



Preface

About SunFounder

SunFounder is a technology company focused on Raspberry Pi and Arduino open source community development. Committed to the promotion of open source culture, we strive to bring the fun of electronics making to people all around the world and enable everyone to be a maker. Our products include learning kits, development boards, robots, sensor modules and development tools. In addition to high quality products, SunFounder also offers video tutorials to help you build your own project. If you have interest in open source or making something cool, welcome to join us! Visit www.sunfounder.com for more!

About This Kit

In this book, we will show you how to build the bionic robot via description, illustrations of physical components, in both hardware and software respects. You may visit our website www.sunfounder.com to download the related code and view the user manual on [LEARN -> Get Tutorials](#) and watch related videos under [VIDEO](#).

Free Support

-  If you have any **TECHNICAL** questions, add a topic under **FORUM** section on our website and we'll reply as soon as possible.
-  For **NON-TECH** questions like order and shipment issues, please **send an email to service@sunfounder.com**. You're also welcomed to share your projects on FORUM.



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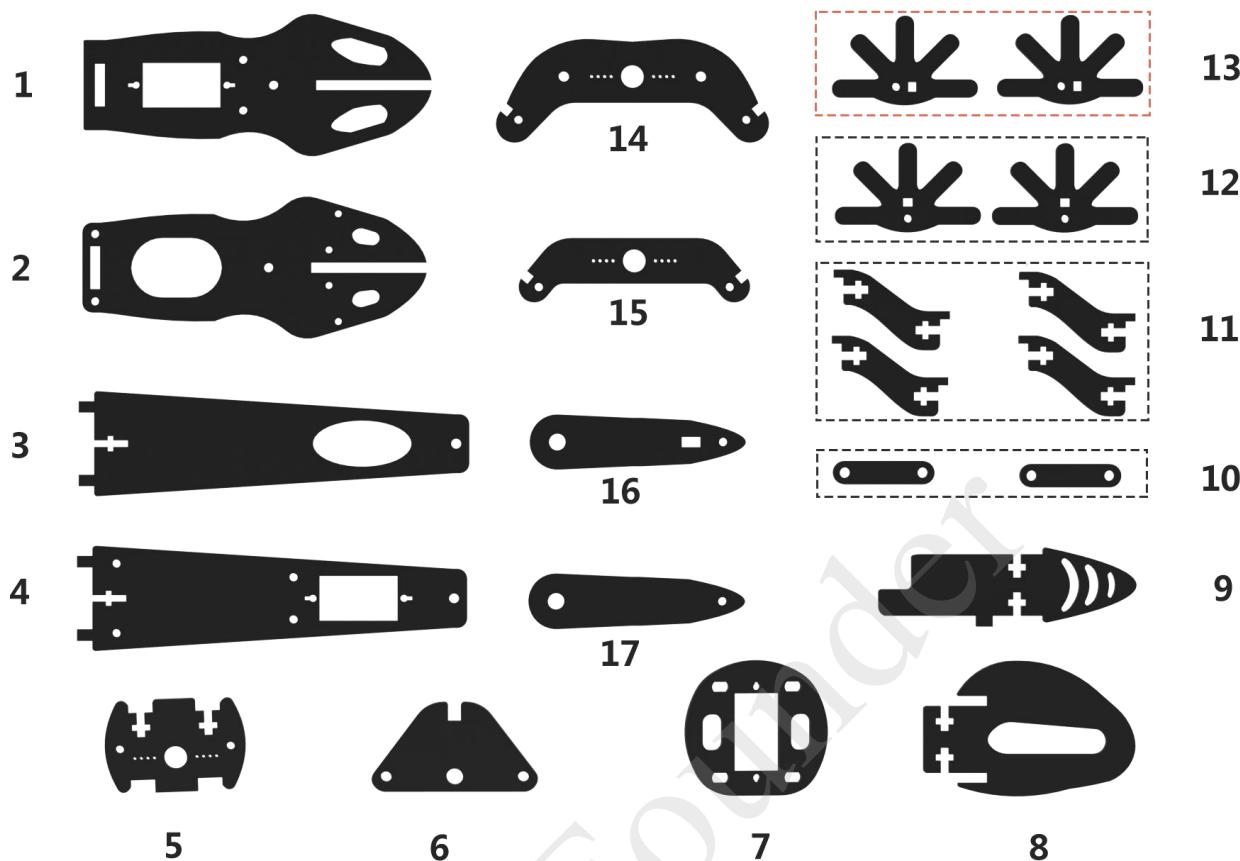


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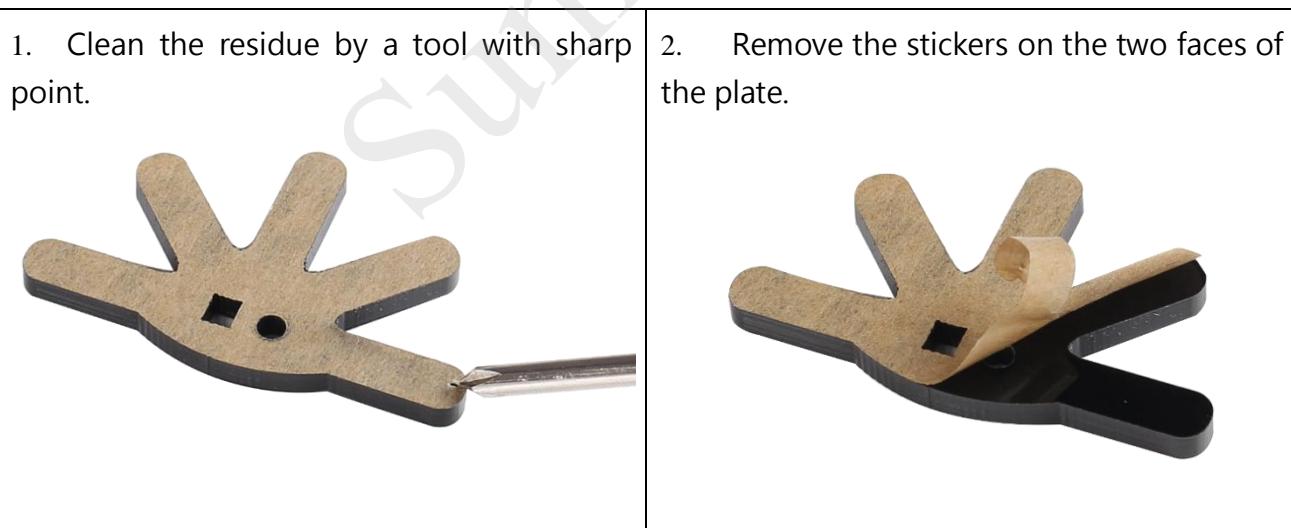
SunFounder

Components List

Acrylic Plate



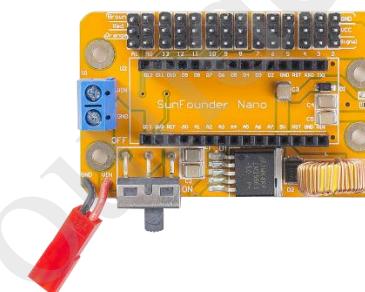
You need to clean the acrylic plates before using. Here takes one plate as example.



Mechanical Fasteners

Name	Components	Qty.
M1.2 x 4mm Self-tapping Screw		8
M2 x 10 Screw		6
M2 x 14 Screw		4
M2.5 x 8 Screw		14
M2.5 x 10 Screw		16
M3 x 6 Screw		4
M3 x 12 Screw		6
M2 Nut		8
M2.5 Nut		16
M3 Self-locking Nut		6
M2.5*13 Copper Standoff		8
M3 x 25 Red Aluminum Standoff		1

Electrical Components

Name	Components	Qty.
9g SF0180 Servo	 A blue 9g servo motor with a black plastic case and three red and orange wires extending from the back.	3
Nano board	 An Arduino Nano microcontroller board with a blue PCB and many pins.	1
Sensor shield	 A yellow Sensor Shield expansion board for the Arduino Nano, featuring various sensors and connectors.	1
2S battery	 A 2S LiPo battery with a JST connector, labeled with "AS2540" and "300mAh 7.4V 2S 30C".	1
Cable Spiral Wrap	 A black coiled cable with a spiral wrap.	1
Velcro Tape (Length 35mm)	 A piece of white Velcro tape.	1
Mini USB Cable	 A blue braided Mini USB cable.	1

IR Remote Control	 A grey remote control with a numeric keypad (0-9), a power button, and various function buttons like 'SPECIAL FOR MFI', 'G', 'USB', and directional arrows.	1
IR Receiver Module	 A blue printed circuit board (PCB) featuring a central infrared receiver LED and a surrounding array of resistors and capacitors. It is labeled 'HS00388 IR Receiver'.	1
3Pin-Anti-reverse Cable	 A cable with three wires: red, black, and yellow. It has a grey plastic connector on one end and a black plastic connector with three pins on the other.	1
2S Lithium Battery USB Charger Cable	 A black USB cable with a standard A-type male connector at one end and a smaller micro-B or similar connector at the other.	1
Phillips Screw Driver	 A screwdriver with a purple handle and a Phillips head tip.	1
Cross Socket Wrench	 A silver-colored cross socket wrench, commonly used for removing and tightening cross-head screws.	1

Introduction

This is a bionic robot - Lizard. It is control walking by three servos, the walking shape is imitate Lizard and looks flexible and vivid. Infrared module is equipped, you can control the Lizard walk by the remote controller.

Before using it, you need to assemble according to the tutorial. After assembling and adjusting, you can control it walk by the remote controller.

You can also add other sensors on the Lizard, like obstacles avoiding, line following and so on. There are remaining pins on the sensor shield. You can find the schematic diagram of Sensor Shield at the file of Circuit.

Besides, in order to control the robot in a more simple way, there is a tutorial wrote for the visual programming: [How to use Lizard robot with Mixly](#). Visual programming is a kind of modularize programming software, users do not need to have much basis on programming, but just logic.



Get Started

Note: Before starting your own project, you must download the **Bionic Robot Kit for Arduino - Lizard.zip** package on our website by visiting [LEARN -> Get Tutorials -> Lizard](#) and unzip it.

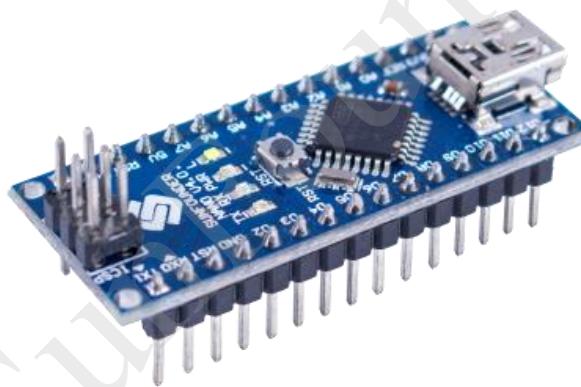
Arduino Description

Arduino is an open source platform that applies simple software and hardware. You can get it in a short time even when you know little about it. It provides an integrated development environment (IDE) for code editing and compiling, compatible with multiple control boards. So you can just download the Arduino IDE, upload the sketches (i.e. the code files) to the board, and then you can see experimental phenomena. For more information, you can refer to <http://www.arduino.cc>.

Arduino Board – SunFounder Compatible

Arduino senses the environment by receiving inputs from many sensors, and affects its surroundings by controlling lights, motors, and other actuators.

In this kit, the SunFounder Nano board is used.



Install Arduino IDE

The code in this kit is written based on Arduino, so you need to install the IDE at the very beginning. Skip if you have done this.

Now go to the arduino.cc website and click **DOWNLOAD**. On the page, check the software list on the right side under **Download the Arduino Software**. The picture following is just an example, please download the latest edition IDE.

ARDUINO 1.8.4

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software.

This software can be used with any Arduino board. Refer to the [Getting Started](#) page for Installation instructions.

Windows ZIP file for non admin install

Windows app 

Mac OS X 10.7 Lion or newer

Linux 32 bits

Linux 64 bits

Linux ARM

[Release Notes](#)

[Source Code](#)

[Checksums \(sha512\)](#)

Find the one that suits your operation system and click to download. There are two versions of Arduino for Windows: **Installer** or **ZIP file**. You're recommended to download the former. Just download the package, and run the executable file to start installation. It will download the driver needed to run Arduino IDE. After downloading, follow the prompts to install. For the details of installing steps, you can refer to the guide on [Learning->Getting Started with Arduino](#), scroll down and see [Install the Arduino Software](#).

After installing, you will see Arduino icon on your desk and double click to open it.



Install the Driver

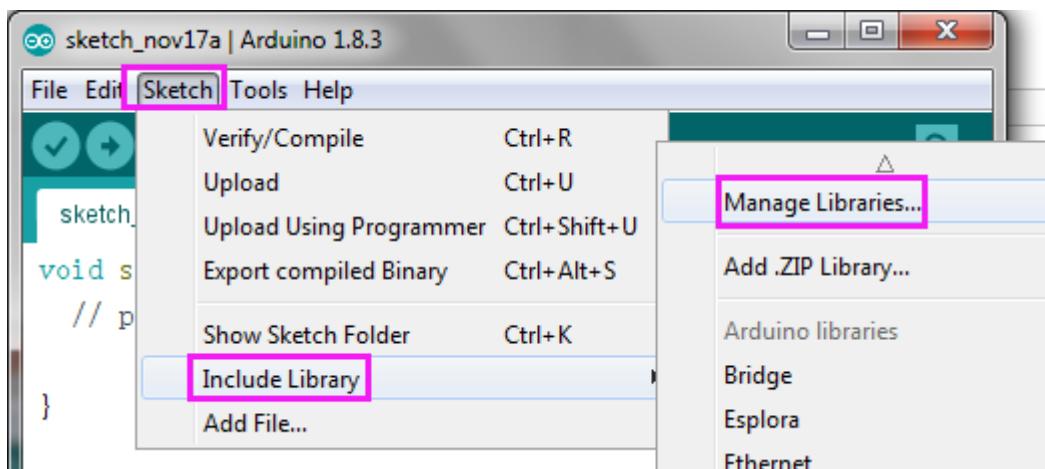
If the driver is not installed, the Nano board will not be recognized by your computer. Therefore, before using it, please install appropriate driver.

For Windows users, run *PL2303_Prolific_DriverInstaller_v1180B* in the folder Driver.

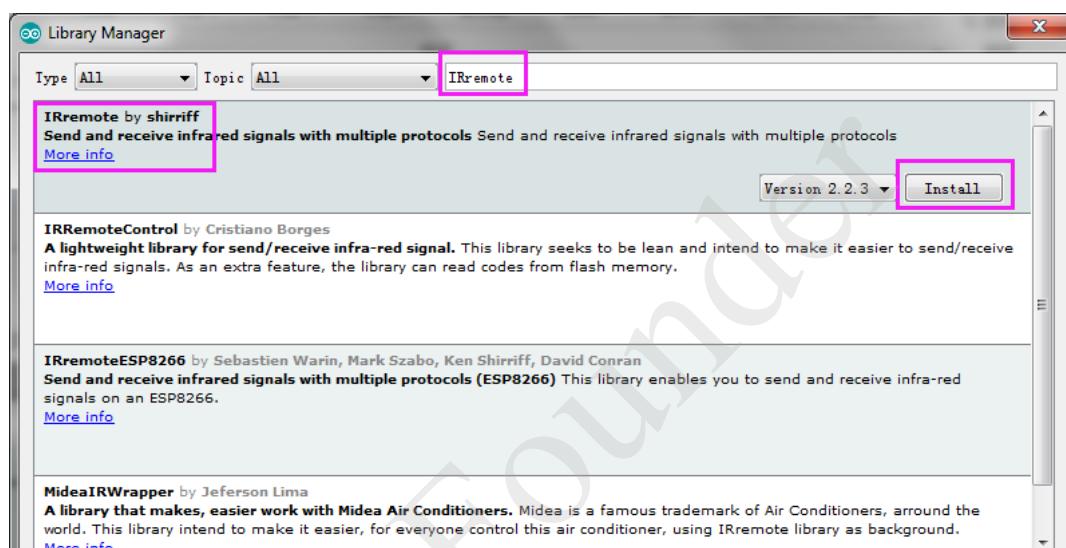
For Mac users, refer to the folder *PL2303_MacOSX_1_6_1_20170620* in the folder Driver.

Add Libraries

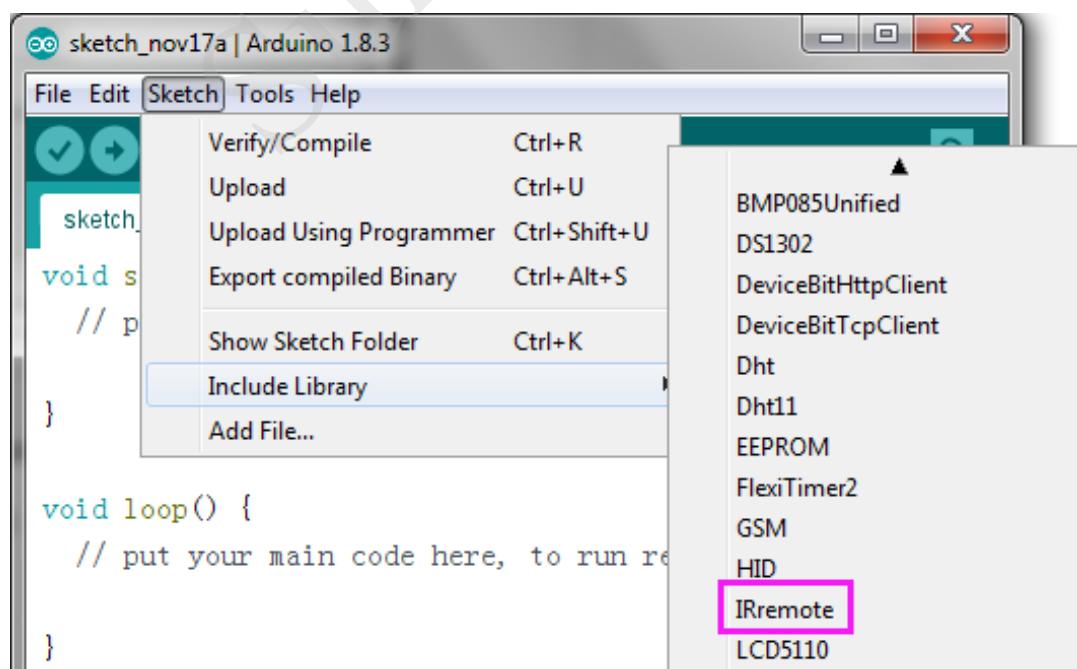
- 1) Select **Sketch -> Include Library -> Management Libraries**



2) Input **IRremote**, then the library will appear, click **Install** button to install it.



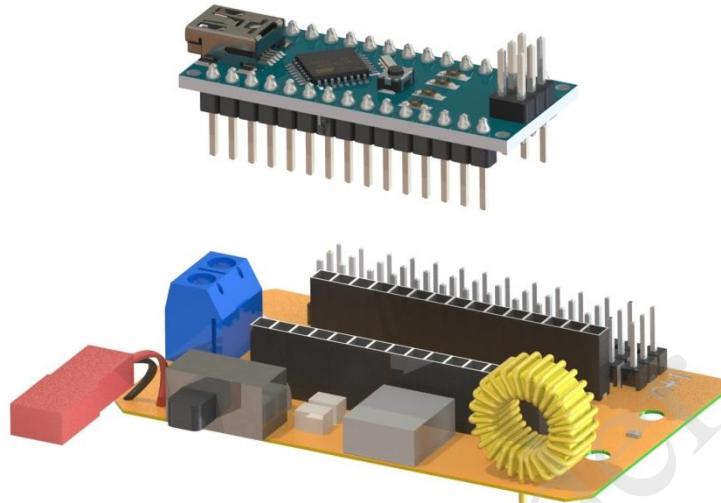
3) You can see the libraries just imported have appeared on the list by going to **Sketch->Include Library->IRremote**.



Test

Build Circuit

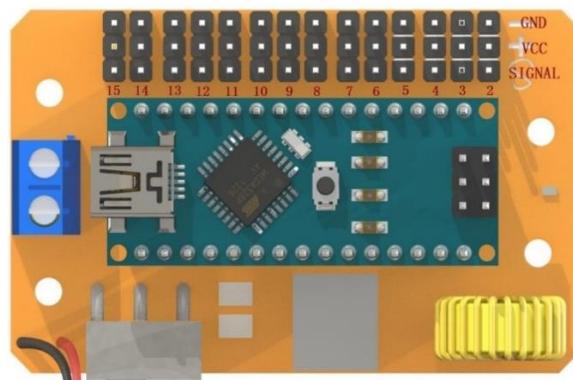
- 1) Insert SunFounder Nano board into the Sensor Shield. **Note:** The USB port should be at the same side with blue power supply terminal.

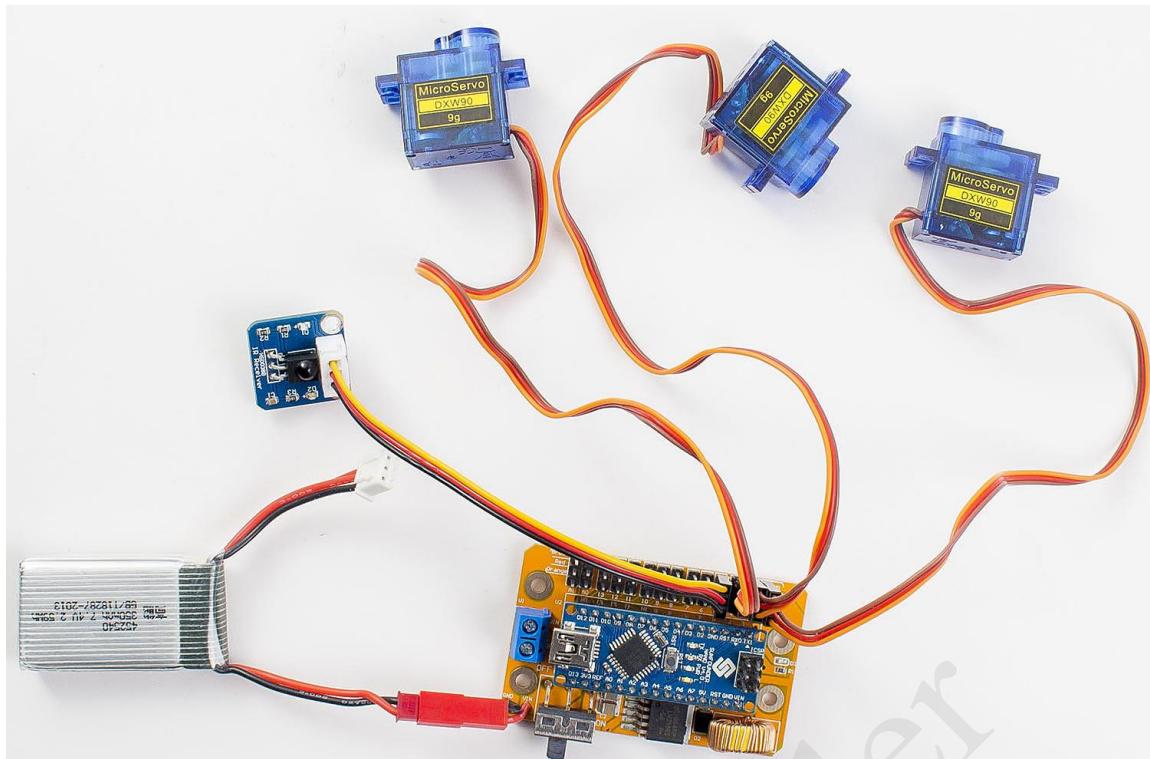


- 2) Insert the battery JST female pin into the red power of the Sensor Shield.
- 3) Connect 3 servos and Infrared receive module with sensor shield. Insert 3 rocker arms into servos in that observe if they are rotate or not.

Note: The Black wire of IR Receiver module connect to sensor shield pin 5, then yellow wire connect to GND pin

Servo	Sensor Shield	IR Receiver	Sensor Shield
Orange	2,3,4	Black	5
Red	+	Red	+
Brown	-	Yellow	GND





Pay attention to the colors and the directions of the anti-reverse cable.

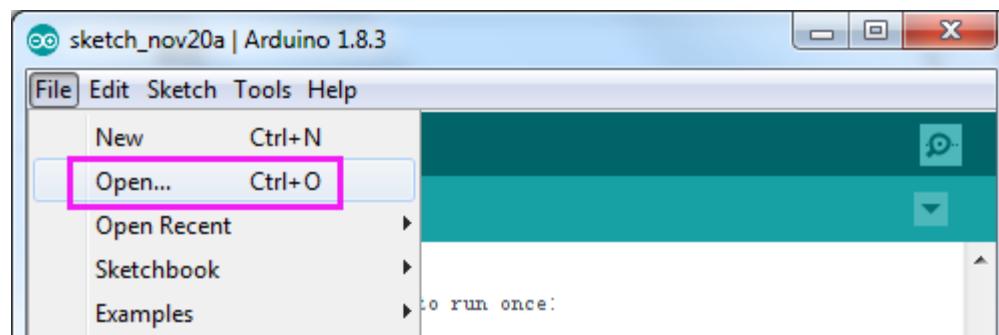


Upload the code

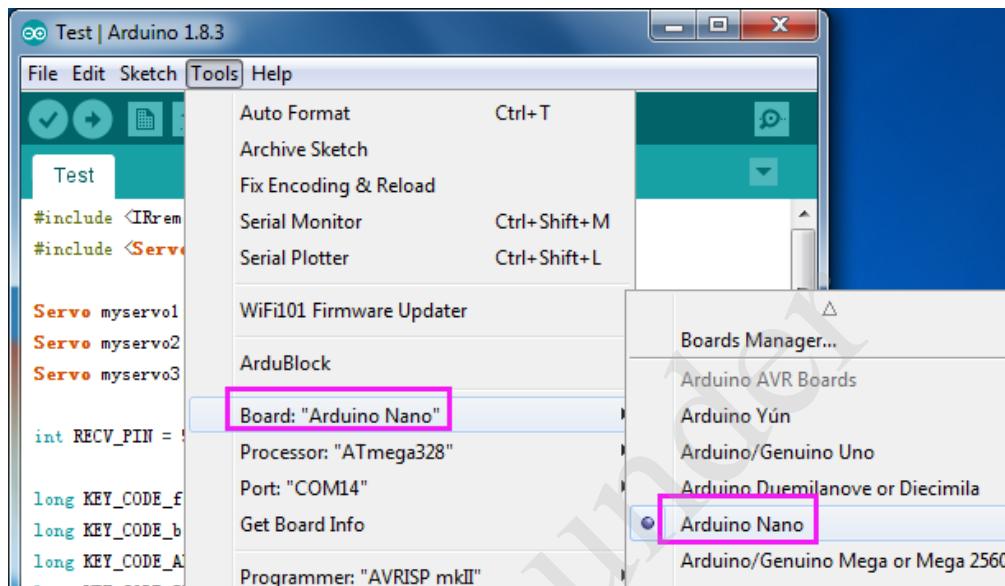
- 4) If everything looks good, connect the Sensor Shield to your PC with a USB cable, then the blue LED on SunFounder Nano board will light up.

If there display “**USB Device not recognized**”, it means that you haven’t installed the driver, thus you need to install the driver below:

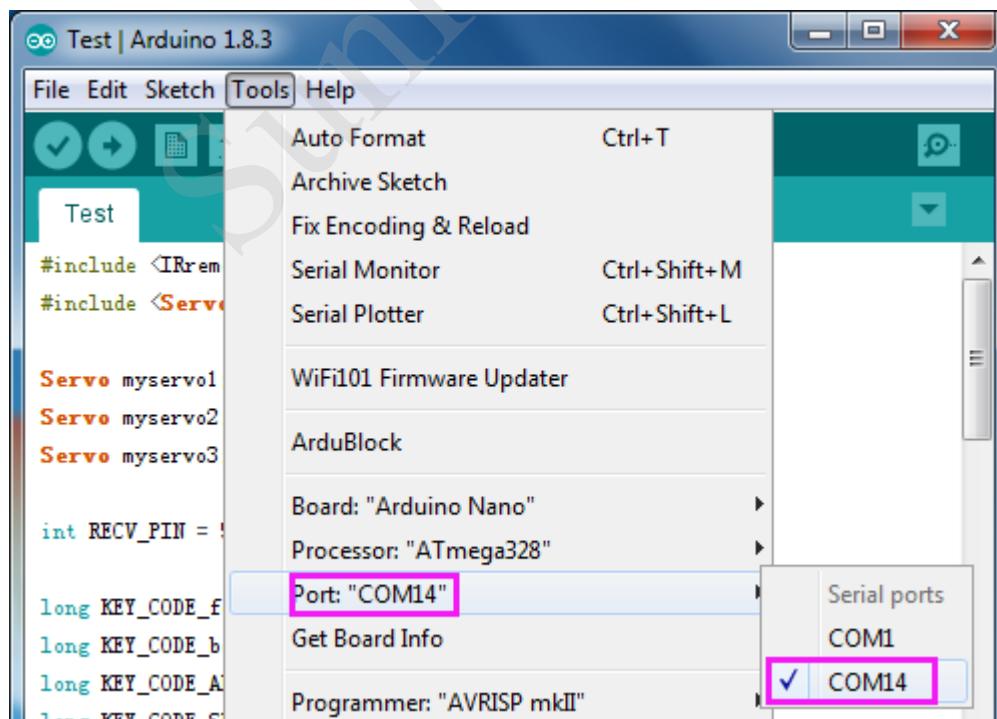
- ◆ For Windows users, run **PL2303_Prolific_DriverInstaller_v1180B** in the folder Driver.
 - ◆ For Mac users, refer to the folder **PL2303_MacOSX_1_6_1_20170620** in the folder Driver.
- 5) Open the Arduino Software (IDE), Select **File->Open**. On the pop-up window, go to the Bionic Robot Kit for Arduino – Lizard -> Code -> Test directory and find **Test.ino**. Click it to open.



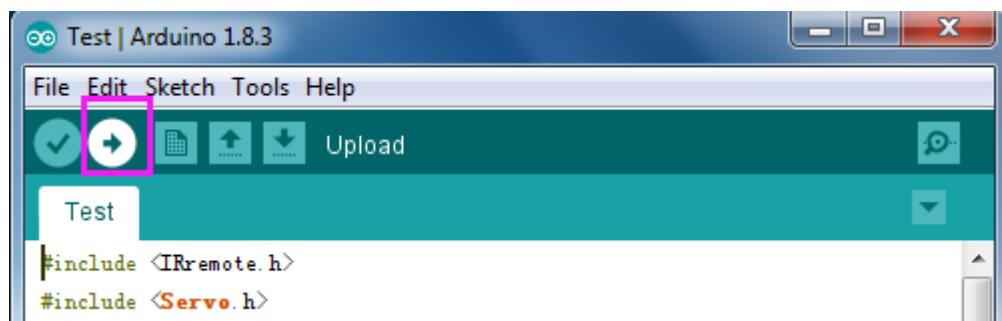
6) Select a board. Here we select Arduino Nano. The Processor is ATmega328.



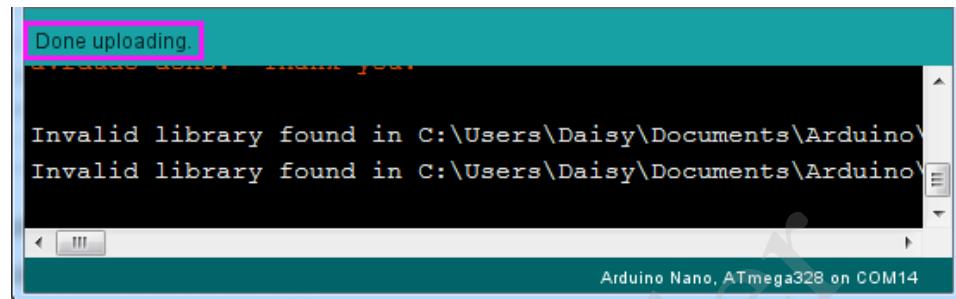
7) Go to Tools -> Port to select the port. Your serial port may be different from what's shown here (right-click My Computer on desktop, click Properties>Device Manager>Ports).



8) Click the following button to upload.

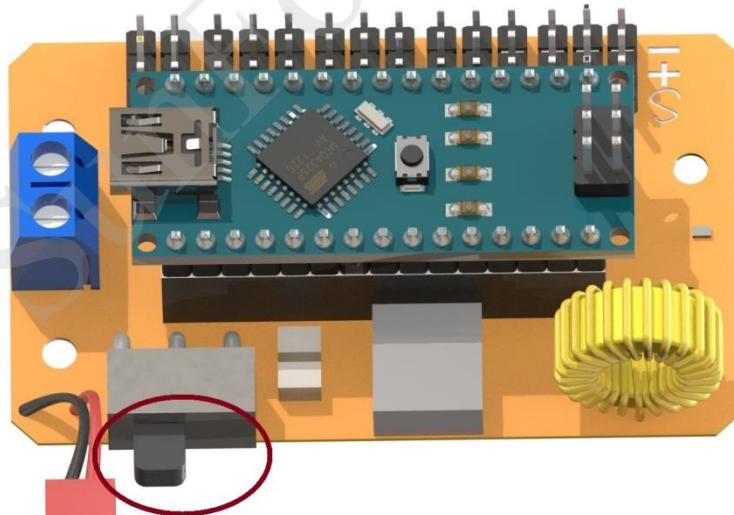


9) Wait for a moment until the following information appears at the bottom of the window, which indicates it is uploaded successfully.



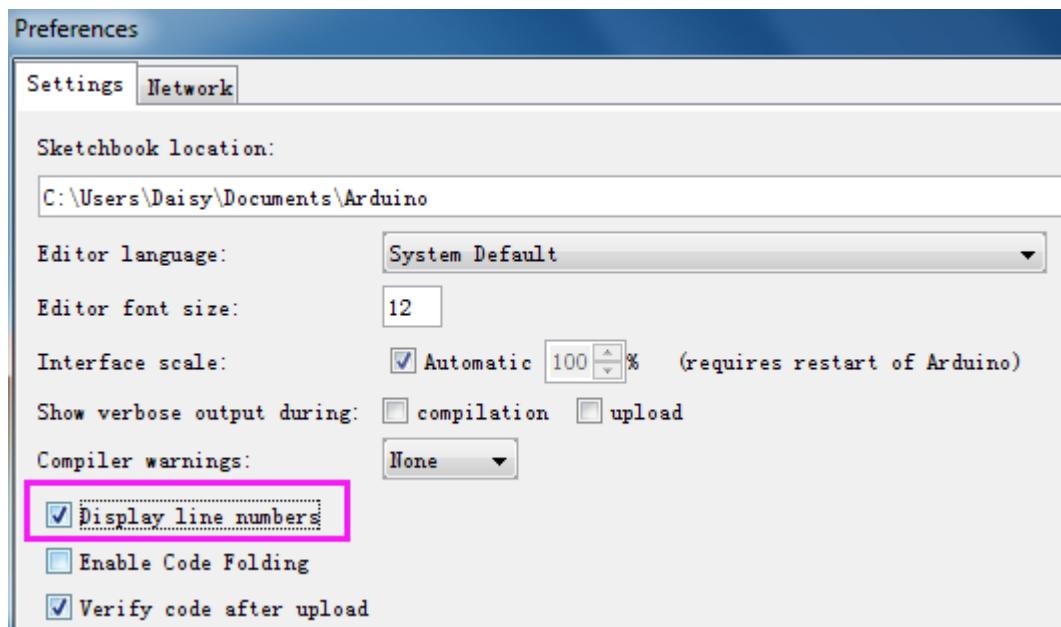
Servo Test

10) Switch on the power, you will find the 3 servos rotate from 0 degree to 180 degree and then stop at 90 degree. If you haven't seen clear of the process, you can press the **Reset** button on the Nano board, the servo will rotate again.



Test IR Receiver

11) Click **File -> Preference** to enable display line numbers, then select **OK**.



12) Comment line 31 by "/*", uncomment line 32 and then upload the code again.

```
31 // #define SERVO //uncomment only this to test the ir receiver
32 #define RECEIVER //uncomment only this to TEST the servos
```

13) Open the Serial Monitor  on the top-right of Arduino IDE, held and press the button of the IR Remote Controller toward IR receive module.

14) You will see it display the value of button on the Serial Monitor.

Note: Press the button on the remote controller gently. If you press the button forcefully, it will be default as long press and display FFFFFFF.

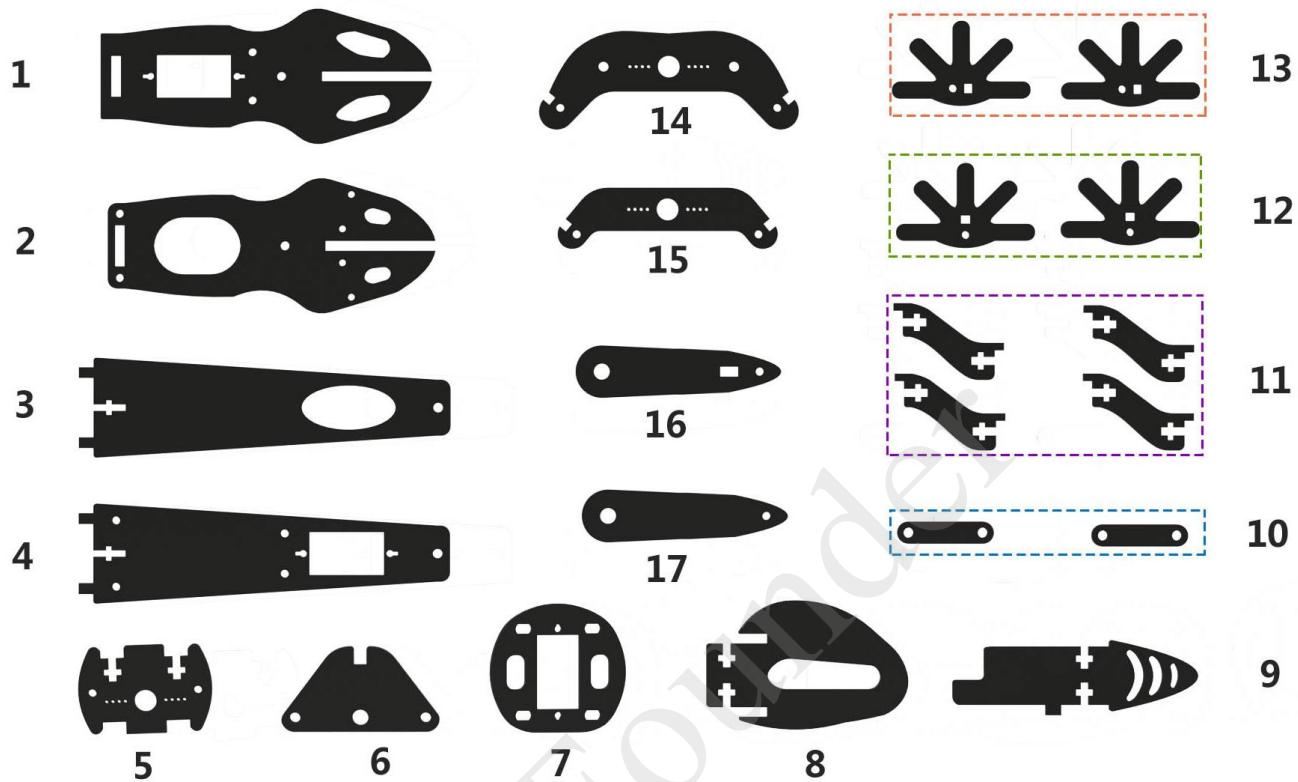
After testing, extract the servo and the Infrared Module.

Note: The axis of the servos is not moved accidentally in the subsequent installation. If the axes are moved, adjust them again before the installation.

Now let's begin to assemble the Lizard robot.

Assembly

Note : In order to conveniently recognize, here number every acrylic plate as shown below. In the following description, the number will be used. There is an independent picture of the following one, you can refer to **Acrylic Plate.png**.



Assemble the forefeet

- 1) Assemble the acrylic plate **11** to **12**. **Note:**
The direction of the plate 11 can't be put on
reverse side.



- 2) Insert the plate **11** into the **12**.



- 3) Connect these two components with an M2.5x10 screw and an M2.5 nut.



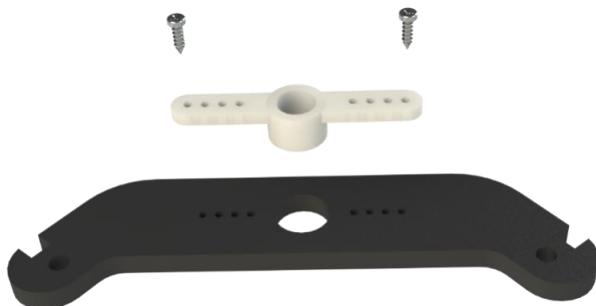
- 4) It looks as the picture shown below after assembling.



- 5) Assemble the other forefoot at the same way.



- 6) Assemble the rocker arm (packaged with the servo) to the **acrylic plate 15**, then connect them by M1.2 x 4mm self-tapping screw.



- 7) Fasten the self-tapping screw.

Do not over tighten it! Or the screw may be broken!



- 8) Fix plate 11 and 15 by M2.5 x 10 screw and M2.5 nut.



- 9) Fasten the screw and nut. **Note :** Plate 15 with white rocker arm side should be Downward.



- 10) Assemble the other foot at the same way.



- 11) Top view.



Assemble the back feet

- 1) Assemble the acrylic plate 11 to the 13. **Note:** The direction of the 11 plate can't be put on reverse side. The square hole of 13 plate is on the right side.



- 2) Fasten the acrylic plate 11 and 13.



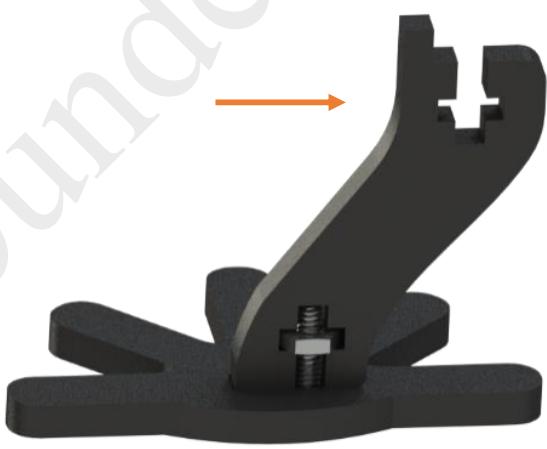
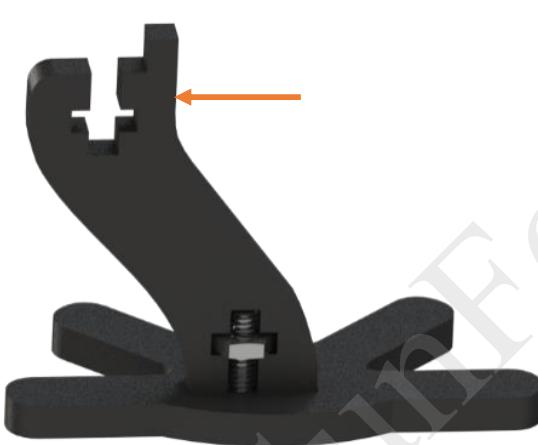
3) Fix them by M2.5x10 screw and M2.5 nut.



4) After assembling, it looks as shown below.



5) Assemble the other two back feet at the same way, you will find the two back feet are in opposite direction.



6) Assemble the rocker arm (packaged with the servo) to the acrylic plate **14**, then connect them by **M1.2 x 4mm self-tapping screw**.



7) Fasten the screw.



- 8) Fix the plate **11** and **14** by M2.5x10 screw and M2.5 nut.



- 9) Fasten the screw and nut

Note : Plate **14** with white rocker arm side should be Downward.



- 10) Assemble the other foot at the same way.

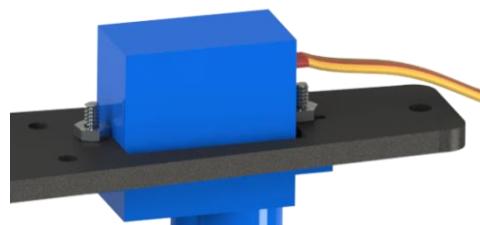
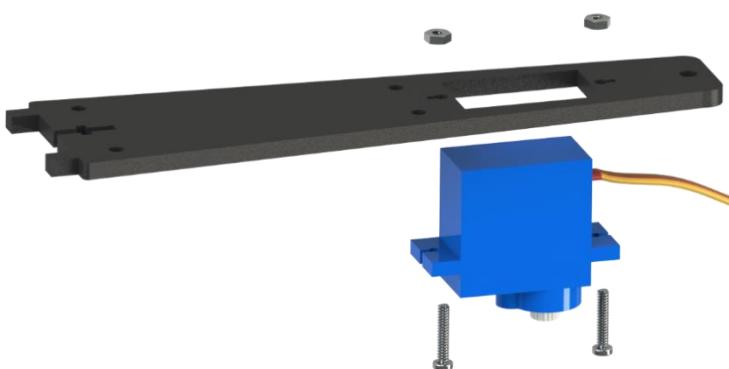


- 11) Top view

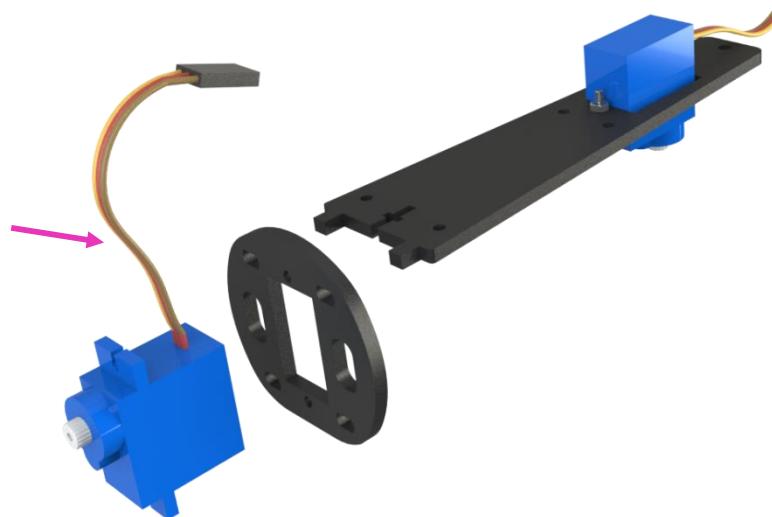


Lizard body

- 1) Assemble the servo onto the acrylic plate **4** by the M2 x 10 screw and M2 nut.

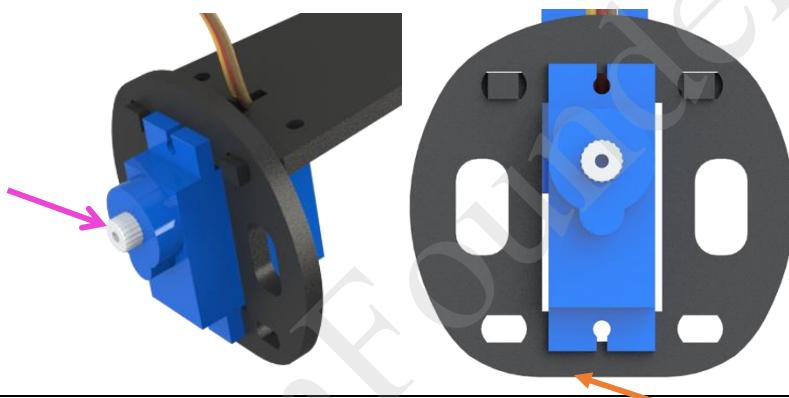


- 2) Assemble the servo onto the plate 7, then assemble them with plate 4.



- 3) After assembling, it looks as shown below:

Note : 1) **servo axis** should be upward; 2) Plain side of **plate 7** should be downward



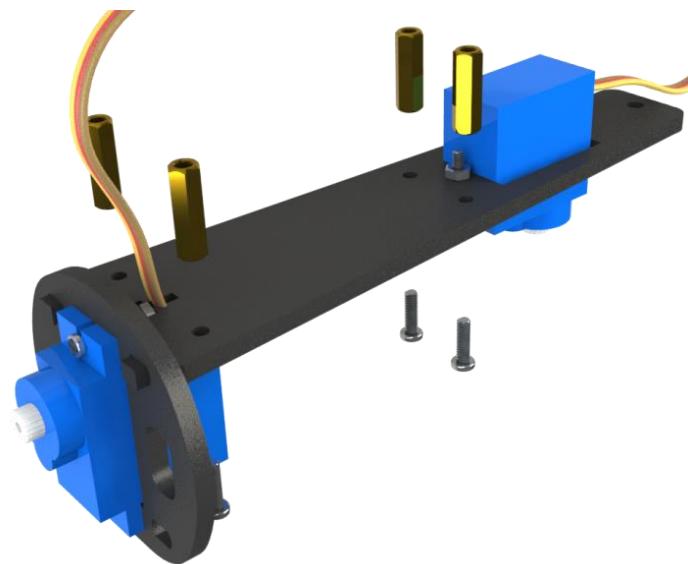
- 4) Insert the **M2 x 14 screw** and **M2 nut** as shown below:



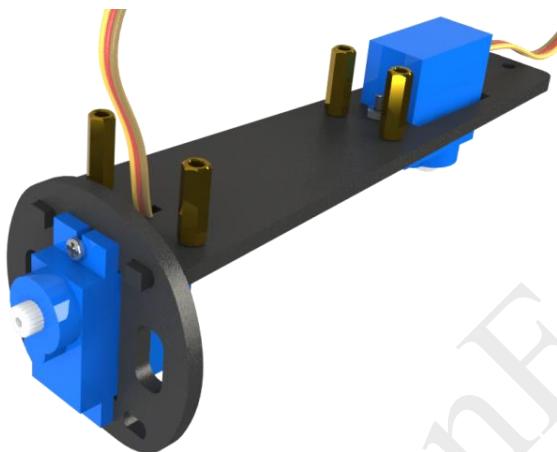
Tips: Put plate 4, 7 and the servo at the right place, then insert **M2 nut** and **M2 x14 screw** and fix by screwdriver.



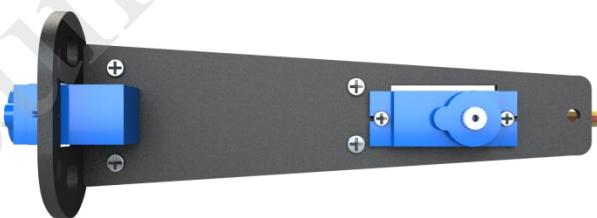
- 5) Fasten the M2.5 x 8mm screw and M2.5 x 13mm Bi-pass copper standoff into the plate 4.



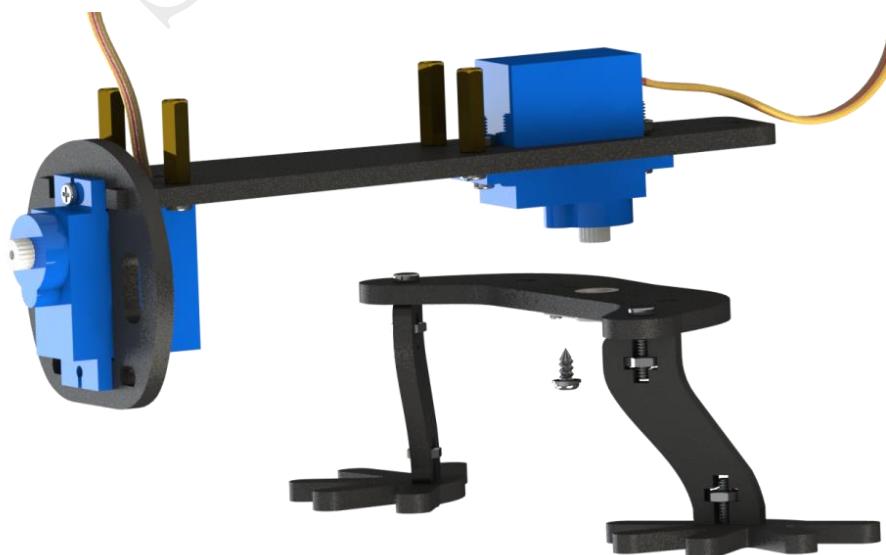
- 6) After assembling, it looks as shown below:



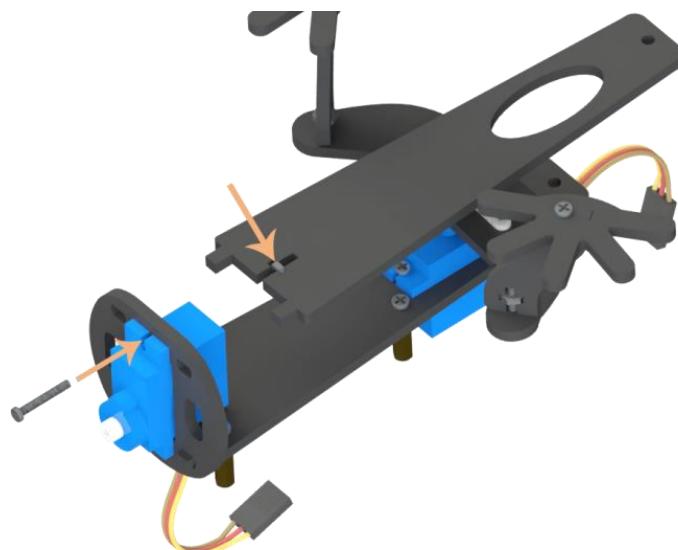
Top view



- 7) Connect the following plate with servo screws.(Packaged with the servo, the servo screws are within the smaller two of five screws.)

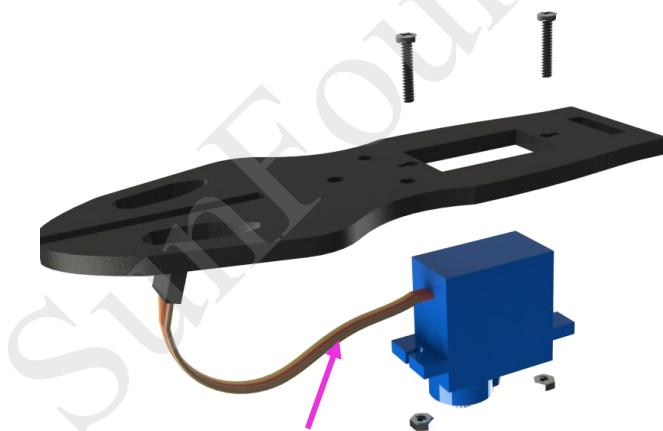


- 8) Assemble the acrylic plate **3** and **7** by M2 x 14 screw and M2 nut.

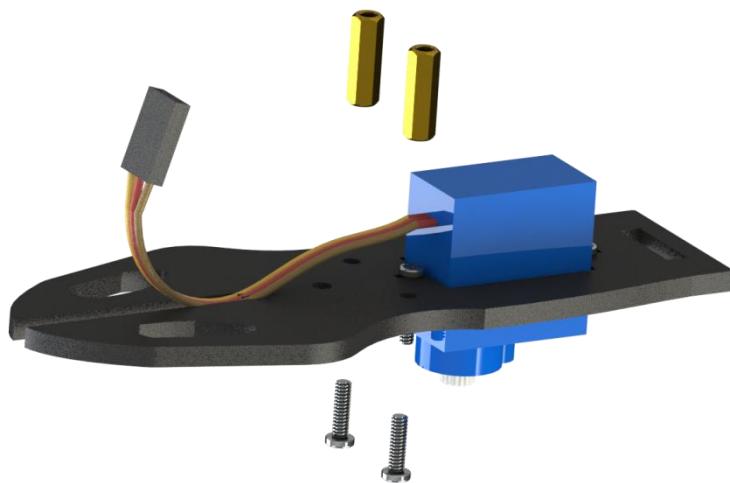


Assemble head and neck

- 1) Use **M2 x 10 screw** and **M2 nut** to combine the servo to **1** acrylic plate. **Note the servo line direction.**



- 2) Fasten the **M2.5x8 screw** and **M2.5x13 copper standoff** into the plate **1**.



- 3) Fasten the following plate with servo screw.



- 4) After assembling, it looks as shown below:

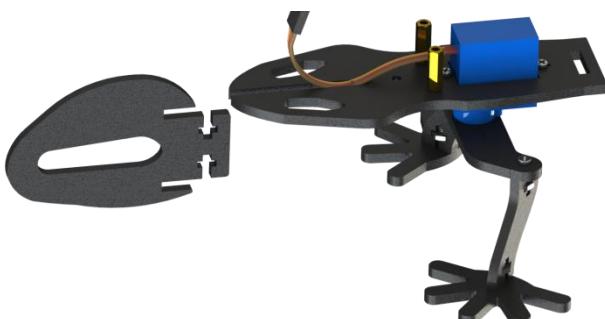
Note: The feet should be forward.



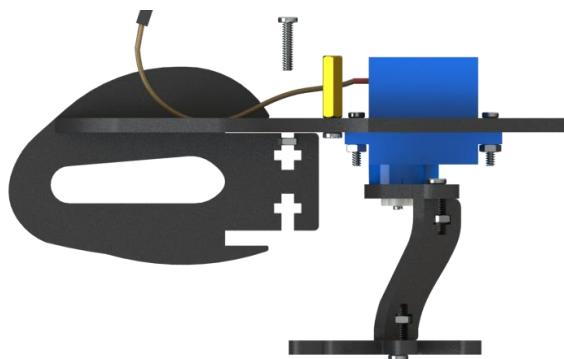
Top view



- 5) Insert the acrylic plate 8.



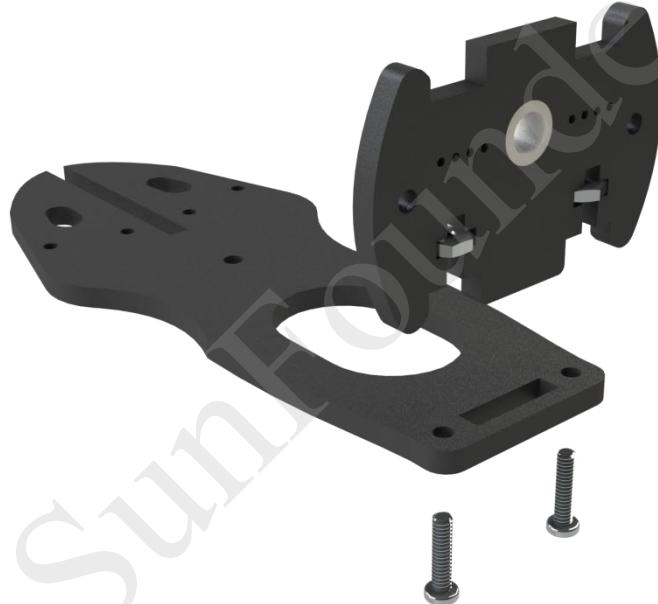
- 6) Fasten them with M2.5x10 screw and M2.5 nut.



- 7) Assemble the rocker arm (packaged with the servo) to the acrylic plate 5, then connect them by M1.2 x 4mm self-tapping screw.



- 8) Connect the acrylic plate 2 and 5 with M2.5 x 10mm screw and M2.5 nut.



- 9) Fasten the following plate with servo screw.



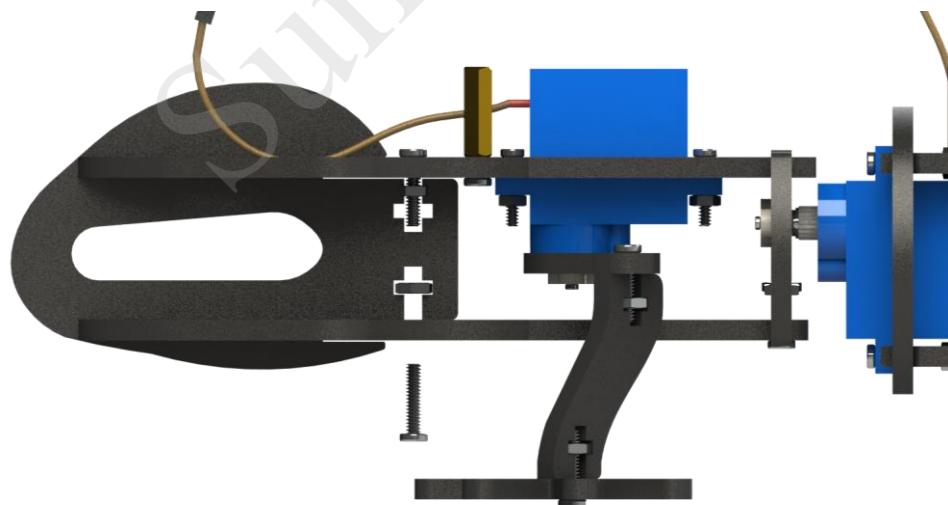
- 10) Insert the plate 8 into the plate 2. **Note:** Be careful, in case of breaking the acrylic plate.



- 11) After assembling, it looks as shown below:

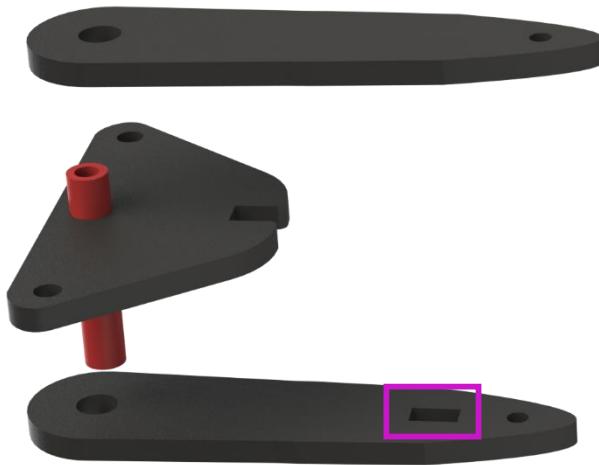


- 12) Fasten them with M2.5x10 screw and M2.5 nut.

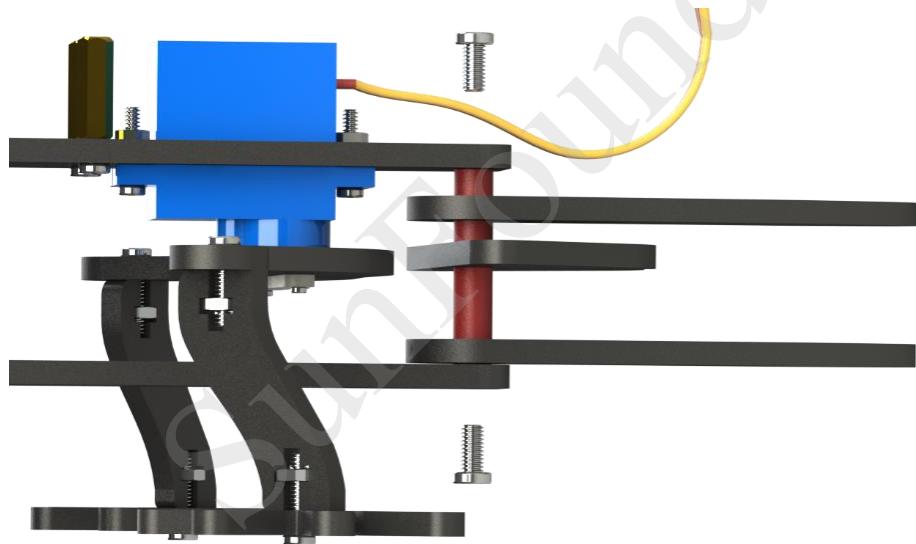


Body+ head+ limb+ tail

- 1) Insert the three acrylic plate together into the aluminum standoff in the order as shown below:



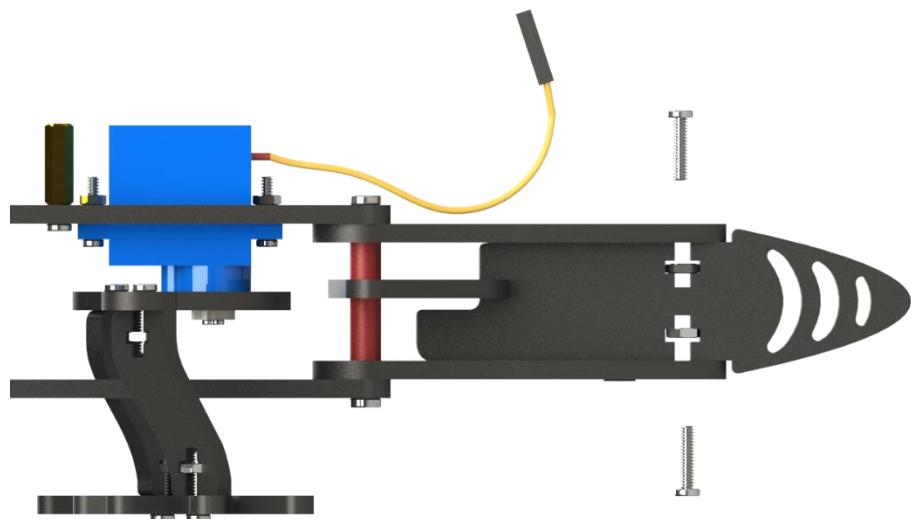
- 2) Fix the aluminum standoff by M3 x 6mm screw.



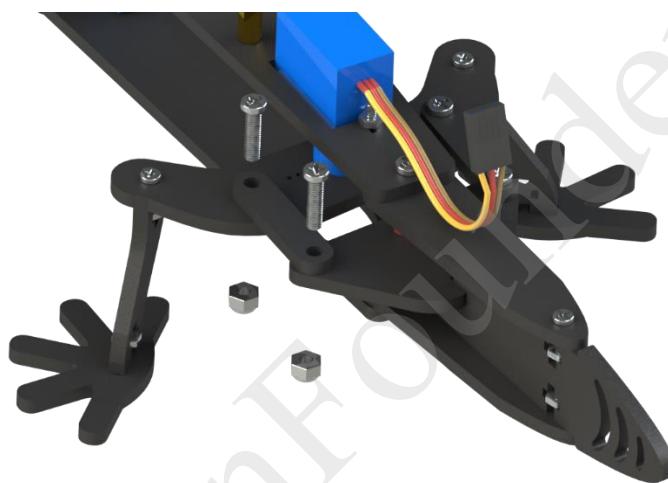
- 3) Insert the acrylic plate 9.



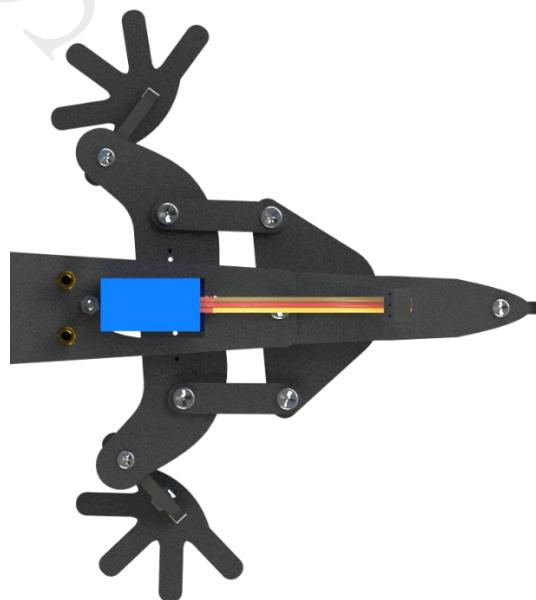
- 4) After inserting, use M2.5 x 10mm screw and M2.5 nut to fix it.



- 5) Connect the acrylic plate 10, 6 and 14 with M3 x 12mm screw and M3 self-locking nut.

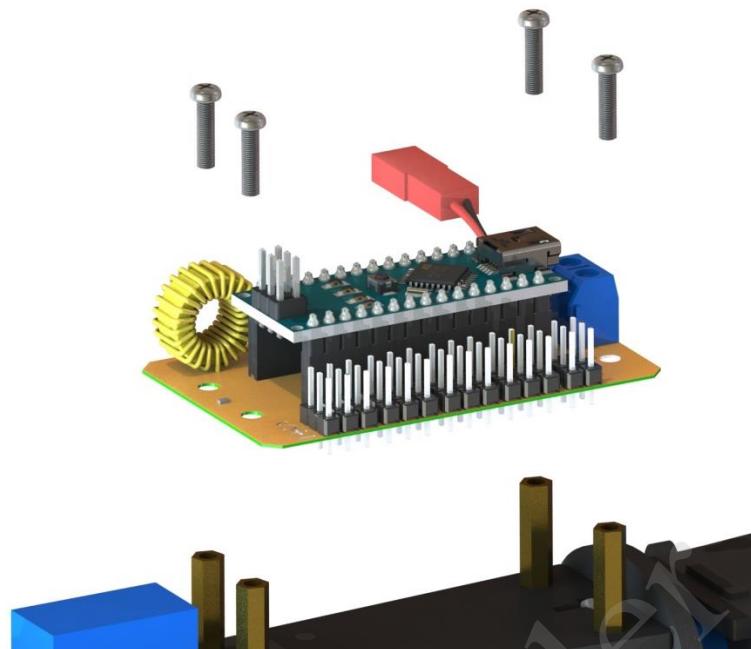


- 6) Tighten the other screw and nut. **Note :** Self-locking screw do not need to be tightened too much, as it need to swing.

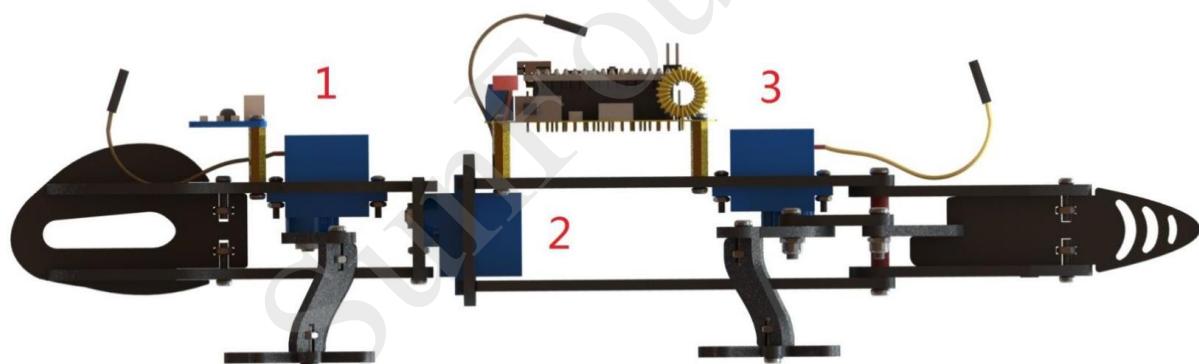


Circuit Connect

- 1) Connect the Sensor Shield into the copper standoff by M2.5 x 8mm screw.

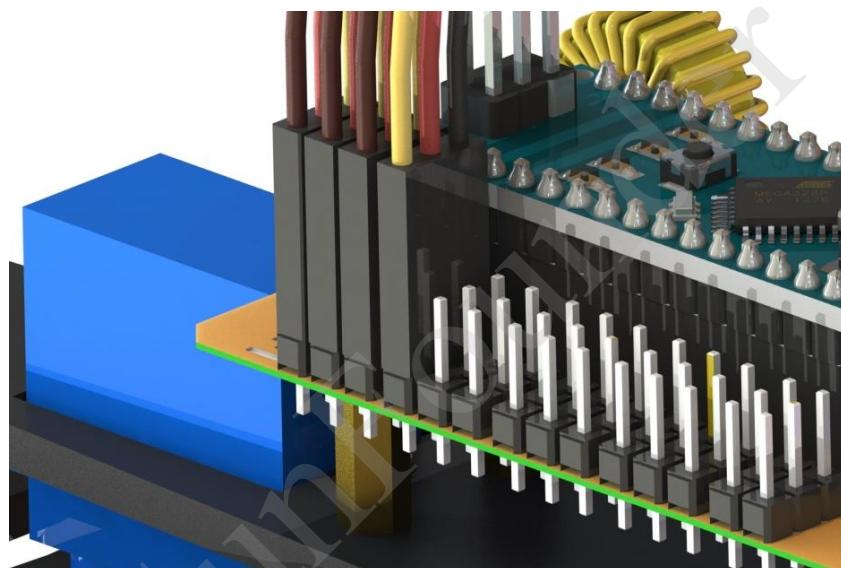
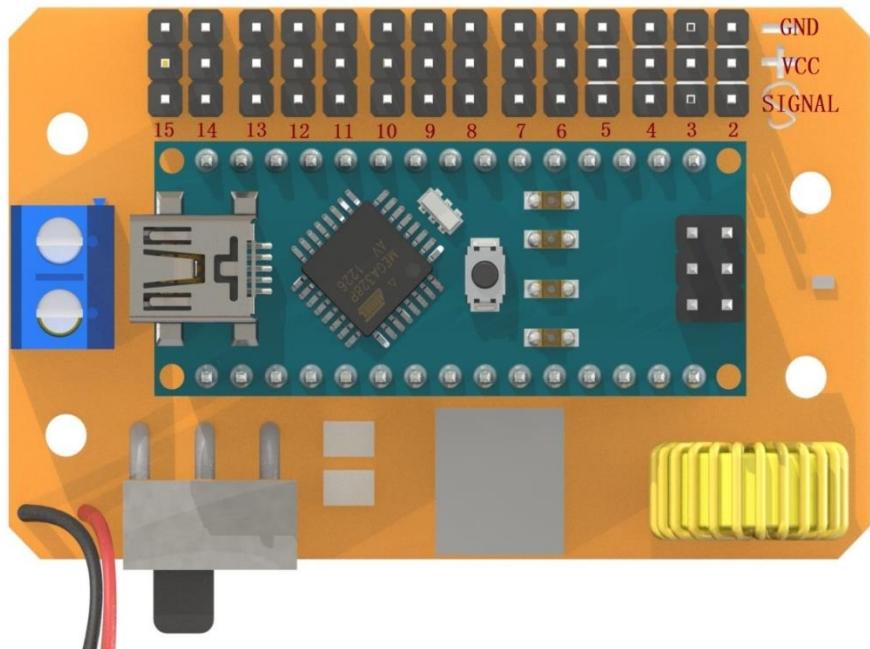


- 2) Insert the three servos into the Sensor Shield, the numbers on the servos are as shown below. Insert the 1 servo to the pin 2, 2 servo to pin 3, 3 servo to the pin 4, and IR receiver module to pin 5.

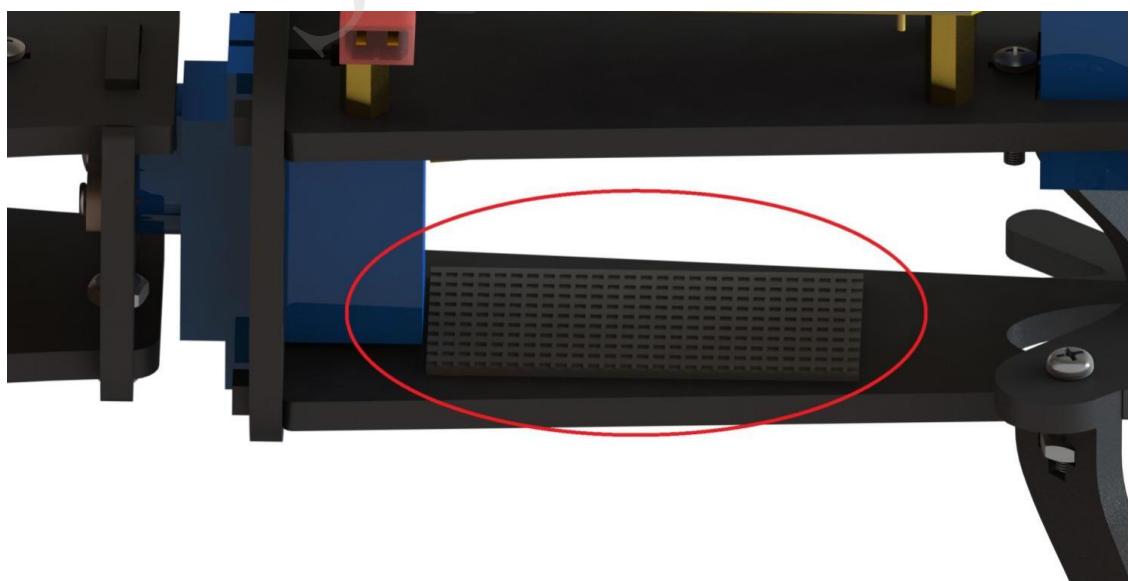


Servo	Sensor Shield
Orange	2,3,4
Red	+
Brown	-

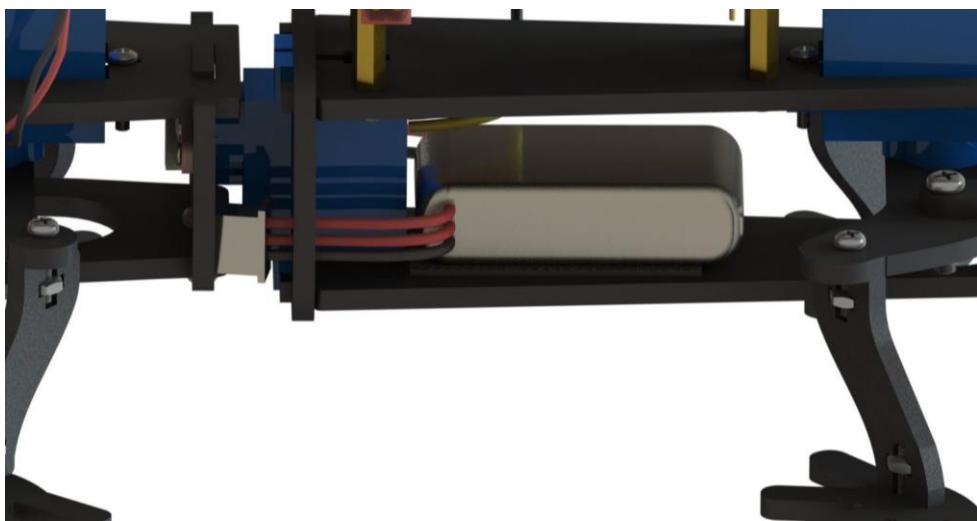
IR Receiver	Sensor Shield
Black	5
Red	+
Yellow	-



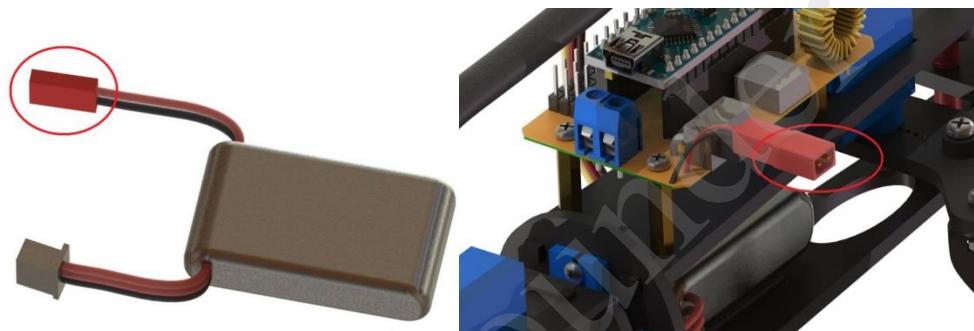
- 3) Stick the Velcro to the plate 3.



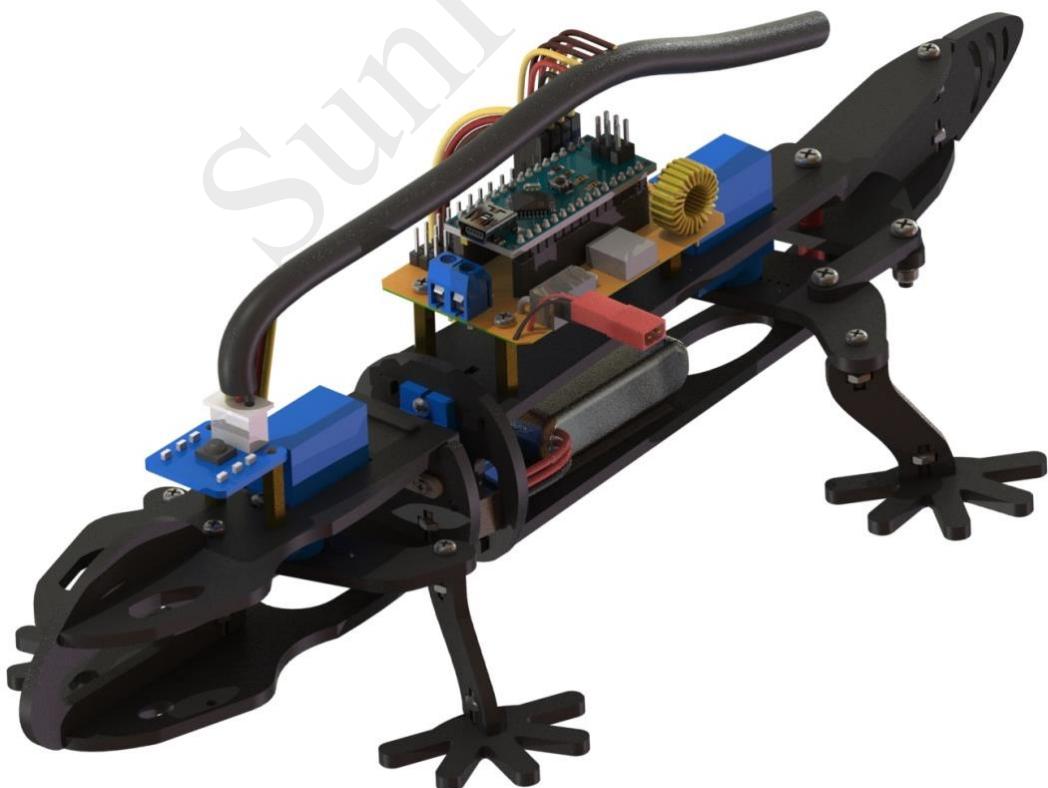
- 4) Stick the batteries on the Velcro.



- 5) Connect the battery case and the Sensor Shield together.



- 6) In order to be clean, you can tie all the wires together by cable pipe.



Adjusting

In the process of assembling, there may occur the two feet are not on the ground or inclined to another direction, thus you can adjust by the way as shown below:

Case 1: The forefeet are inclined

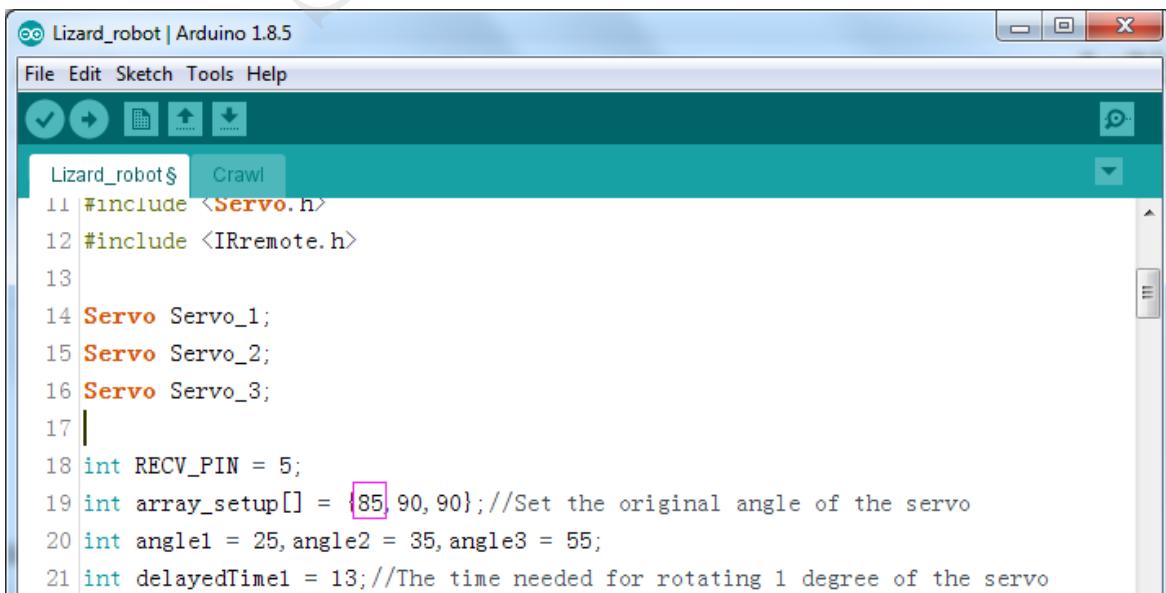
- 1) The left foot is in front, but the right one is behind



Step 1: Open Lizard_robot.ino file under the path Bionic Robot Kit for Arduino - Lizard\Code\Lizard_robot.

Step 2: Find the statement: int array_setup[] = {90,90,90}//Set the original angle of the servo.

The three 90 inside the array stands for the angle of the three servos, the forefeet are controlled by number 1 servo. When the left foot is in front and the right one is behind, you should minus the first value of 90, but do not decrese too much in one time.



```
Lizard_robot | Arduino 1.8.5
File Edit Sketch Tools Help
Lizard_robot$ Crawl
11 #include <Servo.h>
12 #include <IRremote.h>
13
14 Servo Servo_1;
15 Servo Servo_2;
16 Servo Servo_3;
17
18 int RECV_PIN = 5;
19 int array_setup[] = {85, 90, 90}; //Set the original angle of the servo
20 int angle1 = 25, angle2 = 35, angle3 = 55;
21 int delayedTime1 = 13; //The time needed for rotating 1 degree of the servo
```

Step 3: Upload the code to the Sensor Shield.

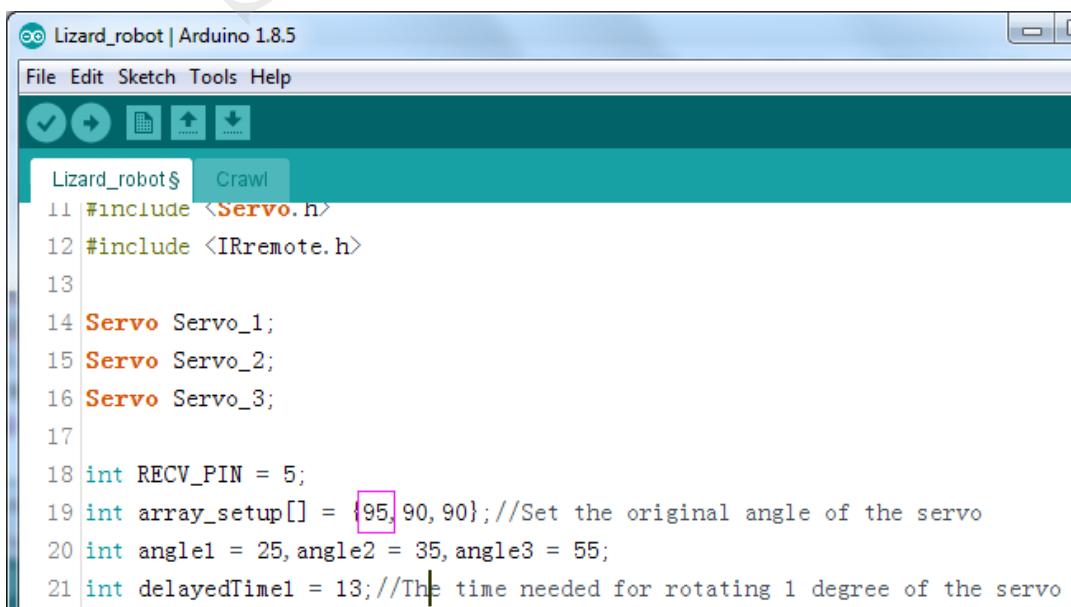
If it looks still inclined then continue to decrease until it looks vertical to its body.



2) The left foot is behind but the right is in front.



You need to increase the value of the first servo.

A screenshot of the Arduino IDE interface. The title bar says "Lizard_robot | Arduino 1.8.5". The menu bar includes File, Edit, Sketch, Tools, Help. The toolbar has icons for upload, refresh, and file operations. The code editor shows the following C++ code:

```
File Edit Sketch Tools Help
Lizard_robot$ Crawl
11 #include <Servo.h>
12 #include <IRremote.h>
13
14 Servo Servo_1;
15 Servo Servo_2;
16 Servo Servo_3;
17
18 int RECV_PIN = 5;
19 int array_setup[] = {95, 90, 90}; //Set the original angle of the servo
20 int angle1 = 25, angle2 = 35, angle3 = 55;
21 int delayedTime1 = 13; //The time needed for rotating 1 degree of the servo
```

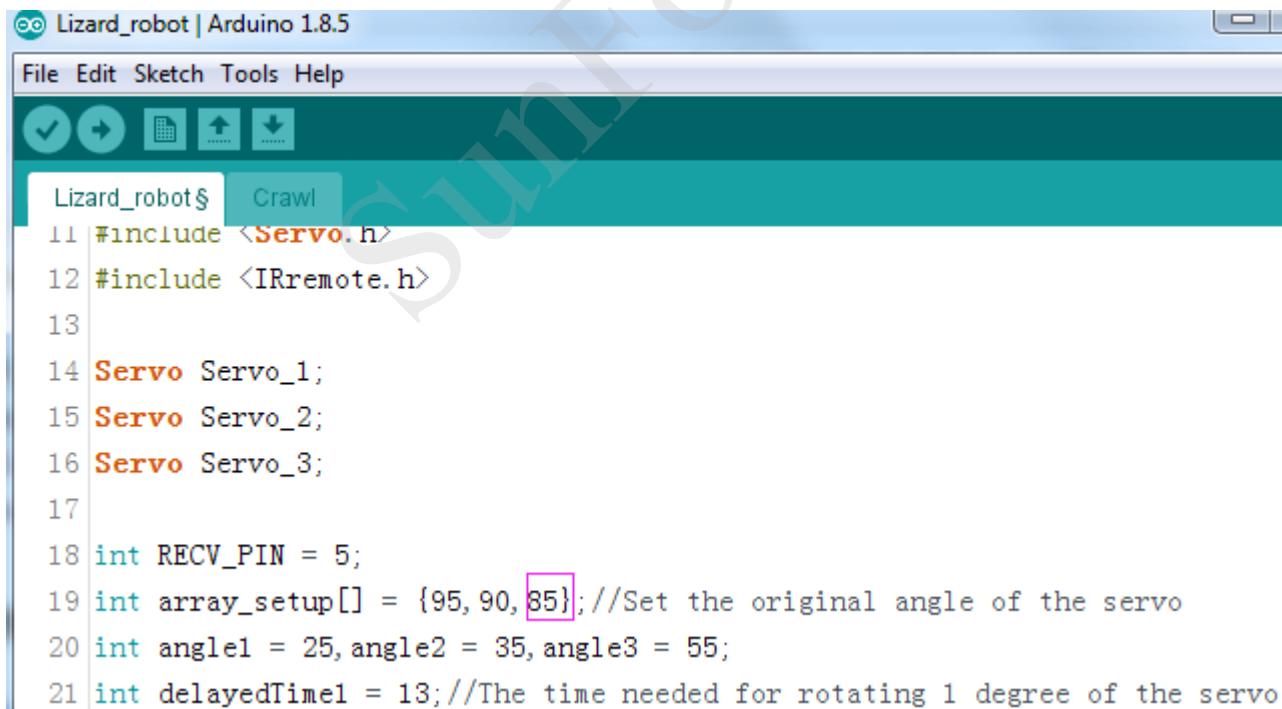
The line "int array_setup[] = {95, 90, 90};" is highlighted with a pink rectangle.

Case 2: The back foot is inclined

1) The left foot is in front, the right foot is behind



The back leg is controlled by servo 3, when the left leg is in front but the right one is behind, the third value in the array need be decreased.

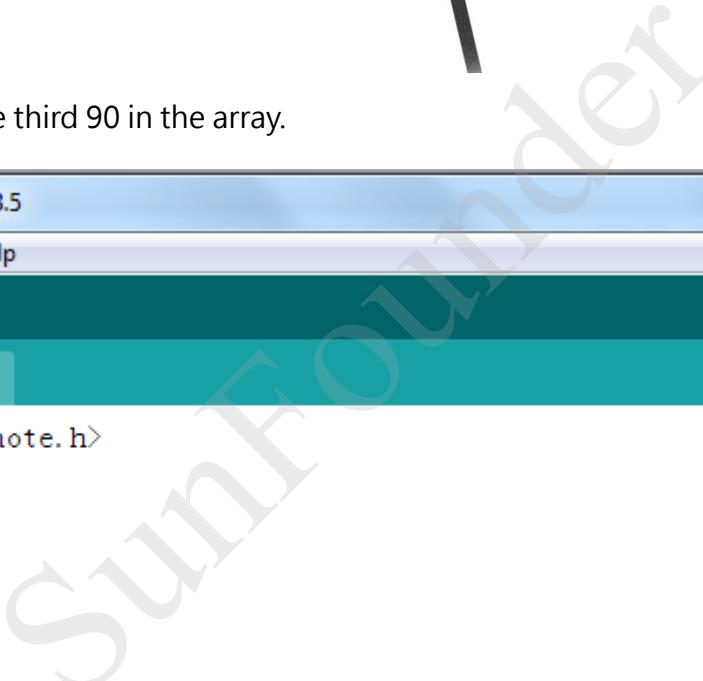


```
Lizard_robot | Arduino 1.8.5
File Edit Sketch Tools Help
Lizard_robot$ Crawl
11 #include <Servo.h>
12 #include <IRremote.h>
13
14 Servo Servo_1;
15 Servo Servo_2;
16 Servo Servo_3;
17
18 int RECV_PIN = 5;
19 int array_setup[] = {95, 90, 85}; //Set the original angle of the servo
20 int angle1 = 25, angle2 = 35, angle3 = 55;
21 int delayedTime1 = 13; //The time needed for rotating 1 degree of the servo
```

2) The left leg is in back, but the right one is in front



Increase the value of the third 90 in the array.



```
Lizard_robot | Arduino 1.8.5
File Edit Sketch Tools Help
Lizard_robot§ Crawl
12 #include <IRremote.h>
13
14 Servo Servo_1;
15 Servo Servo_2;
16 Servo Servo_3;
17
18 int RECV_PIN = 5;
19 int array_setup[] = {95, 90, 95}; //Set the original angle of the servo
20 int angle1 = 25, angle2 = 35, angle3 = 55;
21 int delayedTime1 = 13; //The time needed for rotating 1 degree of the servo
```

Case 3: The Lizard can't stand steadily

When the head is deviation counter-clockwise and one of the forefoot can't stand steadily, the second 90 in the array need to be decrease.



Lizard_robot | Arduino 1.8.5

File Edit Sketch Tools Help

Lizard_robot§ Crawl

```
10 /* Include */
11 #include <Servo.h>
12 #include <IRremote.h>
13
14 Servo Servo_1;
15 Servo Servo_2;
16 Servo Servo_3;
17
18 int RECV_PIN = 5;
19 int array_setup[] = {90, 85, 90}; //Set the original angle of the servo
20 int angle1 = 25, angle2 = 35, angle3 = 55;
21 int delayedTime1 = 13; //The time needed for rotating 1 degree of the servo
```

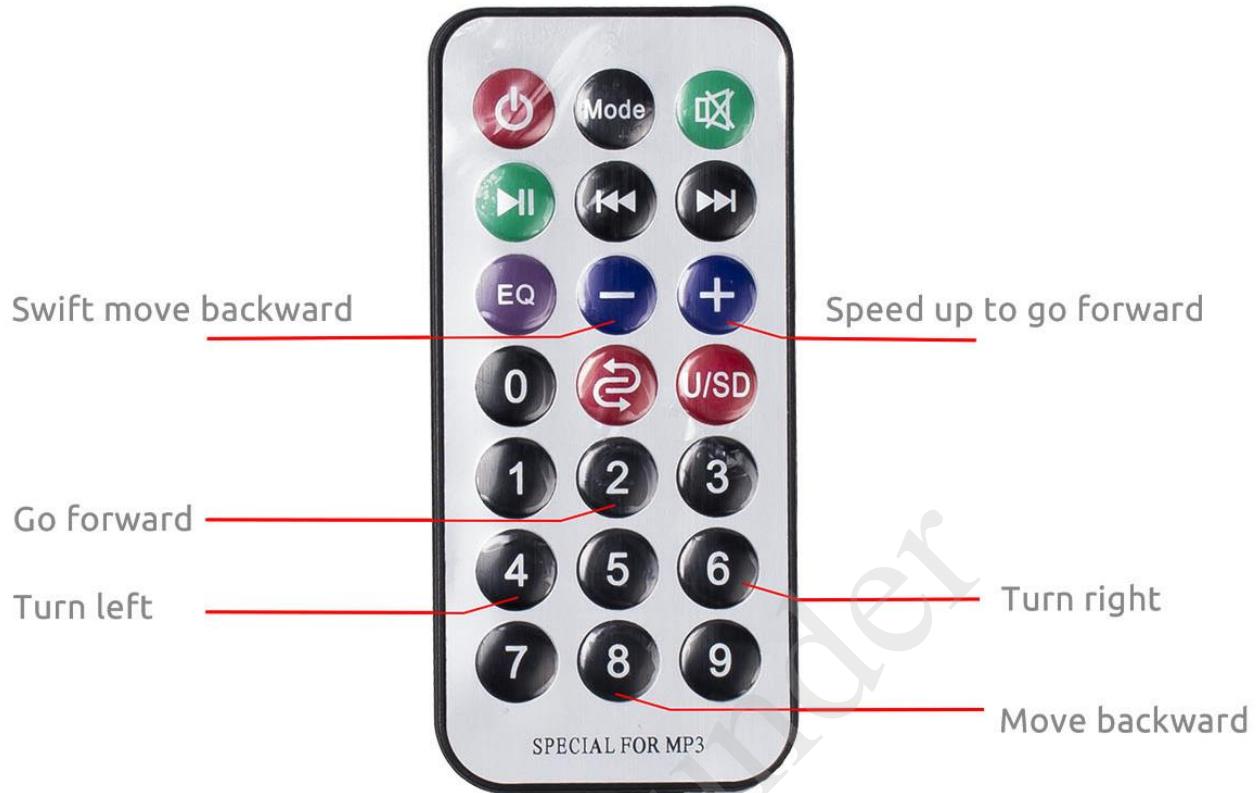
If it is clockwise, the second 90 need to be increased. When finishing adjusting, you can control the Lizard by remote controller.

Now the Lizard is complete adjust, you can use the remote controller to control the Liard moving.

From the figure below, the 2 button to control Liard go forward, 4 to turn left, 6 to turn right, 8 to

move backward. The “-” and “+” button let Liard speed up to go backward and forward.

If you want to learn to how to set one button to control Lizard moving, you can refer to: [How to use Lizard robot with Mixly](#)



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