmill; 6-Blinking; 7-Random static expressions; 8- Designated static expression, needs to be combined with the use of static_emotion
static_emotion: parameter of static expressions, Range: 0-20. Only available when mode=8.

```
void clearEmtions(void);
void eyesRotate(int delay_ms);
void eyesBlink(int delay_ms);
void eyesSmile(int delay_ms);
void eyesCry(int delay_ms);
void wheel(int mode, int delay_ms);
void staticEmtions(int emotion);
```

These are 7 non-blocking function for expressions display which are called through Emotion_Show(). And we use Emotion_SetMode() function to select which mode to display.
clearEmtions(void): Clear the dislaying content on the module
eyesRotate(int delay_ms): Rotate eyeballs. delay_ms refers to the speed the eyeballs rotates, the larger the number, the slower the speed.
eyesBlink(int delay_ms): Eyes blinking
eyesSmile(int delay_ms): Happy
eyesCry(int delay_ms): Sad
wheel(int mode, int delay_ms): Windmill ratoting. If mode=1, rotate to left; If mode=2, rotate to right.
staticEmtions(int emotion): The function for static expressions displaying. The range of emotion is 0-20.

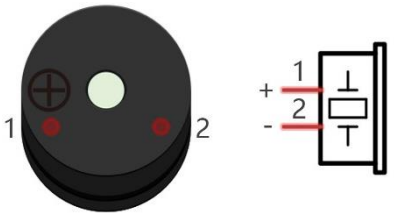
Chapter5 ADC and Buzzer Test

Component Knowledge

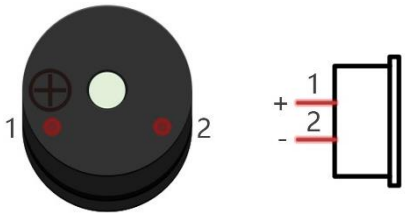
Buzzer

Buzzer is a sounding component, which is widely used in electronic devices such as calculator, electronic warning clock and alarm. Buzzer has two types: active and passive. Active buzzer has oscillator inside, which will sound as long as it is supplied with power. Passive buzzer requires external oscillator signal (generally use PWM with different frequency) to make a sound.

Active buzzer



Passive buzzer



Active buzzer is easy to use. Generally, it can only make a specific frequency of sound. Passive buzzer requires an external circuit to make a sound, but it can be controlled to make a sound with different frequency. The resonant frequency of the passive buzzer is 2kHz, which means the passive buzzer is loudest when its resonant frequency is 2kHz.

Next, we will use an active buzzer to make a doorbell and a passive buzzer to make an alarm.

How to identify active and passive buzzer?

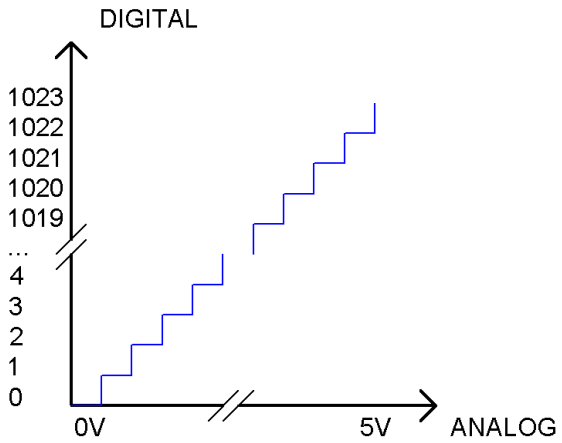
1. Usually, there is a label on the surface of active buzzer covering the vocal hole, but this is not an absolute judgment method.
2. Active buzzers are more complex than passive buzzers in their manufacture. There are many circuits and crystal oscillator elements inside active buzzers; all of this is usually protected with a waterproof coating (and a housing) exposing only its pins from the underside. On the other hand, passive buzzers do not have protective coatings on their underside. From the pin holes viewing of a passive buzzer, you can see the circuit board, coils, and a permanent magnet (all or any combination of these components depending on the model.

Active buzzer

Passive buzzer

ADC

An ADC is an electronic integrated circuit used to convert analog signals such as voltages to digital or binary form consisting of 1s and 0s. The range of our ADC module is 10 bits, that means the resolution is 2^10=1024, so that its range (at 5V) will be divided equally into 1024 parts.
Any analog value can be mapped to one digital value using the resolution of the converter. So the more bits the ADC has, the denser the partition of analog will be and the greater the precision of the resulting conversion.



Subsection 1: the analog in rang of 0V-5/1024V corresponds to digital 0;
Subsection 2: the analog in rang of 5 /1024V-2*5/1024V corresponds to digital 1;
The following analog signal will be divided accordingly.

$$ADC\ Value = \frac{\text{Analog Voltage}}{5.0} * 1023$$

Calculation of External Referenced Voltage

To get more accurate battery level, we use external referenced pins.
For more information of external reference, please visit:
https://www.arduino.cc/reference/en/language/functions/analog-io/analogreference/

Notes and Warnings

After changing the analog reference, the first few readings from `analogRead()` may not be accurate.

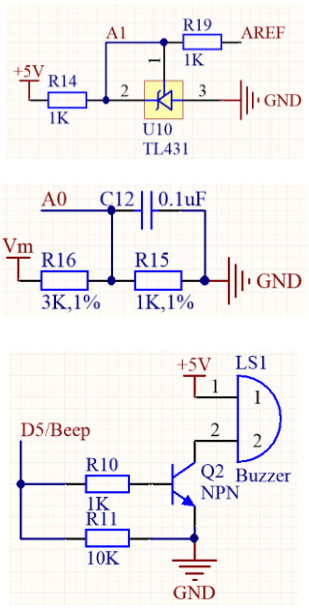
Don't use anything less than 0V or more than 5V for external reference voltage on the AREF pin! If you're using an external reference on the AREF pin, you must set the analog reference to EXTERNAL before calling `analogRead()`. Otherwise, you will short together the active reference voltage (internally generated) and the AREF pin, possibly damaging the microcontroller on your Arduino board.

Alternatively, you can connect the external reference voltage to the AREF pin through a 5K resistor, allowing you to switch between external and internal reference voltages. Note that the resistor will alter the voltage that gets used as the reference because there is an internal 32K resistor on the AREF pin. The two act as a voltage divider, so, for example, 2.5V applied through the resistor will yield 2.5 * 32 / (32 + 5) = ~2.2V at the AREF pin.

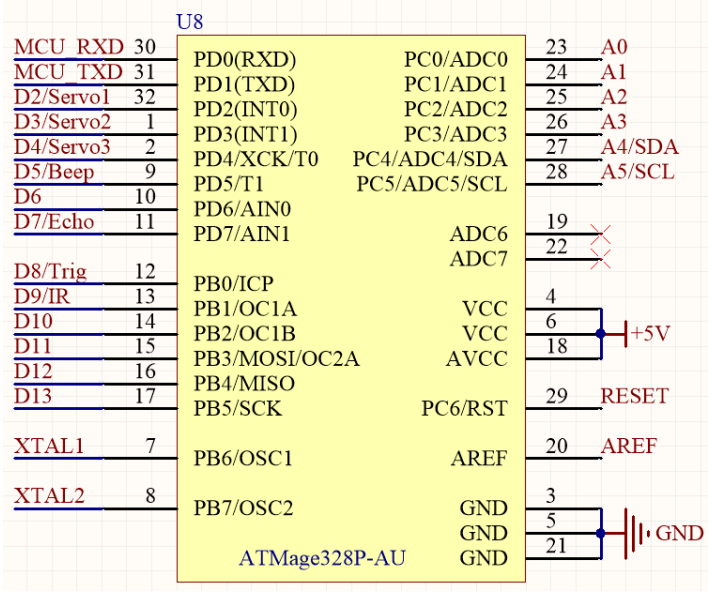
Circuit

Schematic diagram

Battery and buzzer circuits

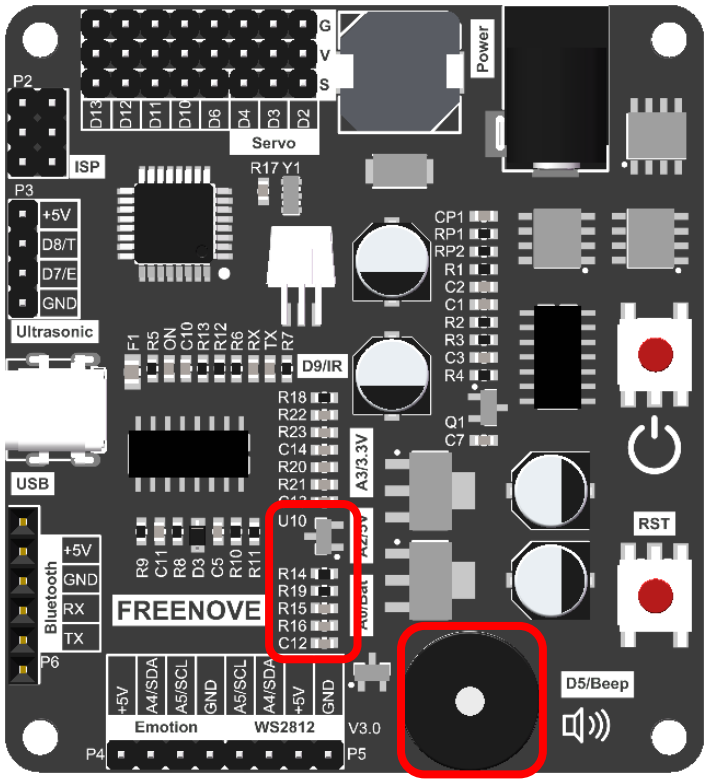


Main Control Chip Pins



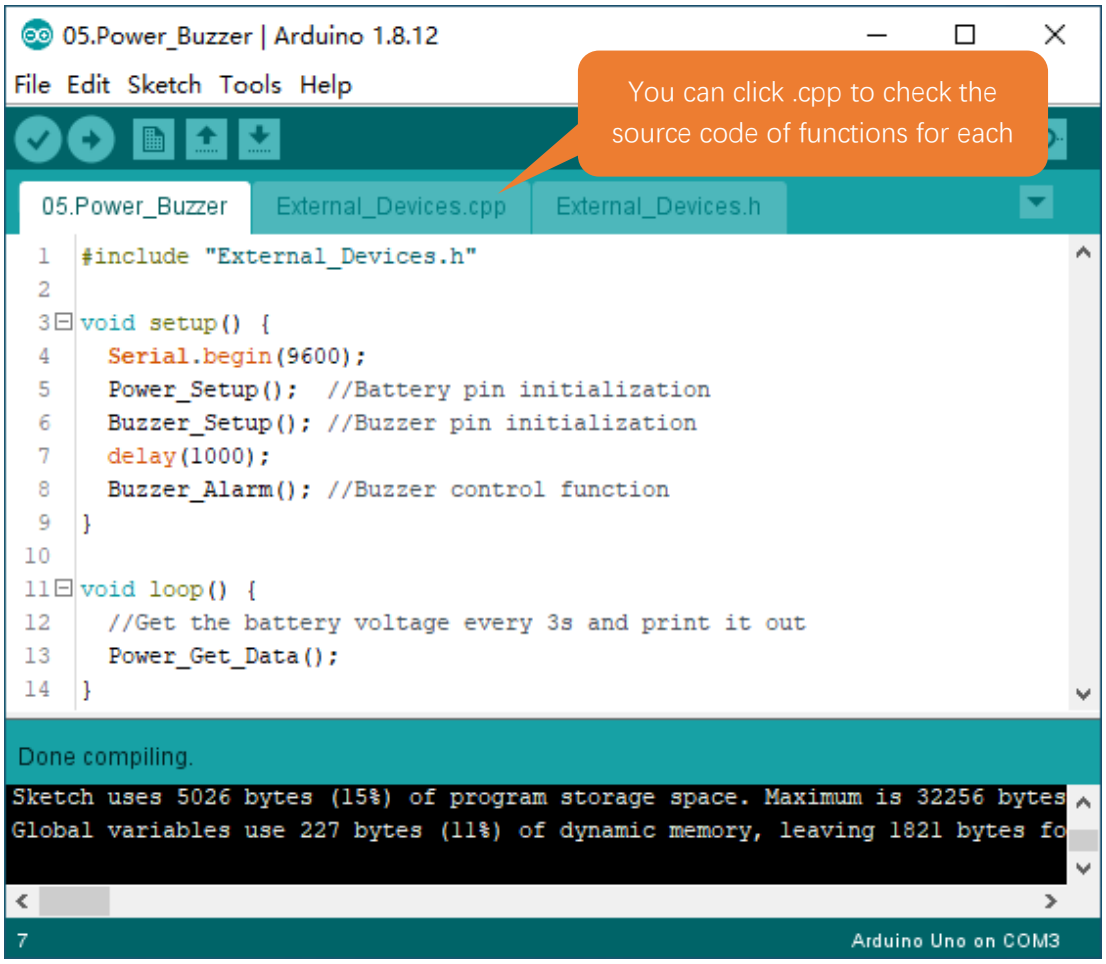
Hardware connection. If you need any support, please feel free to contact us via: support@freenove.com

The area where the circuits lie

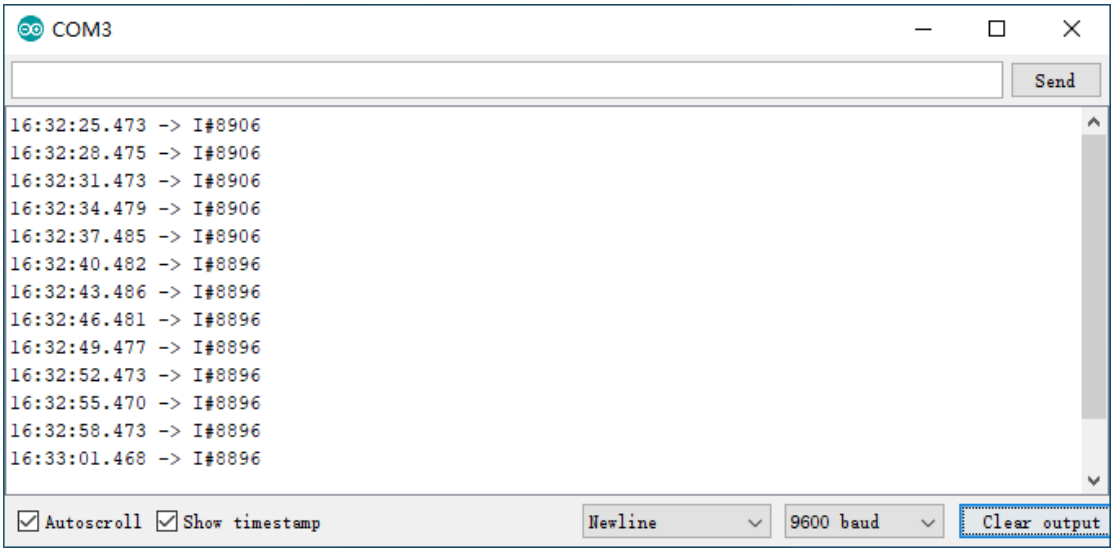


Sketch

Open 05.Power_Buzzer.ino in **Freenove_Robot_Ant_Kit\Sketches\05.Power_Buzzer.**



Compile and upload code, open serial monitor, ser baud rate to 9600 and you will observe the mian board obtains the voltage of batteries and print it through serial port after multiplying the number by 1000.



Code:

```
#include "External_Devices.h"
void setup() {
  Serial.begin(9600);
  Power_Setup();  //Battery pin initialization
  Buzzer_Setup(); //Buzzer pin initialization
  delay(1000);
  Buzzer_Alarm(); //Buzzer control function
}
void loop() {
  //Get the battery voltage every 3s and print it out
  Power_Get_Data();
}
```

Explanation of Code

Include the header file of library function, which makes it easier to call the program.

```
#include "External_Devices.h"
```

Power_ Setup() is called to initialize ADC of control board and calculate external referenced voltage.

```
  Power_Setup();  //Battery pin initialization
```

Buzzer_Setup() is called to initialize D5 of control board so that it can control buzzer to emit sound.

```
  Buzzer_Setup(); //Buzzer pin initialization
```

Buzzer_Alarm() function is used to drive the buzzer. Each time when this function is called, the buzzer will sound at a frequency of 1k and last for 0.1s.

```
  Buzzer_Alarm(); //Buzzer control function
```

In main loop, Power_Get_Data() is constantly called to have ADC obtain battery level data every 3s and print through serial port.

```
  Power_Get_Data();//Get the battery voltage every 3s and print it out
```

Reference

`void Power_Setup(void);`

Every time when this function is called, control board will switch referenced voltage pin mode to default mode and uses A1 pin to read ADC value and then get the external voltage of referenced voltage pin by calculating. And finally, it will set referenced voltage pin mode to external mode.

`void Power_Correct(float value);`

The function to set external voltage of referenced voltage pin. If you think that the external voltage value coefficient calculating automatically by control board is not accurate enough, you can use this function to reset the value to get better battery voltage feedback.

`void Power_Bluetooth_Data(void);`

The function for Bluetooth to get battery voltage, using with Bluetooth mode. When Bluetooth module receive checking commands, the function will be called to get battery voltage once and send it to Bluetooth module.

`void Power_Get_Data(void);`

The function to obtain battery voltage every 3s.

`void Buzzer_Setup(void);`
The function to initialize the pin that controls buzzer. Before using buzzer, the function should be called to initialize the pin; otherwise it won't be able to drive the buzzer.
`void Buzzer_Alarm(int frequency=1000, int msdelay=100, int times=1);`
Function for buzzer to emit sound. frequency: the frequency of buzzer, 1K Hz by default. msdelay: the duration of buzzer souding, 100ms by default. times: times of buzzer sounding, one time by default

Chapter6 Infrared Sensor Test

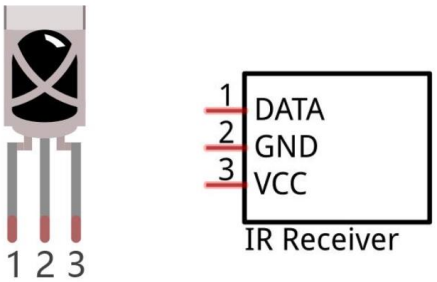
Component Knowledge

Infrared Remote

An infrared(IR) remote control is a device with a certain number of buttons. Pressing down different buttons will make the infrared emission tube, which is located in the front of the remote control, send infrared ray with different command. Infrared remote control technology is widely used in electronic products such as TV, air conditioning, etc. Thus making it possible for you to switch TV programs and adjust the temperature of the air conditioning when away from them. The remote control we use is shown below:

Infrared receiver

An infrared(IR) receiver is a component which can receive the infrared light, so we can use it to detect the signal emitted by the infrared remote control. DATA pin here outputs the received infrared signal.



When using IR remote controller, it will send the value of the pressed key to the receiving circuit. We can program the control board so it can print the receiving key value through serial monitor.

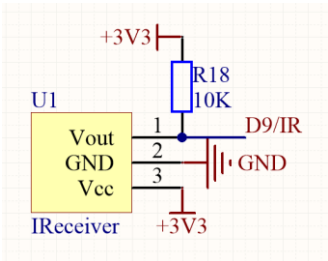
The followings are the key values of each key

ICON	KEY Value	ICON	KEY Value
	FFA25D	C	FFB04F
MENU	FFE21D	1	FF30CF
TEST	FF22DD	2	FF18E7
+	FF02FD	3	FF7A85
⏪	FFC23D	4	FF10EF
⏮	FFE01F	5	FF38C7
▶	FFA857	6	FF5AA5
⏭	FF906F	7	FF42BD
0	FF6897	8	FF4AB5
−	FF9867	9	FF52AD

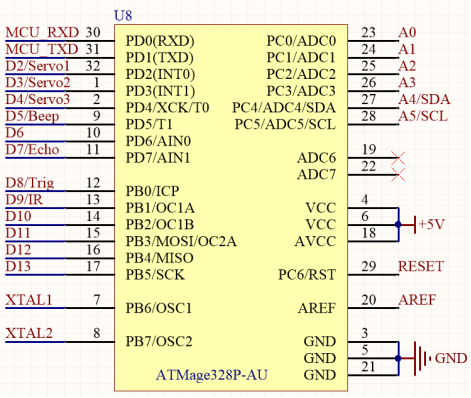
Circuit

Schematic diagram

Infrared Sensor Pins

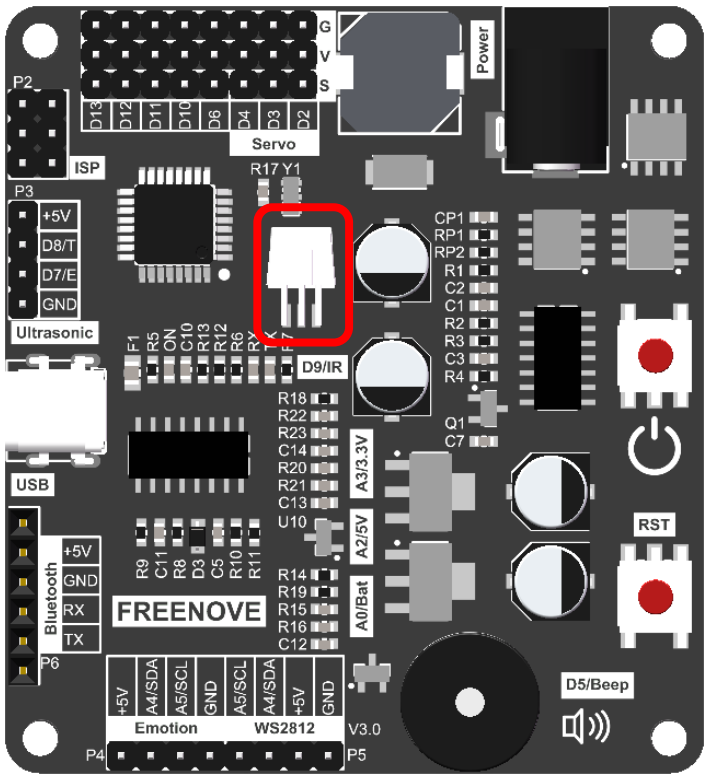


Main Control Chip Pins



Hardware connection. If you need any support, please feel free to contact us via: support@freenove.com

The location of the circuit



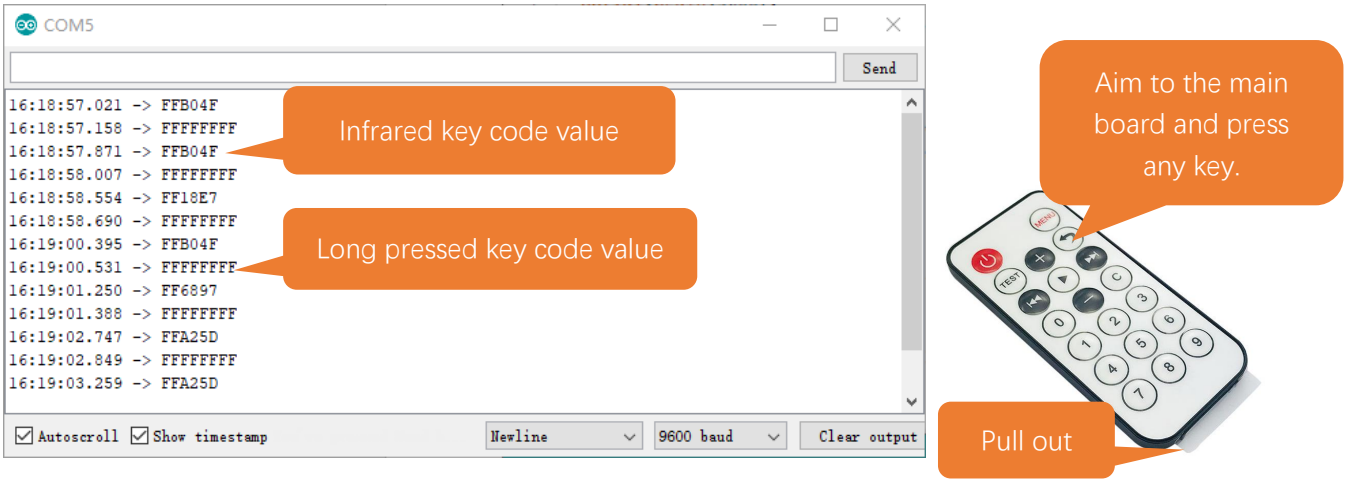
Sketch

Download the code to control board to control the robot ant to move.

Open 06.IR.ino in **Freenove_Robot_Ant_Kit\Sketches\06.IR.**


```
#include "myIRremote.h"

void setup() {
  Serial.begin(9600);
  IRremote_Setup();//Initialize the infrared receiving pin
}

void loop() {
  IRremote_Read();//Read the infrared key value
  if(IRremote_flag==1)//If the infrared key value is received,IRremote_flag=1
  {
     IRremote_flag = 0;
     Serial.println(IRremote_value, HEX);
  }
  else if (IRremote_flag == 2)//If you press the button long enough,IRremote_flag=2
  {
    IRremote_flag = 0;
    Serial.println(IRremote_value, HEX);
  }
}
```

Compile and upload code. When the code is uploadede successfully, open serial monitor and set baud rate to 9600. Aim the IR remote controller to control board and press the keys.



Code:

```
#include "myIRremote.h"

void setup() {
  Serial.begin(9600);
  IRremote_Setup();//Initialize the infrared receiving pin
}

void loop() {
  IRremote_Read();//Read the infrared key value
  if(IRremote_flag==1) {//If the infrared key value is received,IRremote_flag=1
     IRremote_flag = 0;
     Serial.println(IRremote_value, HEX);
  }
  else if (IRremote_flag == 2) {//If you press the button long enough,IRremote_flag=2
    IRremote_flag = 0;
    Serial.println(IRremote_value, HEX);
  }
}
```

Explanation of Code

Include the header file of library function, which makes it easier to call the program.

```
#include "WS2812.h"
```

IRremote_Setup() function is called to initialize infrared receiving pins.

```
  IRremote_Setup();//Initialize the infrared receiving pin
```

IRremote_ Read() function is called to read the value of a pressed key and store it to variable IRremote_value\

```
  IRremote_Read();
```

When infrared receiver receives key value from the controller, IRremote_flag will be set to 1. If users long press the key, IRremote_flag will be set to 2. When receiving key value, print it through serial port.

```
10    if(IRremote_flag==1) {//If the infrared key value is received,IRremote_flag=1
11       IRremote_flag = 0;
12       Serial.println(IRremote_value, HEX);
13    }
14    else if (IRremote_flag == 2) {//If you press the button long enough,IRremote_flag=2
15      IRremote_flag = 0;
16      Serial.println(IRremote_value, HEX);
17    }
```

Reference

`void IRremote_Setup(void);`

IRremote_Setup function is used to initialize infrared receiving pins. When initializing control board, please include it to initialization code.

`void IRremote_Read(void);`

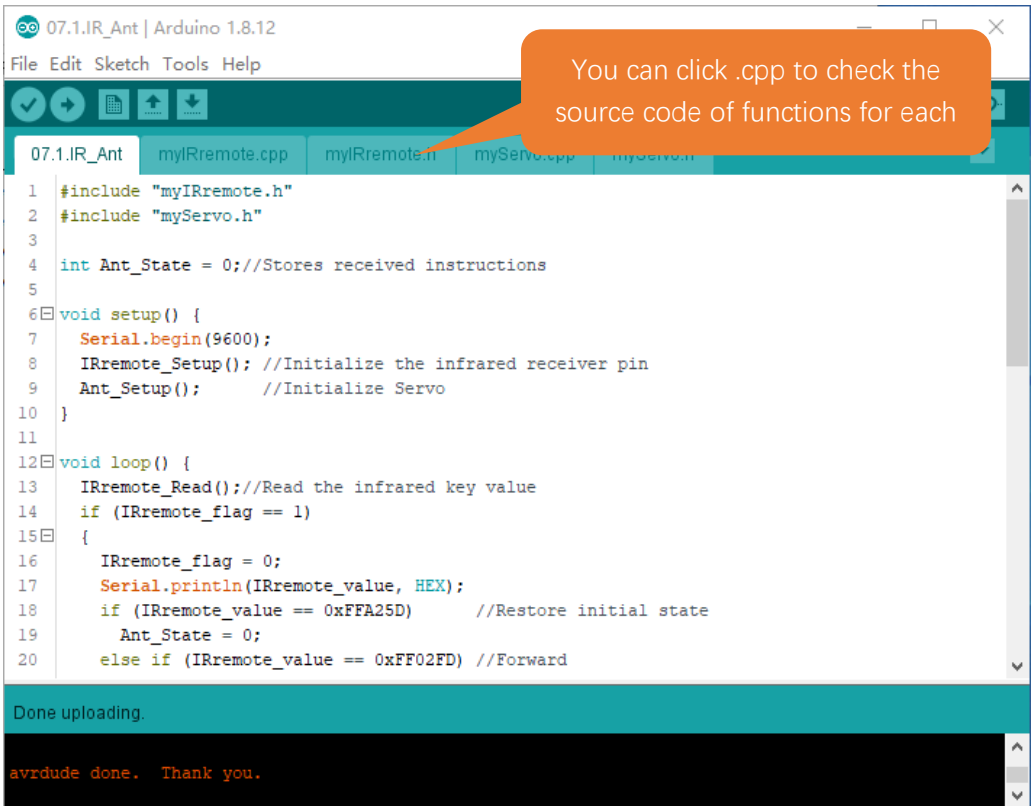
The function to read infrared key value. When reading values, it will store them to IRremote_value and set IRremote_flag to 1. When users long press the infrared remote controller, it will store the receiving value to IRremote_value and set IRremote_flag to 2.

Chapter7 Infrared Controlled Robot

In this chapter, we will leard how to control the robot ant to crawl through the infrared remote controller.

Sketch

Open 07.1.IR_Ant.ino in **Freenove_Robot_Ant_Kit\Sketches\07.1.IR_Ant.**



Compile and upload code. Wait for the code to finish uploading and aim the controller to the robot to control.

	FFA25D	Reset to initial action
	FF02FD	Forward
	FF9867	Backward
	FFE01F	Forward Left
	FF906F	Forward Right
TEST	**FF22DD**	Spot Turn to Left
	FFC23D	Spot Turn to Right

Code:

```
#include "myIRremote.h"
#include "myServo.h"

int Ant_State = 0;//Stores received instructions

void setup() {
  Serial.begin(9600);
  IRremote_Setup(); //Initialize the infrared receiver pin
  Ant_Setup();      //Initialize Servo
}

void loop() {
  IRremote_Read();//Read the infrared key value
  if (IRremote_flag == 1){
    IRremote_flag = 0;
    Serial.println(IRremote_value, HEX);
    if (IRremote_value == 0xFFA25D)      //Restore initial state
      Ant_State = 0;
    else if (IRremote_value == 0xFF02FD) //Forward
      Ant_State = 1;
    else if (IRremote_value == 0xFF9867) //Backwards
      Ant_State = 2;
    else if (IRremote_value == 0xFFE01F) //Forward to the left
      Ant_State = 3;
    else if (IRremote_value == 0xFF906F) //Forward to the right
      Ant_State = 4;
    else if (IRremote_value == 0xFF22DD) //Turn left in situ
      Ant_State = 5;
    else if (IRremote_value == 0xFFC23D) //Turn right in situ
      Ant_State = 6;
  }
  else if (IRremote_flag == 2){
    IRremote_flag = 0;
    Serial.println(IRremote_value, HEX);
  }
  else{
    if (Ant_State == 0)//Restore initial state
      ant_reset_angle();
    if (Ant_State == 1)//Forward
      ant_move_forth(2, 5);
    else if (Ant_State == 2)//Backwards
      ant_move_back(2, 5);
    else if (Ant_State == 3)//Forward to the left
```

```
44          ant_move_left(4, 7);
45        else if (Ant_State == 4)//Forward to the right
46          ant_move_right(4, 7);
47        else if (Ant_State == 5)//Turn left in situ
48          ant_situ_left(2, 7);
49        else if (Ant_State == 6)//Turn right in situ
50          ant_situ_right(2, 7);
51      }
52  }
```

Explanation of Code

Include the header file of library function, which makes it easier to call the program.

```
1   #include "myIRremote.h"
2   #include "myServo.h"
```

IRremote_Setup() function to initialize infrared receiving pins. Ant_Setup() function is called to initialize Servo.

```
8     IRremote_Setup(); //Initialize the infrared receiver pin
9     Ant_Setup();      //Initialize Servo
```

When infrared receiver receives key value from the controller, IRremote_flag will be set to 1. If users long press the key, IRremote_flag will be set to 2. When receiving key value, print it through serial port..

```
13    IRremote_Read();//Read the infrared key value
      //When receiving a specific infrared key code value, it is converted into the corresponding
      motion instruction
14    if (IRremote_flag == 1){
…     …
31    }
      //When a long press command is received, the information is printed to the serial port.
32    else if (IRremote_flag == 2){
…     …
35    }
36    else{//According to the movement command, control the ant robot to crawl
…     …
51    }
```

Chapter8 Obstacle Avoiding Robot Ant

In this chapter, we will learn how to make the robot ant avoid obstacles when crawling.

Sketch

Open 08.1.Ultrasonic_Ant.ino in **Freenove_Robot_Ant_Kit\Sketches\08.1.Ultrasonic_Ant.**

Compile and upload the code. When the code is uploaded successfully, put the robot on the floor and turn ON the switch. After 2 seconds, the ant will be in obstacle avoidance mode.
Note: Please be careful when taking it back, a moving ant may pinch your hands.

Code:

```
#include "Ultrasonic.h"
#include "myServo.h"
void setup() {
  Ultrasonic_Setup();
  Ant_Setup();
  delay(2000);
}
void loop() {
  Ultrasonic_Get_Data(100);
  if (Ultrasonic_Value >= 40)
    ant_run_forth(2, 5);      //Forward
  else if (Ultrasonic_Value >= 20 && Ultrasonic_Value < 40)
    ant_run_left(2, 5);       //Forward to the left
//  ant_run_right(2, 5);      //Forward to the right
  else if (Ultrasonic_Value >= 10 && Ultrasonic_Value < 20)
    ant_run_situ_left(2, 5);  //Turn left in situ
//  ant_run_situ_right(2, 5); //Turn right in situ
  else
    ant_run_back(2, 5);       //Backwards
}
```

Explanation of Code

Include the header file of library function, which makes it easier to call the program.

```
#include "Ultrasonic.h"
#include "myServo.h"
```

Ultrasonic_Setup() function is called to initialize ultrasonic module. Ant_Setup() function is called to initialize servo.

```
  Ultrasonic_Setup();
  Ant_Setup();
```

Ultrasonic_Get_Data() is called to obtain distance information every 100 milliseconds and control the robot to make different actions based on the data received. When there is no obstacle 40cm in front of the ant robot, it crawls forward. When the ant robot detects an obstacle 20-40cm ahead, it crawls to the left and ahead to avoid the obstacle in advance. When the ant robot detects an obstacle 10-20cm ahead, which is a relatively close distance, therefore it will make a spot turn to left. When the obstacle is within 10cm, it will move backward to have enough space for the next movement.

```
  Ultrasonic_Get_Data(100);
  if (Ultrasonic_Value >= 40)
    ant_run_forth(2, 5);      //Forward
  else if (Ultrasonic_Value >= 20 && Ultrasonic_Value < 40)
    ant_run_left(2, 5);       //Forward to the left
  else if (Ultrasonic_Value >= 10 && Ultrasonic_Value < 20)
    ant_run_situ_left(2, 5);  //Turn left in situ
  else
    ant_run_back(2, 5);       //Backwards
```

Chapter9 Bluetooth Controlled Robot Ant

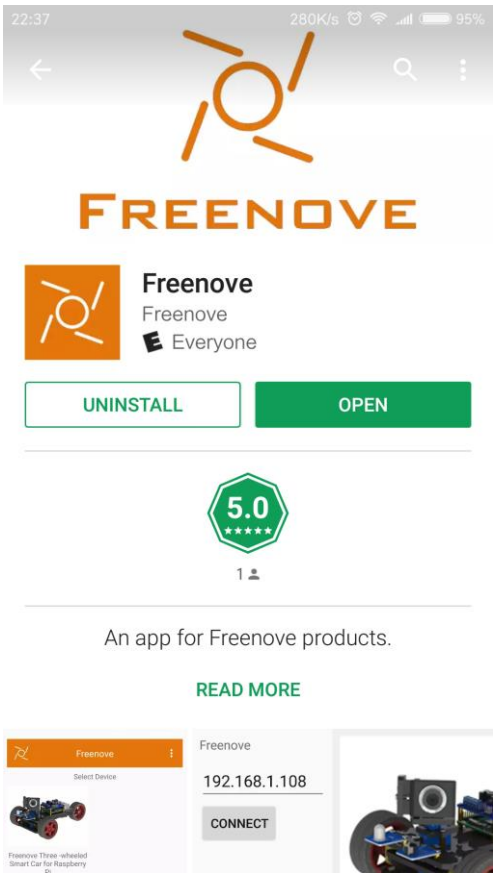
In this chapter, we will learn to use Bluetooth to control the robot.

Install Freenove APP

There are three ways to install our APP, you can choose any one you prefer.

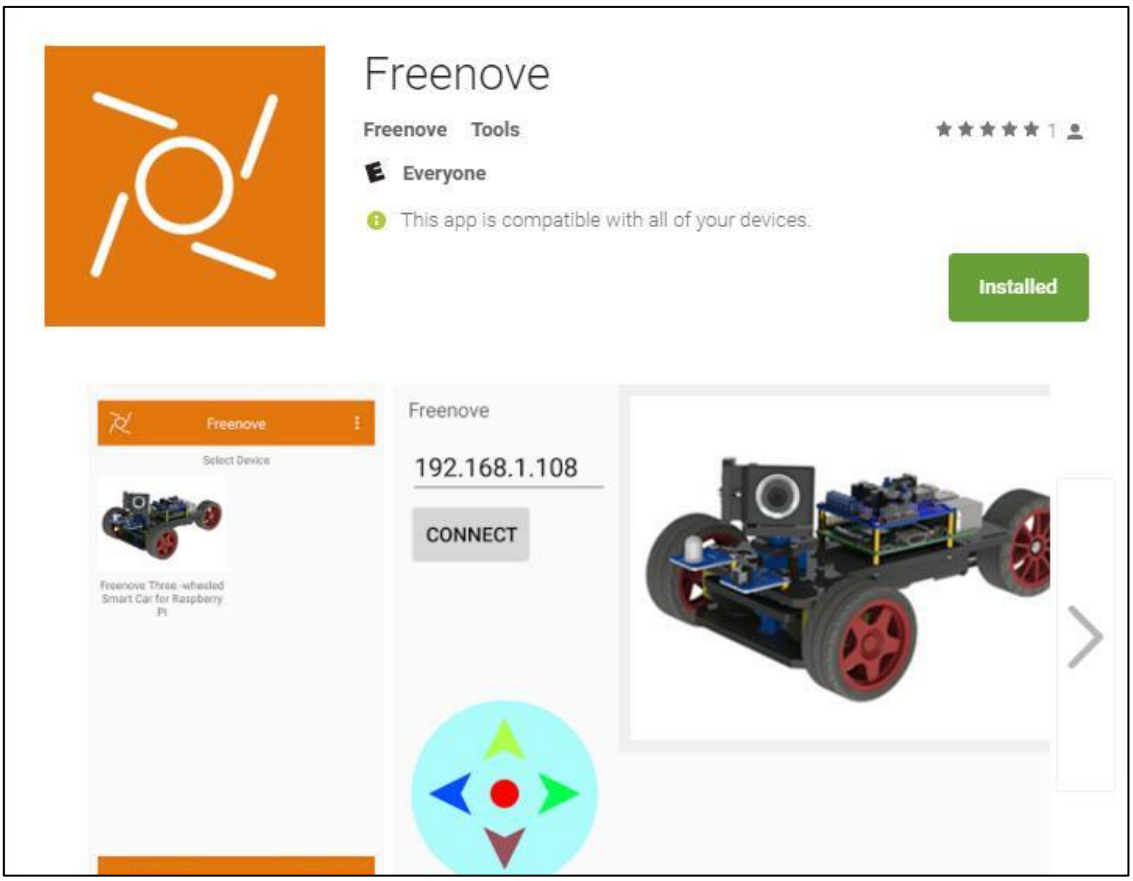
Method 1

Use Google play to search “Freenove”, download and install.



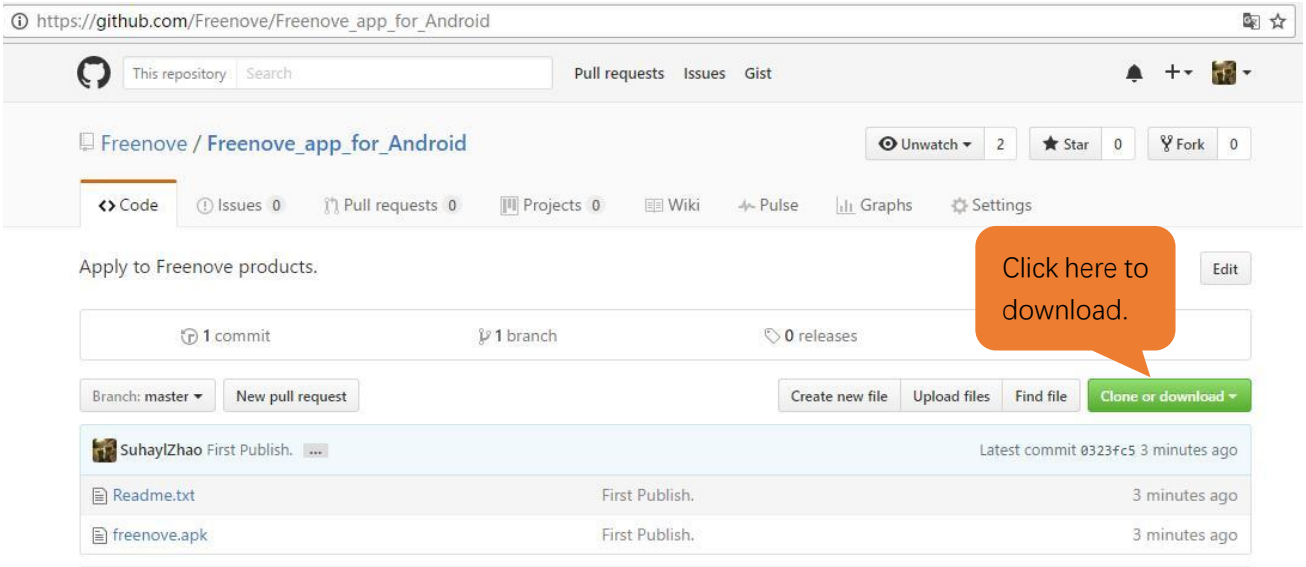
Method 2

Visit https://play.google.com/store/apps/details?id=com.freenove.suhayl.Freenove, and click install.



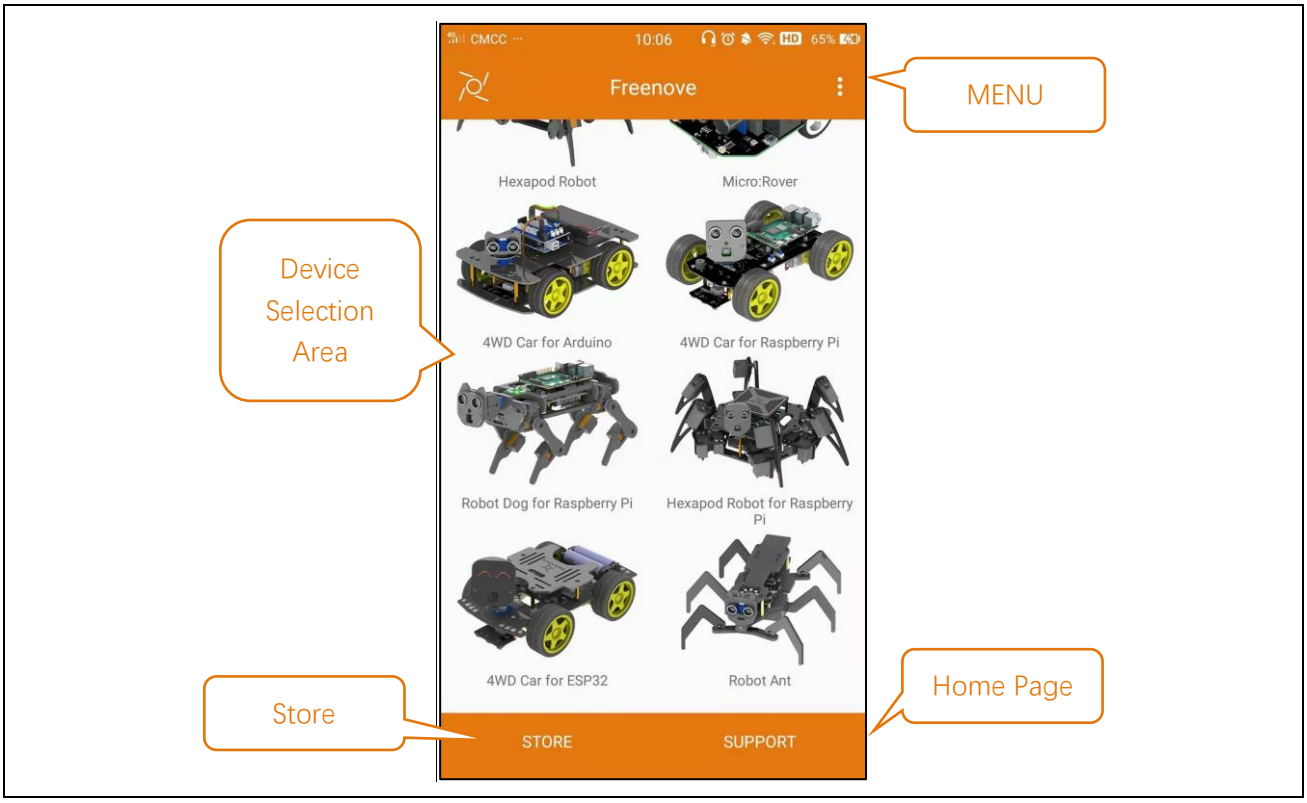
Method 3

Visit https://github.com/Freenove/Freenove_app_for_Android, download the files in this library, and install freenove.apk to your Android phone manually.



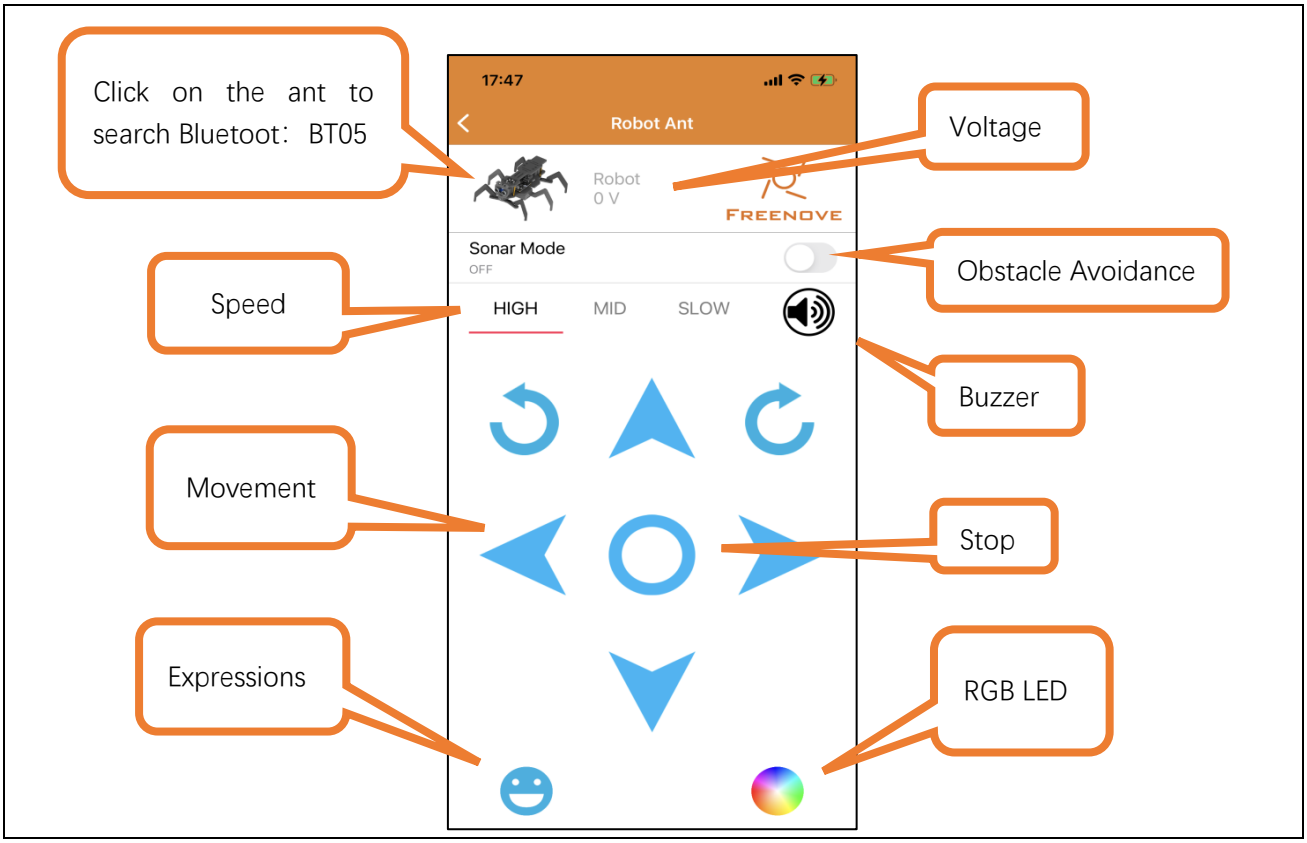
Menu

Open application "Freenove", as shown below:



Introduction of the APP

In this chapter, we use Freenove 4WD Car for ESP32, so it is necessary to understand the interface of this mode.



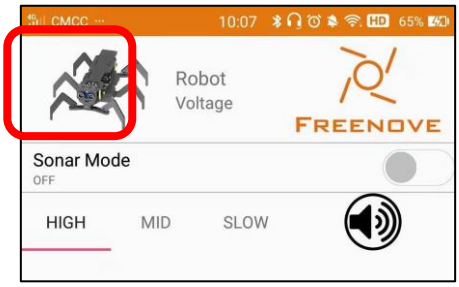
Sketch

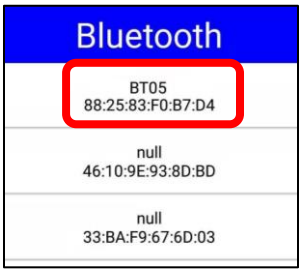
Open 09.Bluetooth_Ant.ino in **Freenove_Robot_Ant_Kit\Sketches\09.Bluetooth_Ant.**

Before uploading code, please remove the Bluetooth module. Because the Bluetooth module uses the same interface as the program download function, they cannot be used simultaneously.

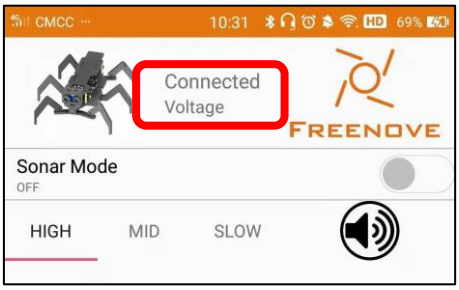
Compile and upload code to control board. When the code is uploaded successfully, replug in the Bluetooth module and turn ON the power. Open the mobile APP and select the robot ant.

Click on the picture of the robot ant and select BT05 to connect to Bluetooth module in the pop-up window.

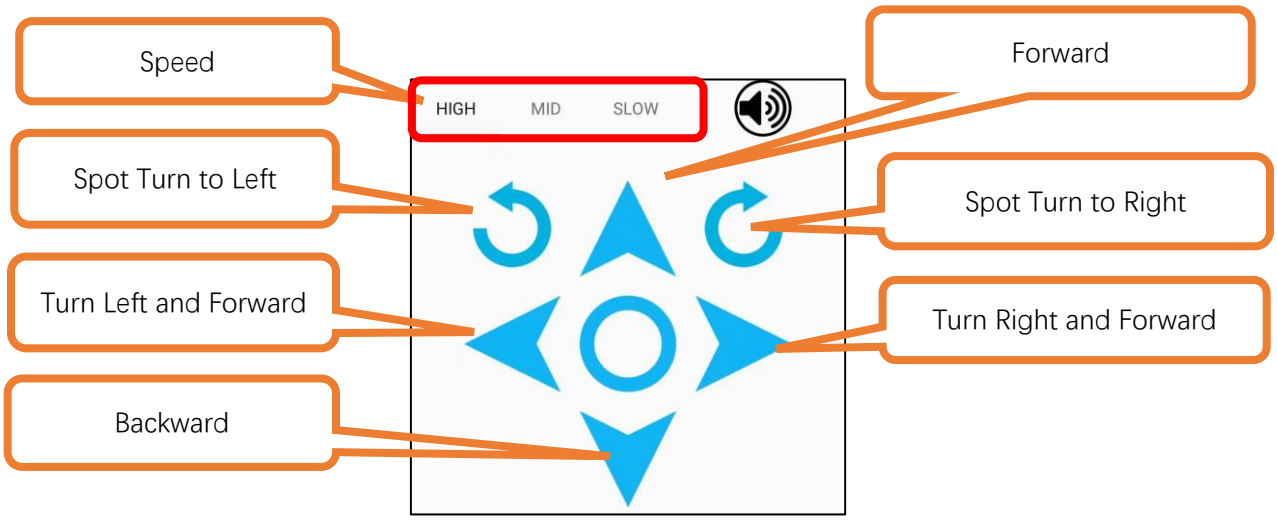




When it connects to Bluetooth module successfully, it will show as below:



At this point, you can use your phone to control the robot ant to move.



Code:

```
#include "BluetoothOrders.h"
#include "myServo.h"

int Ant_Move_Direction = 0; //Direction of ant movement
int Ant_Move_Speed = 0;     //Ant speed

void setup() {
  Bluetooth_Setup();
  Ant_Setup();
}

void loop() {
  if (stringComplete){//Get the Bluetooth command
    Deal_Serial_Data();
    char commandChar = inputCommandArray[0].charAt(0);//Gets the first character of the
inputCommandArray[0]
    if(commandChar==ACTION_MOVE){
        Ant_Move_Direction = paramters[1];
        Ant_Move_Speed = paramters[2];
    }
    inputCommandArray[0] = "";
  }
  else{
    if (Ant_Move_Direction == 0)//Restore initial state
      ant_reset_angle();
    else if (Ant_Move_Direction == 1)//Forward
      ant_move_forth(2, 5+2*Ant_Move_Speed);
    else if (Ant_Move_Direction == 2)//Backwards
      ant_move_back(2, 5+2*Ant_Move_Speed);
    else if (Ant_Move_Direction == 3)//Forward to the left
      ant_move_left(4, 5+2*Ant_Move_Speed);
```

```
31      else if (Ant_Move_Direction == 4)//Forward to the right
32        ant_move_right(4, 5+2*Ant_Move_Speed);
33      else if (Ant_Move_Direction == 5)//Turn left in situ
34        ant_situ_left(2, 5+2*Ant_Move_Speed);
35      else if (Ant_Move_Direction == 6)//Turn right in situ
36        ant_situ_right(2, 5+2*Ant_Move_Speed);
37    }
38  }
```

Explanation of Code

Include the header file of library function, which makes it easier to call the program.

```
1   #include "BluetoothOrders.h"
2   #include "myServo.h"
```

Bluetooth_Setup() is called to initialize serial port and set baud rate to 9600. Ant_Setup() is called to initialize Servo.

```
8     Bluetooth_Setup();
9     Ant_Setup();
```

Define two variables: one is to store the moving direction of the robot ant and the other to store the speed level.

```
4   int Ant_Move_Direction = 0; //Direction of ant movement
5   int Ant_Move_Speed = 0;     //Ant speed
```

When Bluetooth module receives data from phone, the serial port will interrupt the function receiving data and store the variable to inputStringBLE, and set variable stingComplete to true at the same time.

When the main program detects that stringComplete is true, it will call Deal_Serial_Data() to analyze the receiving data and save the commands to array inputCommandArray and store the parameter to array paramters.

When the control board receives commands to make the ant move, it will store the data of the ant's moving direction and speed to Ant_Move_Direction and Ant_Move_Speed.

```
13    if (stringComplete){//Get the Bluetooth command
14      Deal_Serial_Data();
15      char commandChar = inputCommandArray[0].charAt(0);//Gets the first character of the
    inputCommandArray[0]
16      if(commandChar==ACTION_MOVE){
17          Ant_Move_Direction = paramters[1];
18          Ant_Move_Speed = paramters[2];
19      }
20      inputCommandArray[0] = "";
21    }
```

If the Bluetooth module doesn't receive any data, the robot ant will perform the instructions that has been received before new instructions arrive .

```
22  else{
23      if (Ant_Move_Direction == 0)//Restore initial state
24        ant_reset_angle();
25      else if (Ant_Move_Direction == 1)//Forward
26        ant_move_forth(2, 5+2*Ant_Move_Speed);
```

```
27      else if (Ant_Move_Direction == 2)//Backwards
28        ant_move_back(2, 5+2*Ant_Move_Speed);
29      else if (Ant_Move_Direction == 3)//Forward to the left
30        ant_move_left(4, 5+2*Ant_Move_Speed);
31      else if (Ant_Move_Direction == 4)//Forward to the right
32        ant_move_right(4, 5+2*Ant_Move_Speed);
33      else if (Ant_Move_Direction == 5)//Turn left in situ
34        ant_situ_left(2, 5+2*Ant_Move_Speed);
35      else if (Ant_Move_Direction == 6)//Turn right in situ
36        ant_situ_right(2, 5+2*Ant_Move_Speed);
37    }
```

Commands of Bluetooth Module

```
#define ACTION_MOVE             'A'     //Ant movement commands
#define ACTION_EMOTION          'B'     //Expression control commands
#define ACTION_RGB              'C'     //WS2812 control commands
#define ACTION_BUZZER           'D'     //Buzzer control commands
#define ACTION_ULTRASONIC       'E'     //Ultrasonic control commands
#define ACTION_CAR_MODE         'H'     //Ultrasonic Obstacle Avoidance Command
#define ACTION_GET_VOLTAGE      'I'     //Battery Power Query
#define INTERVAL_CHAR           '#'     //The directive resolves the separator character
```

Reference

`void Bluetooth_Setup(void);`

The Bluetooth module applies serial communication with a default baud rate of 9600. Every time this function is called to initialize serial port so that it can communicate with Bluetooth module.

`void Deal_Serial_Data(void);`

The parse function of serial port data. Every time when this function is called, the program will stop receiving data and analyze the content received, and then store the parsed instruction in the array InputCommandArray and the parsed instruction parameters in the array paramters. 。

Chapter10 Integrated Routine

In this chapter, we will integrate all the previous features to make a robot feature with RGB LED, expressions, buzzer, battery level query and modes of infrared remote control, Bluetooth remote control, and obstacle avoidance.

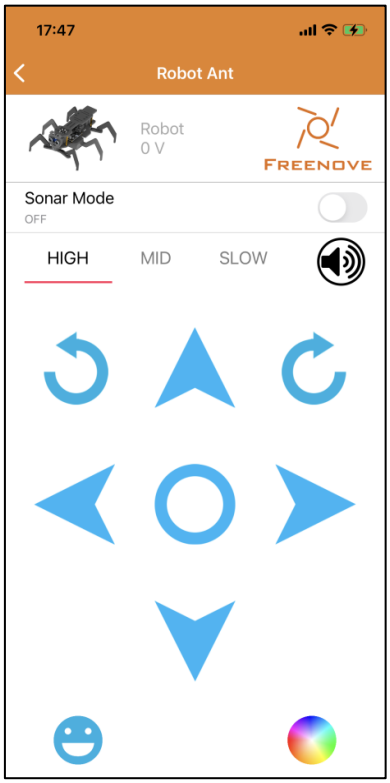
Sketch

Open 10.Multifunctional_Ant.ino in **Freenove_Robot_Ant_Kit\Sketches\10.Multifunctional_Ant**.

Before uploading code, please remove the Bluetooth module. After compile and upload code to control board, replug in the Bluetooth module and then turn ON power.

Reset			MENU	Buzzer ON/OFF
TEST	Turn Left		Forward		Spot Turn to Right
	Forward Left		Speed Adjustment		Forward Right
0	Obstacle Avoidance		Backward	C	Obstacle Avoidance Mode OFF
1	Red of RGB LED ON/OFF	2	Green of RGB LED ON/OFF	3	Blue of RGB LED ON/OFF
4	Modes of WS2812	5	Modes of Dynamic Expressions	6	Random Display of Static Expressions
7	Custom	8	Custom	9	Custom

You can also use phone APP to control the robot ant.



Code:

```
#include "BluetoothOrders.h"
#include "Emotion.h"
#include "External_Devices.h"
#include "Ultrasonic.h"
#include "WS2812.h"
```

```
#include "myIRremote.h"
#include "myServo.h"

bool Sonic_Mode = 0;         //Ultrasonic mode
int Ant_Move_Direction = 0; //Direction of ant movement
int Ant_Move_Speed = 0;      //Ant speed

void setup() {
  Buzzer_Setup();      //Buzzer pin initialization
  Emotion_Setup();     //Initializes the Led Matrix
  Power_Setup();       //Battery pin initialization
  Ultrasonic_Setup(); //Ultrasonic initialization
  WS2812_Setup();      //WS2812 initialization function
  IRremote_Setup();    //IR initialisation
  Ant_Setup();         //Initialize the servo
  Bluetooth_Setup();  //Test whether the Bluetooth is connected
}

void loop() {
  if (Sonic_Mode == 1){//Ultrasonic obstacle avoidance mode
    //Get the distance value every 1s and store it in the Ultrasonic_Value
    Ultrasonic_Get_Data();
    if (Ultrasonic_Value >= 40)
      Ant_Move_Direction = 1;//Forward
    else if (Ultrasonic_Value >= 20 && Ultrasonic_Value < 40)
      Ant_Move_Direction = 3;//Forward to the left
    else if (Ultrasonic_Value >= 10 && Ultrasonic_Value < 20)
      Ant_Move_Direction = 5;//Turn right in situ
    else
      Ant_Move_Direction = 2;//Backwards
  }
  if (IRremote_flag != 0){//Get the infrared command
    IRremote_flag = 0;
    switch (IRremote_value){
      case 0xFFA25D://Restore initial state
        Ant_Move_Direction = 0;
        break;
      case 0xFF02FD://Forward
        Ant_Move_Direction = 1;
        break;
      case 0xFF9867://Backwards
        Ant_Move_Direction = 2;
        break;
      case 0xFFE01F://Forward to the left
```

```
50          Ant_Move_Direction = 3;
51          break;
52        case 0xFF906F://Forward to the right
53          Ant_Move_Direction = 4;
54          break;
55        case 0xFF22DD://Turn left in situ
56          Ant_Move_Direction = 5;
57          break;
58        case 0xFFC23D://Turn right in situ
59          Ant_Move_Direction = 6;
60          break;
61        case 0xFFE21D://Buzzer 100ms
62          Buzzer_Alarm();
63          break;
64        case 0xFFA857://Move speed control
65          Ant_Move_Speed--;
66          if (Ant_Move_Speed < 0)
67            Ant_Move_Speed = 2;
68          break;
69        case 0xFF6897://Ultrasonic mode on
70          Sonic_Mode = 1;
71          Buzzer_Alarm();
72          break;
73        case 0xFFB04F://Ultrasonic mode off
74          Sonic_Mode = 0;
75          Ant_Move_Direction = 0;
76          Buzzer_Alarm();
77          break;
78        case 0xFF30CF://WS2812 RED On/Off
79          WS2812_Set_LED(1, 0, 0);
80          break;
81        case 0xFF18E7://WS2812 GREEN On/Off
82          WS2812_Set_LED(0, 1, 0);
83          break;
84        case 0xFF7A85://WS2812 BLUE On/Off
85          WS2812_Set_LED(0, 0, 1);
86          break;
87        case 0xFF10EF://WS2812 set mode
88          ws2812_task_mode++;
89          if (ws2812_task_mode > 5)
90            ws2812_task_mode = 0;
91          break;
92        case 0xFF38C7://Display animated emoticons
93          emotion_count = 0;
```

```
94          emotion_task_mode++;
95          if (emotion_task_mode > 6)
96            emotion_task_mode = 0;
97          break;
98        case 0xFF5AA5://Display static emotions
99          Emotion_SetMode(7);
100         break;
101       default:
102         break;
103     }
104   }
105   if (stringComplete){//Get the Bluetooth command
106     Deal_Serial_Data();
107     char commandChar = inputCommandArray[0].charAt(0);
108     if (commandChar == ACTION_MOVE){//Control ant movement
109       if (Sonic_Mode != 0){
110         Sonic_Mode = 0;
111         Buzzer_Alarm();
112       }
113       Ant_Move_Direction = paramters[1];
114       Ant_Move_Speed = paramters[2];
115     }
116     if (commandChar == ACTION_EMOTION){//Control expression module display
117       if (paramters[1] <= 7)
118         Emotion_SetMode(paramters[1]);
119       else if (paramters[1] > 7)
120         Emotion_SetMode(paramters[1], paramters[2]);
121     }
122     if (commandChar == ACTION_RGB){//Control WS2812 display
123       WS2812_SetMode(paramters[1]);
124       WS2812_Set_Color(paramters[2], paramters[3], paramters[4]);
125     }
126     if (commandChar == ACTION_BUZZER)//Control the buzzer sound
127       Buzzer_Alert(paramters[1]);
128     if (commandChar == ACTION_ULTRASONIC)//Get ultrasonic distance value
129       Ultrasonic_Bluetooth_Data();
130     if (commandChar == ACTION_CAR_MODE){//Ultrasonic mode
131       int cmd_mode = constrain(paramters[1], 0, 1);
132       Sonic_Mode = cmd_mode;
133       if (Sonic_Mode == 0)
134         Ant_Move_Direction = 0;
135       Buzzer_Alarm();
136     }
137     if (commandChar == ACTION_GET_VOLTAGE)//Get battery voltage
```

```
138         Power_Bluetooth_Data();
139       inputCommandArray[0] = "";
140     }
141     else{//Execute code without blocking
142       IRremote_Read();//Non - blocking access to infrared commands
143       Ant_Servo_Mode(Ant_Move_Direction, Ant_Move_Speed);//Non-blocking ant motion function
144       Emotion_Show();//Non-blocking expression module display function
145       WS2812_Show();//Non-blocking color light display function
146     }
147   }
```

Explanation of Code

Include the header file of library function, which makes it easier to call the program.

```
1   #include "BluetoothOrders.h"
2   #include "Emotion.h"
3   #include "External_Devices.h"
4   #include "Ultrasonic.h"
5   #include "WS2812.h"
6   #include "myIRremote.h"
7   #include "myServo.h"
```

The initialization function of each module is called to initialize every feature of the robot ant.

```
14    Buzzer_Setup();      //Buzzer pin initialization
15    Emotion_Setup();     //Initializes the Led Matrix
16    Power_Setup();       //Battery pin initialization
17    Ultrasonic_Setup(); //Ultrasonic initialization
18    WS2812_Setup();      //WS2812 initialization function
19    IRremote_Setup();    //IR initialisation
20    Ant_Setup();         //Initialize the servo
21    Bluetooth_Setup();   //Test whether the Bluetooth is connected
```

Variable Sonic_Mode is used to record whether the obstacle avoidance mode is ON, while the other two variables are used to record the robot's moving direction and speed.

```
9   bool Sonic_Mode = 0;         //Ultrasonic mode
10  int Ant_Move_Direction = 0; //Direction of ant movement
11  int Ant_Move_Speed = 0;      //Ant speed
```

When the obstacle avoidance mode is ON, Ultrasonic_Get_Data() is called to obtain ultrasonic data every 1s and determine the robot's moving direction based on the data.

```
25    if (Sonic_Mode == 1){//Ultrasonic obstacle avoidance mode
26      //Get the distance value every 1s and store it in the Ultrasonic_Value
27      Ultrasonic_Get_Data();
28      if (Ultrasonic_Value >= 40)
29        Ant_Move_Direction = 1;//Forward
30      else if (Ultrasonic_Value >= 20 && Ultrasonic_Value < 40)
31        Ant_Move_Direction = 3;//Forward to the left
32      else if (Ultrasonic_Value >= 10 && Ultrasonic_Value < 20)
33        Ant_Move_Direction = 5;//Turn right in situ
```

```
    else
      Ant_Move_Direction = 2;//Backwards
  }
```

When the robot ant receives intructions from infrared remote controller, it will make corresponding reactions.

```
  if (IRremote_flag != 0){//Get the infrared command
    IRremote_flag = 0;
    switch (IRremote_value){
      case 0xFFA25D://Restore initial state
        Ant_Move_Direction = 0;
        break;
      case 0xFF02FD://Forward
        Ant_Move_Direction = 1;
        break;
      case 0xFF9867://Backwards
        Ant_Move_Direction = 2;
        break;
      case 0xFFE01F://Forward to the left
        Ant_Move_Direction = 3;
        break;
      case 0xFF906F://Forward to the right
        Ant_Move_Direction = 4;
        break;
      case 0xFF22DD://Turn left in situ
        Ant_Move_Direction = 5;
        break;
      case 0xFFC23D://Turn right in situ
        Ant_Move_Direction = 6;
        break;
      case 0xFFE21D://Buzzer 100ms
        Buzzer_Alarm();
        break;
      case 0xFFA857://Move speed control
        Ant_Move_Speed--;
        if (Ant_Move_Speed < 0)
          Ant_Move_Speed = 2;
        break;
      case 0xFF6897://Ultrasonic mode on
        Sonic_Mode = 1;
        Buzzer_Alarm();
        break;
      case 0xFFB04F://Ultrasonic mode off
        Sonic_Mode = 0;
        Ant_Move_Direction = 0;
        Buzzer_Alarm();
```

```
77          break;
78        case 0xFF30CF://WS2812 RED On/Off
79          WS2812_Set_LED(1, 0, 0);
80          break;
81        case 0xFF18E7://WS2812 GREEN On/Off
82          WS2812_Set_LED(0, 1, 0);
83          break;
84        case 0xFF7A85://WS2812 BLUE On/Off
85          WS2812_Set_LED(0, 0, 1);
86          break;
87        case 0xFF10EF://WS2812 set mode
88          ws2812_task_mode++;
89          if (ws2812_task_mode > 5)
90            ws2812_task_mode = 0;
91          break;
92        case 0xFF38C7://Display animated emoticons
93          emotion_count = 0;
94          emotion_task_mode++;
95          if (emotion_task_mode > 6)
96            emotion_task_mode = 0;
97          break;
98        case 0xFF5AA5://Display static emotions
99          Emotion_SetMode(7);
100         break;
101       default:
102         break;
103     }
104   }
```

When the robot ant receives intructions from Bluetooth module, it will make corresponding reactions.

```
105 if (stringComplete){//Get the Bluetooth command
106     Deal_Serial_Data();
107     char commandChar = inputCommandArray[0].charAt(0);
108     if (commandChar == ACTION_MOVE){//Control ant movement
109       if (Sonic_Mode != 0){
110         Sonic_Mode = 0;
111         Buzzer_Alarm();
112       }
113       Ant_Move_Direction = paramters[1];
114       Ant_Move_Speed = paramters[2];
115     }
116     if (commandChar == ACTION_EMOTION){//Control expression module display
117       if (paramters[1] <= 7)
118         Emotion_SetMode(paramters[1]);
```

```
119         else if (paramters[1] > 7)
120           Emotion_SetMode(paramters[1], paramters[2]);
121       }
122       if (commandChar == ACTION_RGB){//Control WS2812 display
123         WS2812_SetMode(paramters[1]);
124         WS2812_Set_Color(paramters[2], paramters[3], paramters[4]);
125       }
126       if (commandChar == ACTION_BUZZER)//Control the buzzer sound
127         Buzzer_Alert(paramters[1]);
128       if (commandChar == ACTION_ULTRASONIC)//Get ultrasonic distance value
129         Ultrasonic_Bluetooth_Data();
130       if (commandChar == ACTION_CAR_MODE){//Ultrasonic mode
131         int cmd_mode = constrain(paramters[1], 0, 1);
132         Sonic_Mode = cmd_mode;
133         if (Sonic_Mode == 0)
134           Ant_Move_Direction = 0;
135         Buzzer_Alarm();
136       }
137       if (commandChar == ACTION_GET_VOLTAGE)//Get battery voltage
138         Power_Bluetooth_Data();
139       inputCommandArray[0] = "";
140     }
```

The program adapts non-blocking functions to constantly detect whether there is any command from infrared controller or Bluetooth module, and then control the robot dog to crawl, emit lights and display expressions accordingly.

```
141 else{//Execute code without blocking
142     IRremote_Read();//Non - blocking access to infrared commands
143     Ant_Servo_Mode(Ant_Move_Direction, Ant_Move_Speed);//Non-blocking ant motion function
144     Emotion_Show();//Non-blocking expression module display function
145     WS2812_Show();//Non-blocking color light display function
146   }
```

What's next?

Thanks for your reading.

This tutorial is all over here. If you find any mistakes, omissions or you have other ideas and questions about contents of this tutorial or the kit and etc, please feel free to contact us: **support@freenove.com**
We will check and correct it as soon as possible.

If you want to learn more about Arduino, Raspberry Pi, smart cars, robots and other interesting products in science and technology, please continue to focus on our website. We will continue to launch cost-effective, innovative and exciting products.
http://www.freenove.com/

Thank you again for choosing Freenove products.