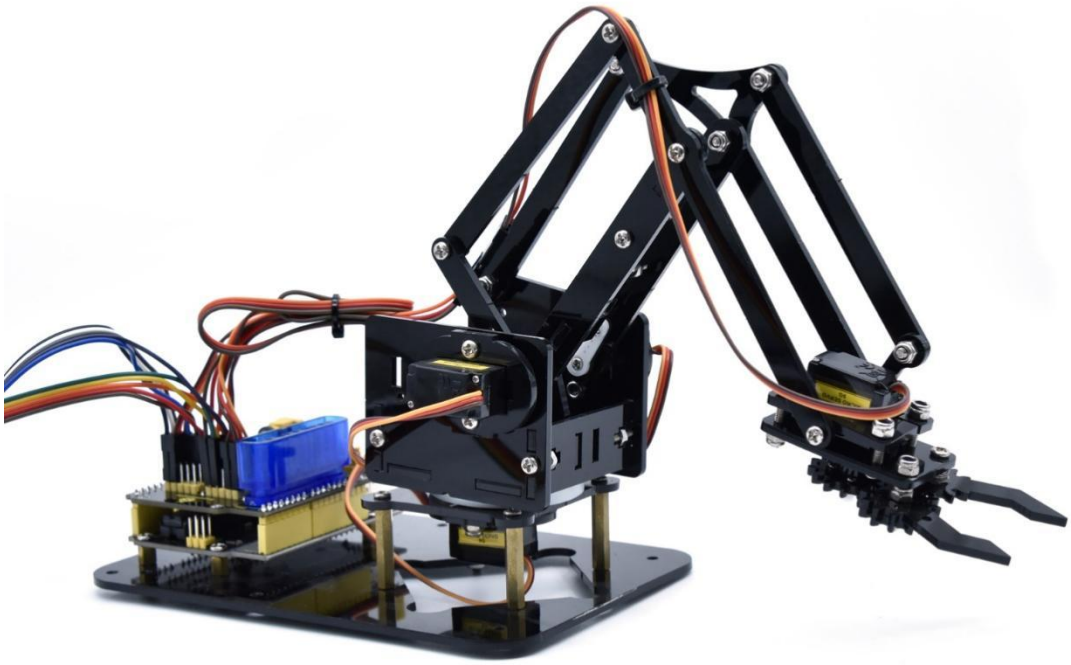
Keyestudio 4DOF Robot Arm Kit for Arduino DIY



Contents

1. Overview

DIY is the activity of making or repairing things yourself, especially in your home. Historically, it has been popular all over the world since 1960s, making our routine life interesting. Combined with STEM education, DIY products can greatly cultivate teenagers' imagination and creativity.

Therefore, we Keyestudio R&D group rolls out an amazing 4DOF mechanical arm kit, which contributes to improving kids' hand-on ability, logical thinking and observation ability.

It is easy to build to say the least. In fact, the four servos of this

robot arm are controlled by V4.0 control board and two joystick modules. What ' s more, the detailed tutorials are provided for you even you are a starter.

For this mechanical robot arm, there are three methods to control. The first one is controller handle we provide(joystick modules), the second one is App; and the third one is wireless PS2 joystick module(not included in this kit).

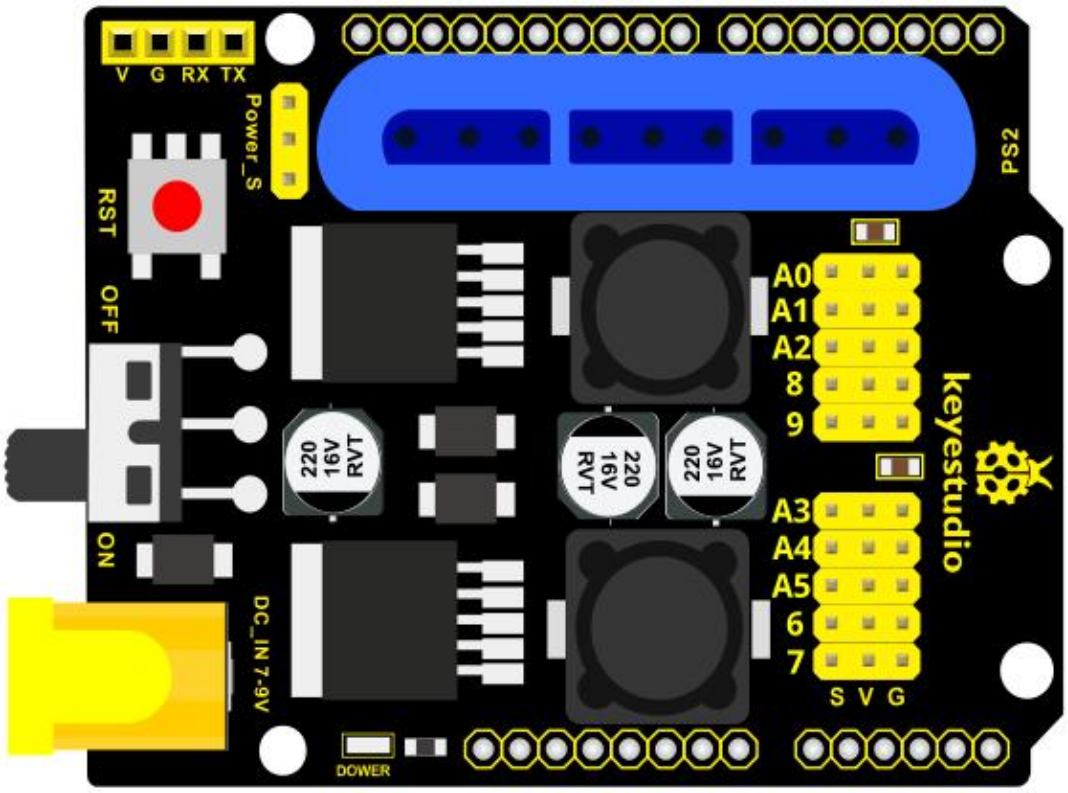
I believe that you can' t help getting down with this kit.

Next, let' s get started.

2. Features

You can check out these features:

- Detailed installation instructions
- Detailed debugging methods, starting Arduino from entry.
- Three controlling methods: Wired JoyStick Control; Phone Bluetooth Control; Wireless PS2 JoyStick Control.



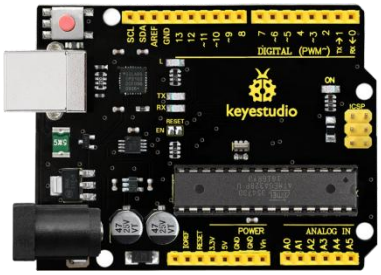
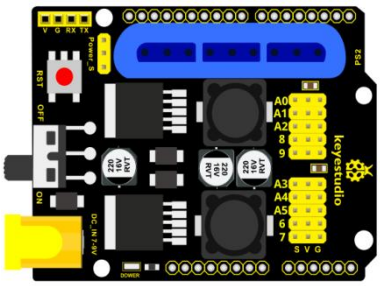
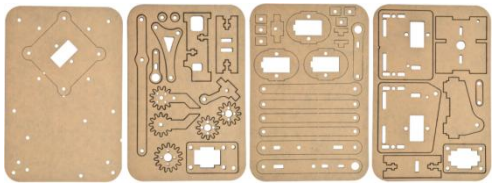
The parameters of keyestudio servo motor/ drive shield are as follows:

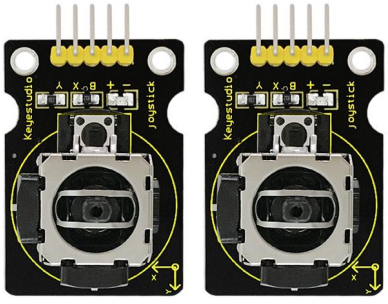
- VIN voltage: VIN = DC 7-15V
- VIN current: 5A
- Two-channl 5V output: 5V/3A
- PS2 interface: compatible with Sony PS2 receiver, can be plugged directly into the expansion board.
- Dimensions: 73*53.34mm

3. Kit List

You can see a pretty beautiful packaging box for the arm kit, and inside the packaging you will find all the parts and screws listed below.

Note: Peel the plastic film off the board first when you install robotic arm.

No.	Item	QTY	Picture
1	Keyestudio V4.0 Control Board	1	
2	Keyestudio Servo Motor Driver Shield	1	
3	Acrylic Boards	1	

4	Acrylic Handle	1	
5	MeArm ABS Cylindrical Holder	1	
6	180° Black Servo	4	
7	BT-24 Module	1	
8	Keyestudio Joystick Module	2	
9	3D PS2 Joystick Cap	2	

10	3*40MM Screwdriver	1	
11	Galvanized Wrench	1	
12	M3*6MM Round Head Screws	12	
13	M3*10MM Round Head Screws	22	
14	M3*14MM Flat Head Screws	2	
15	M3*12MM Round Head Screws	12	
16	M3*24+6MM Copper Pillar	4	
17	M3*6mm+6mm Copper Pillar	10	

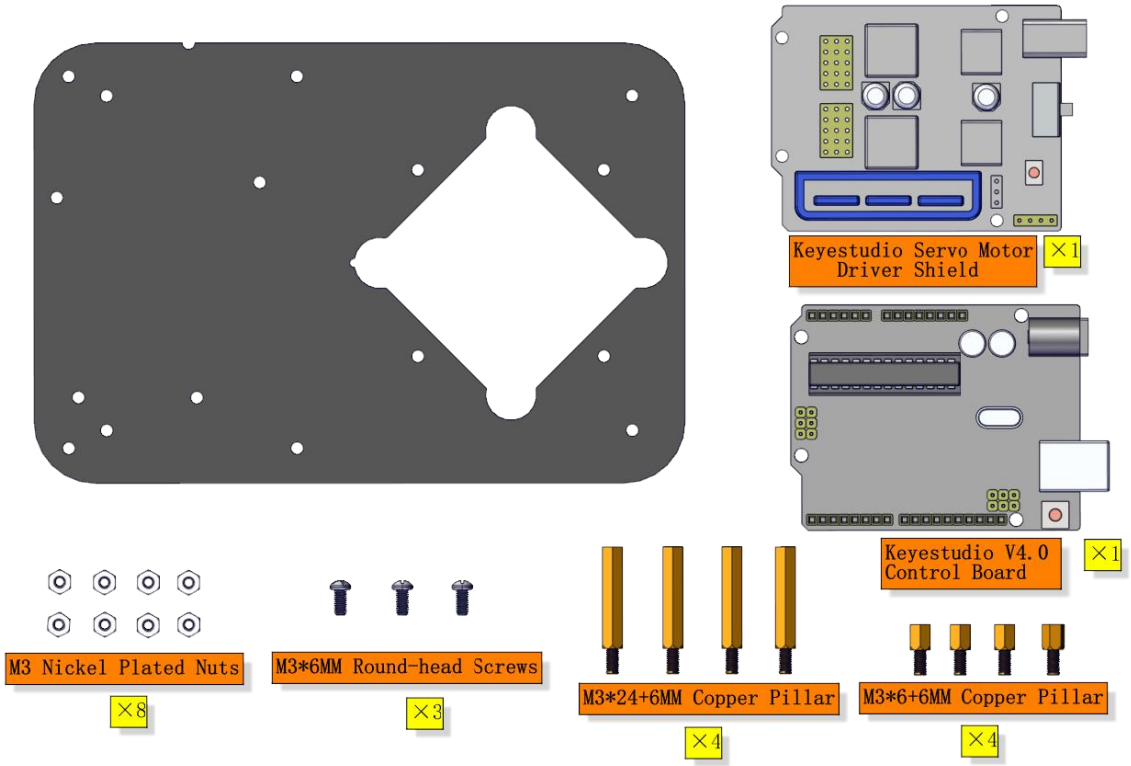
18	M3 Stainless Steel Hex Nuts	22	
19	M3 Hexagon Nuts	24	
20	M1.2x5MM Phillips Self-tapping Screws	8	
21	M2x5MM Phillips Self-tapping Screws	10	
22	M3 304 Stainless Steel Flat Washer	10	
23	M2x8MM Phillips Self-tapping Screws	2	
24	M3*16MM Flat Head Screws	2	
25	Male-Female 10CM Jumper Wire	4	

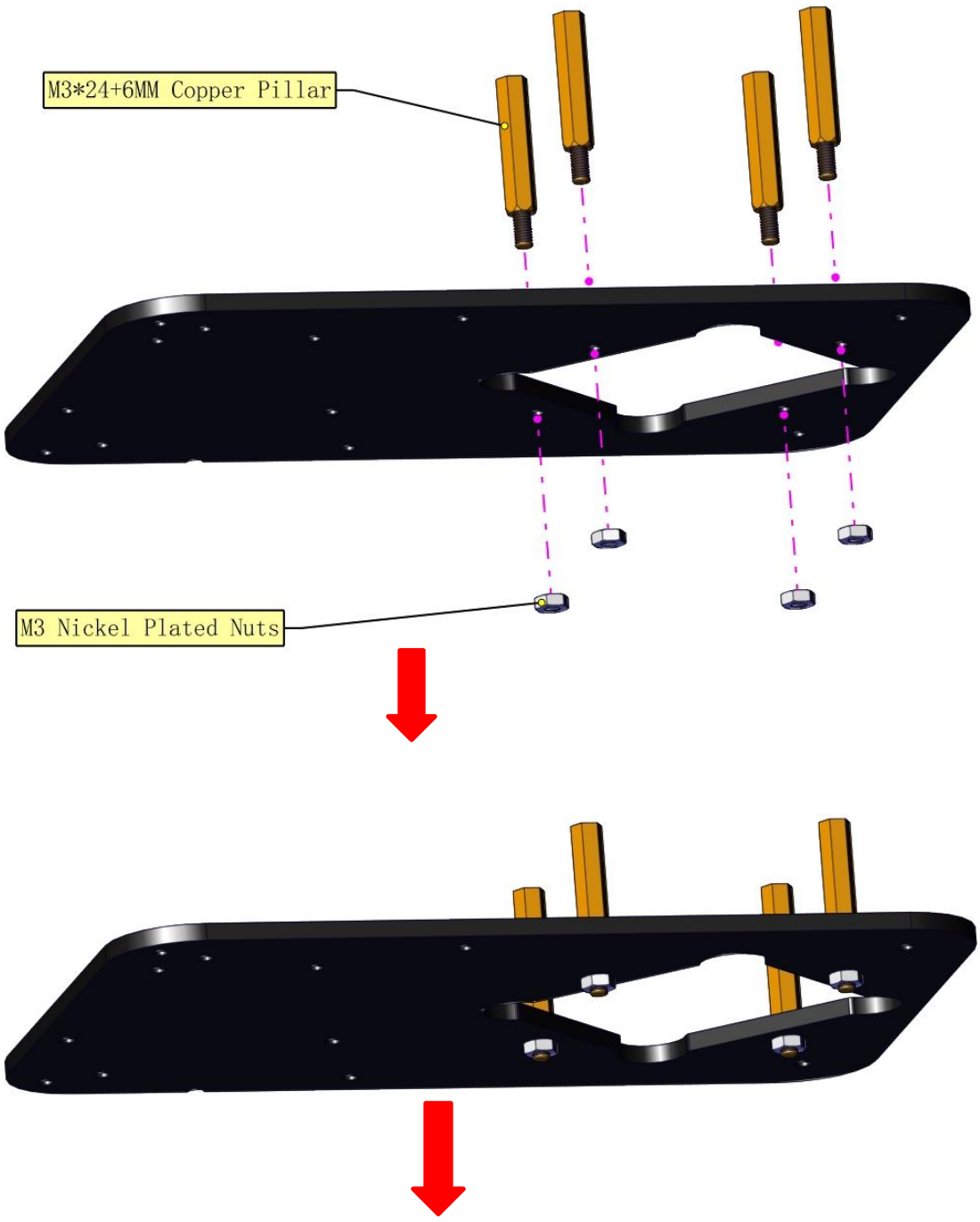
26	Female-Female 50CM Jumper Wire	10	
27	Black 3*100MM Cable Ties	7	
28	18650 2-Slot Battery Holder	1	

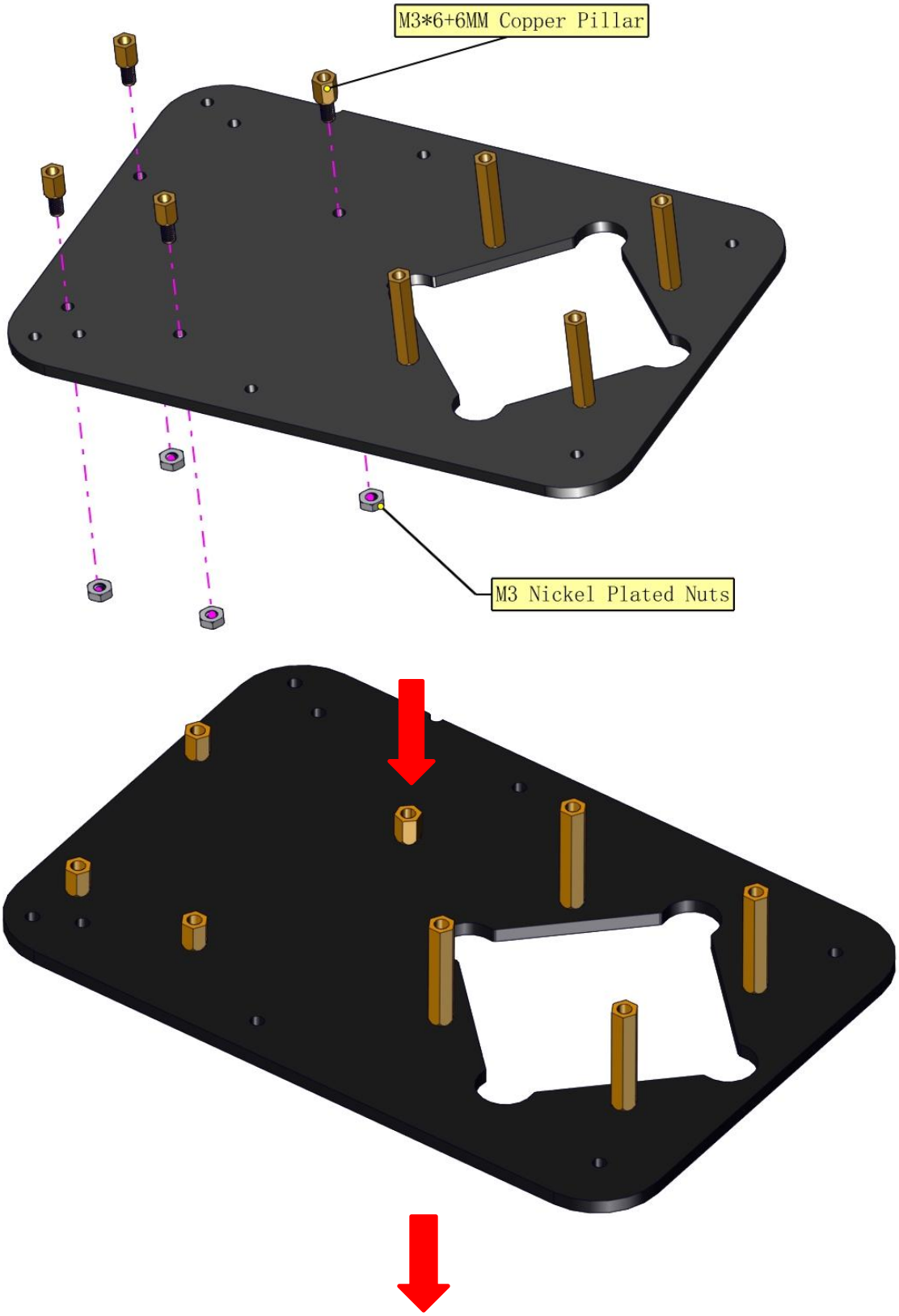
4. Assembly Guide

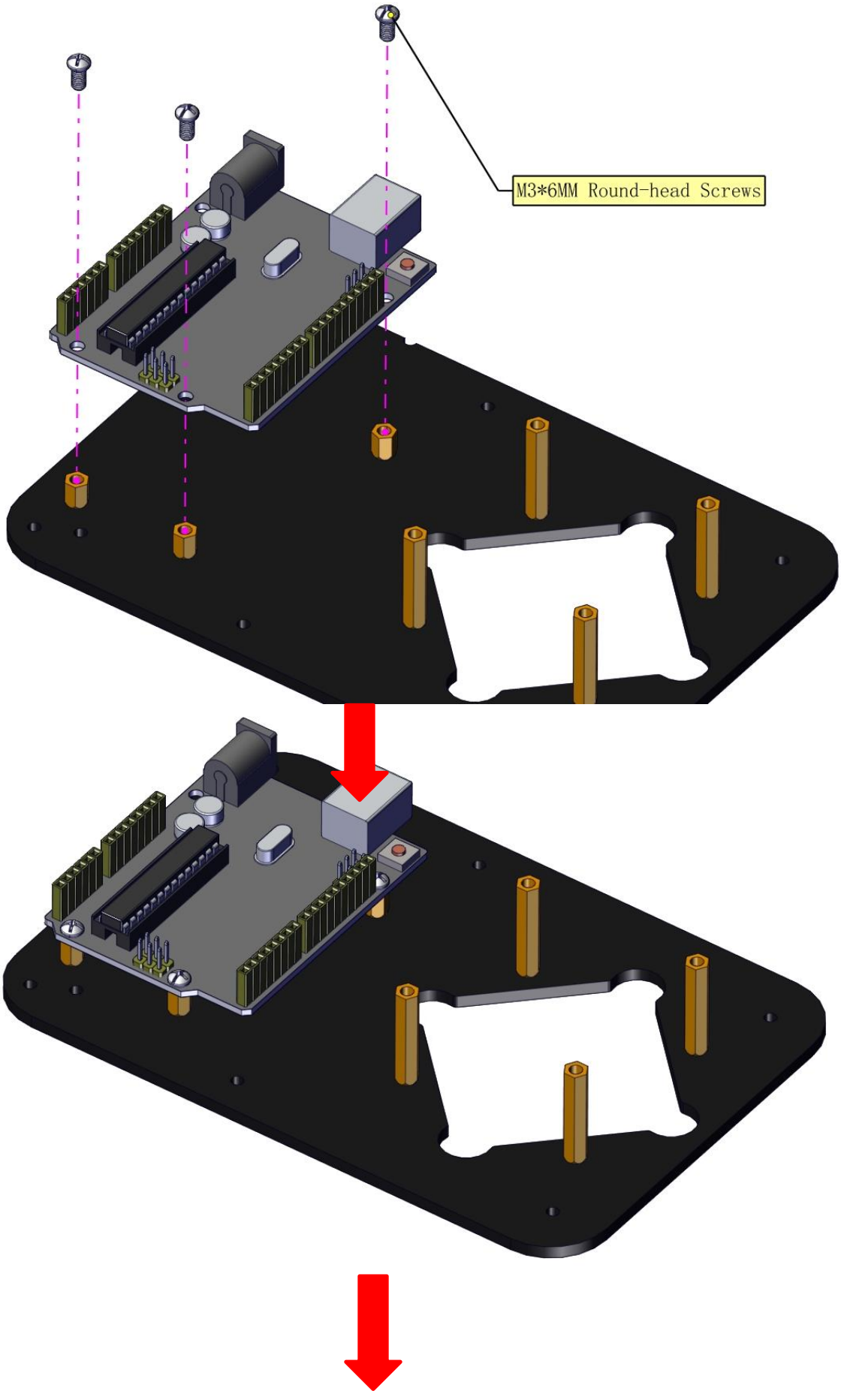
(1) Install the base of the robotic arm

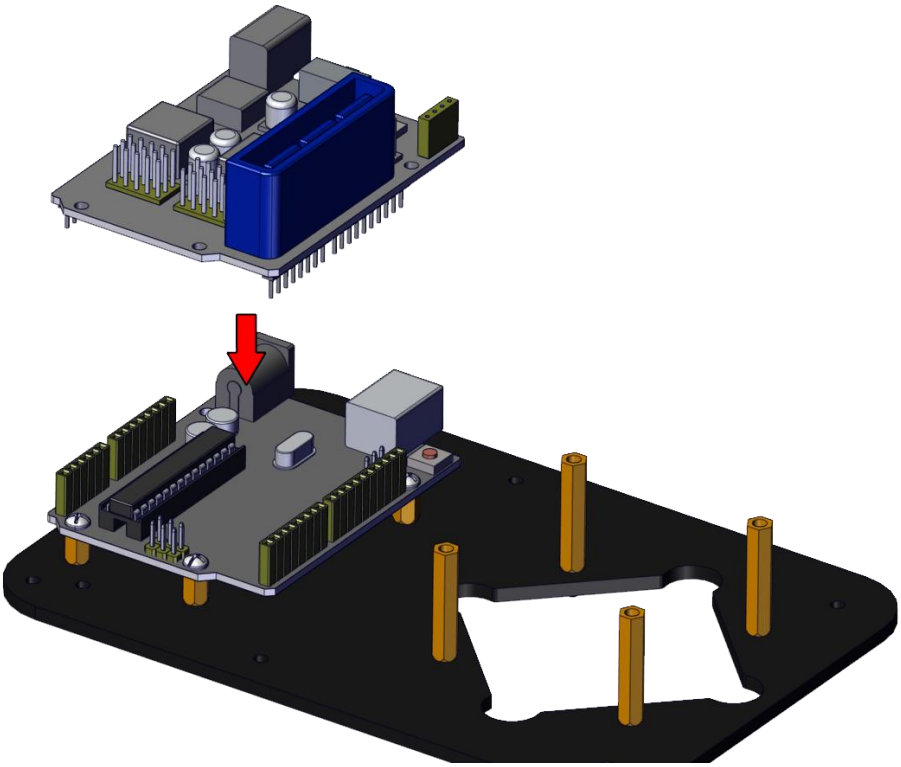
Components Needed:



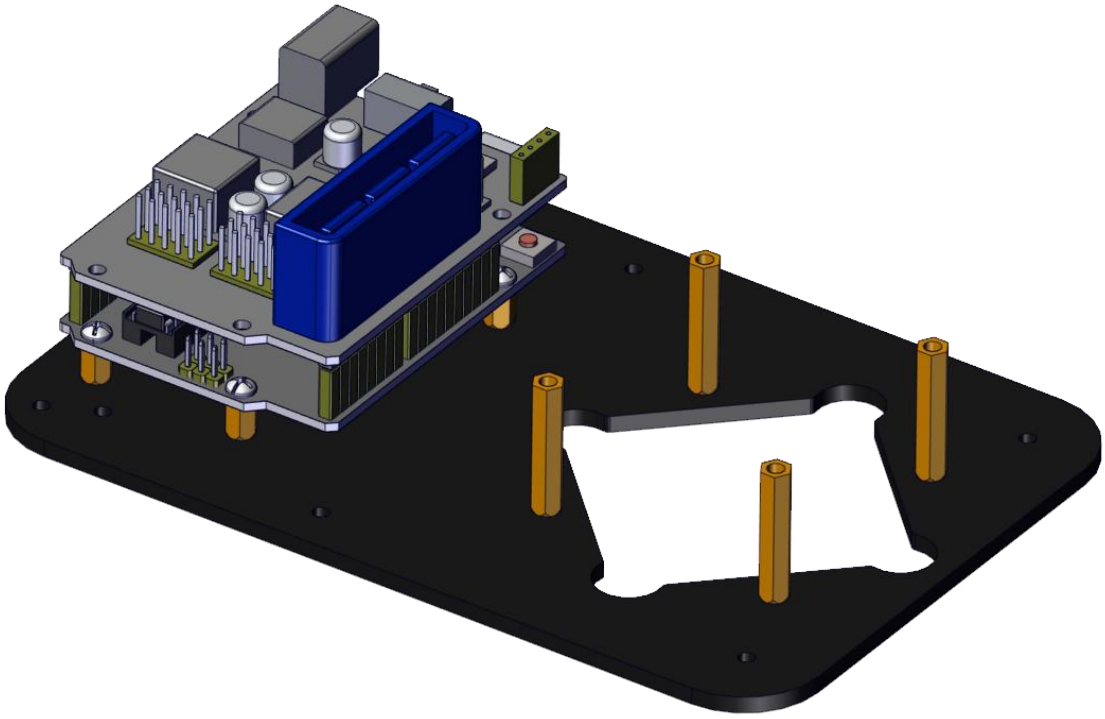

M3*24+6MM Copper Pillar
M3 Nickel Plated Nuts


M3*6+6MM Copper Pillar
M3 Nickel Plated Nuts


M3*6MM Round-head Screws

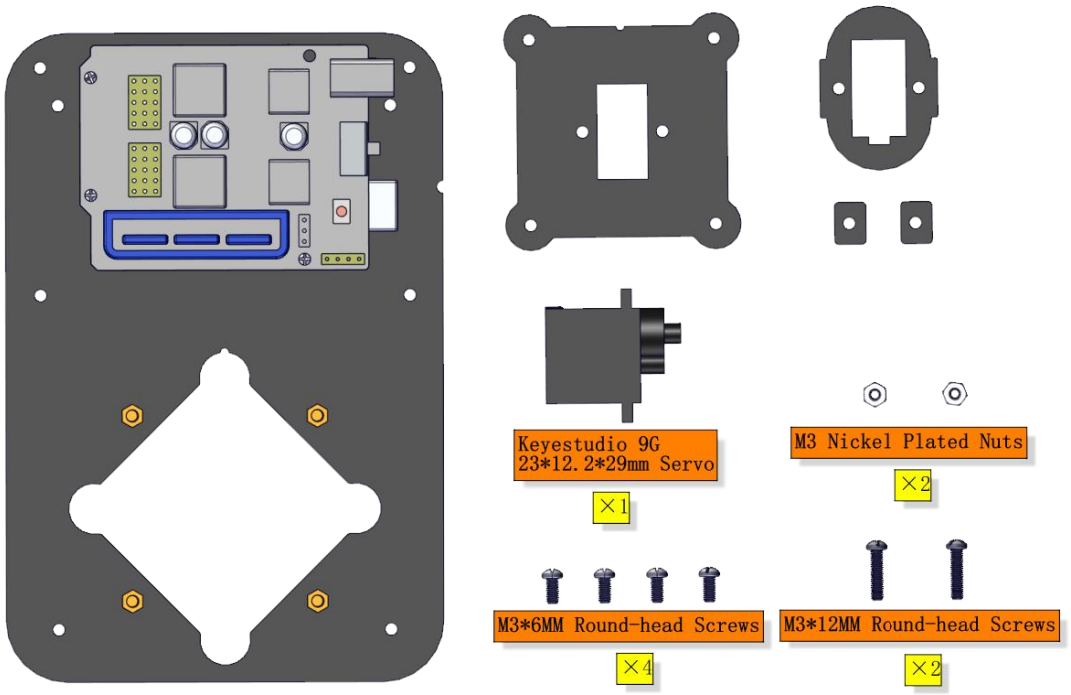


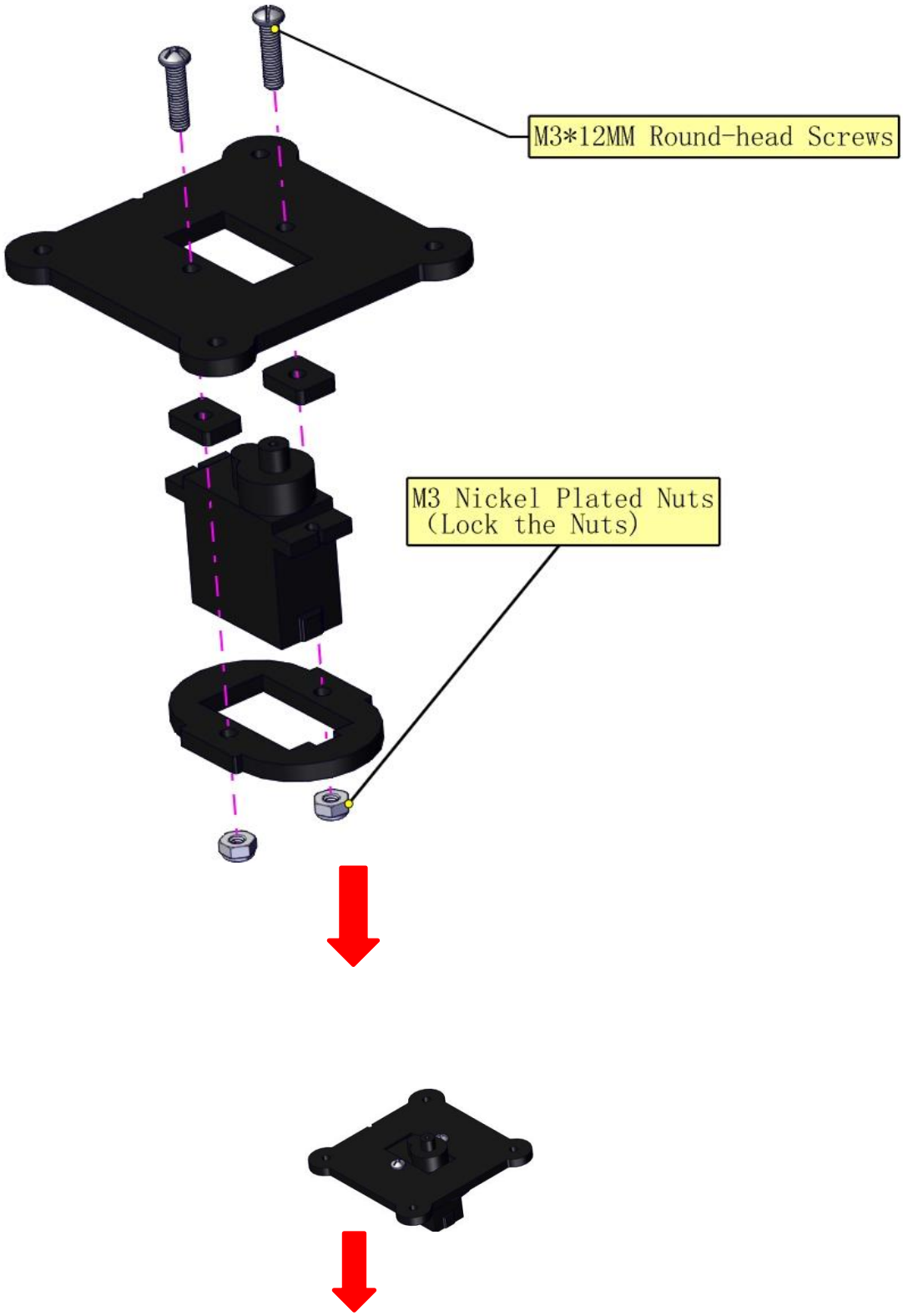
The base is installed successfully.

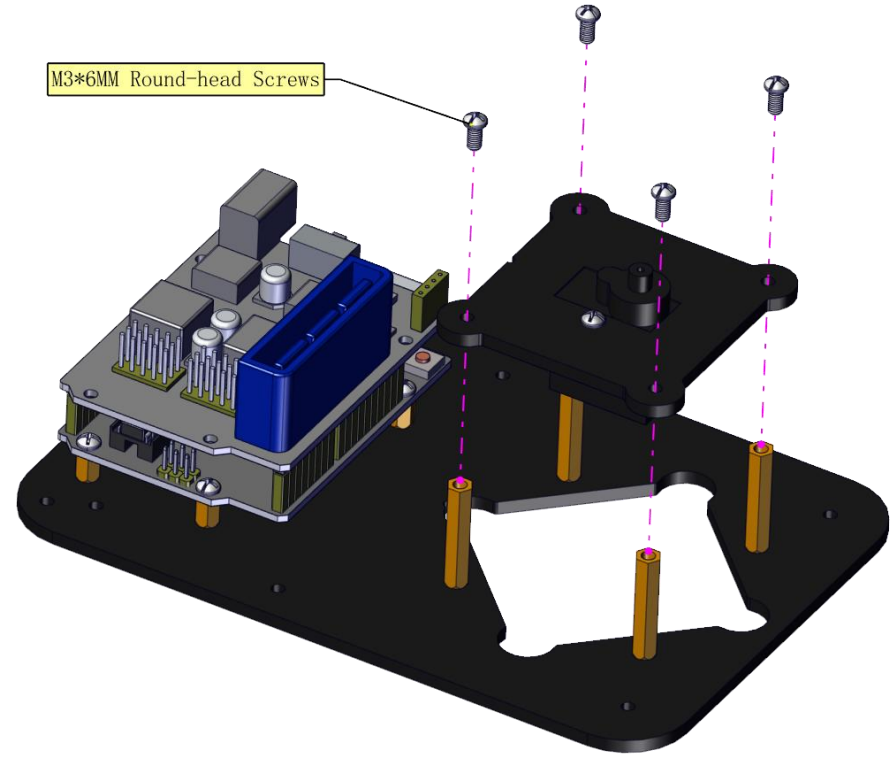


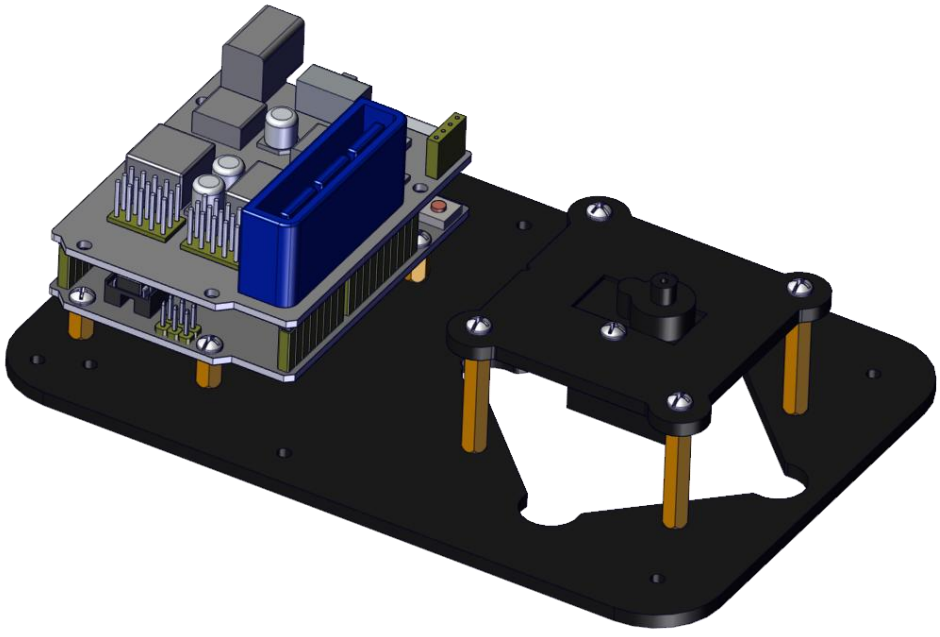
(2) Mount servos onto the base

Components Needed:



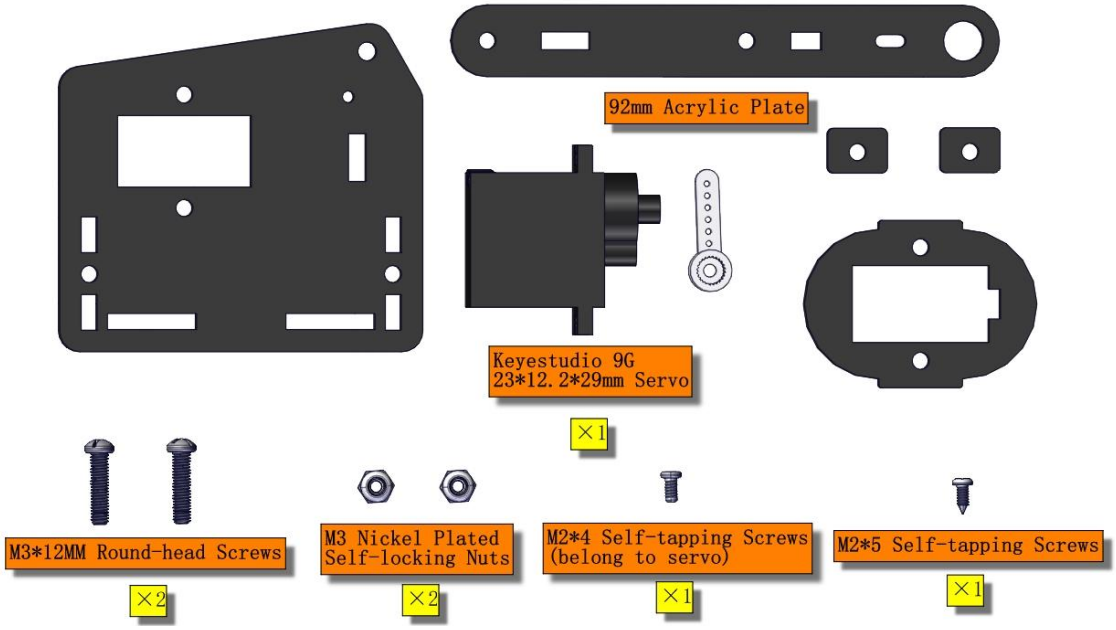

M3*12MM Round-head Screws
M3 Nickel Plated Nuts
(Lock the Nuts)

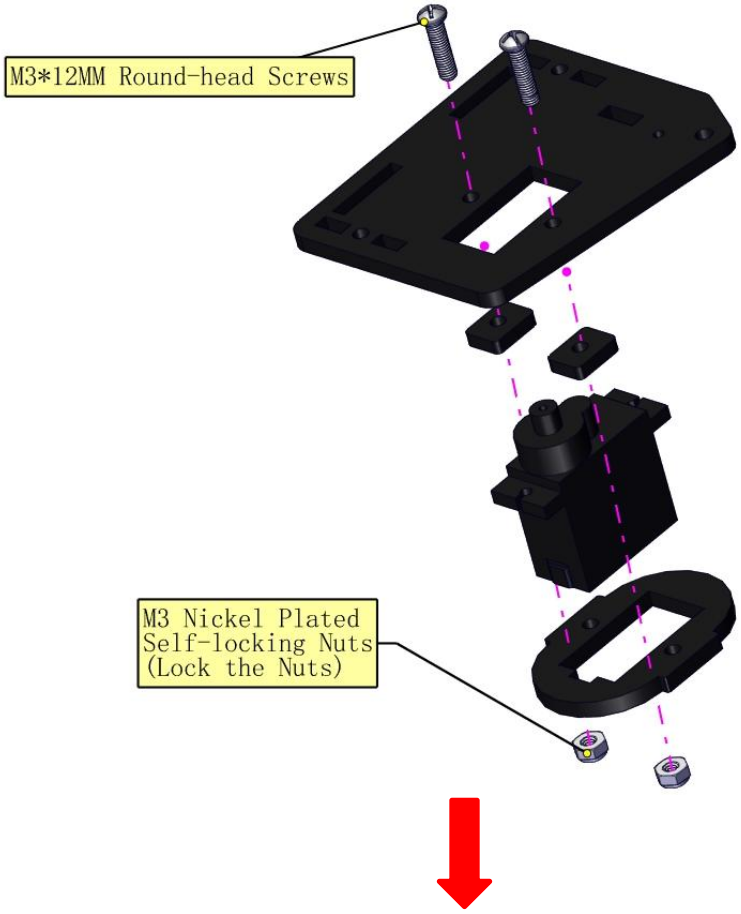




Assemble a servo(left) onto the left board

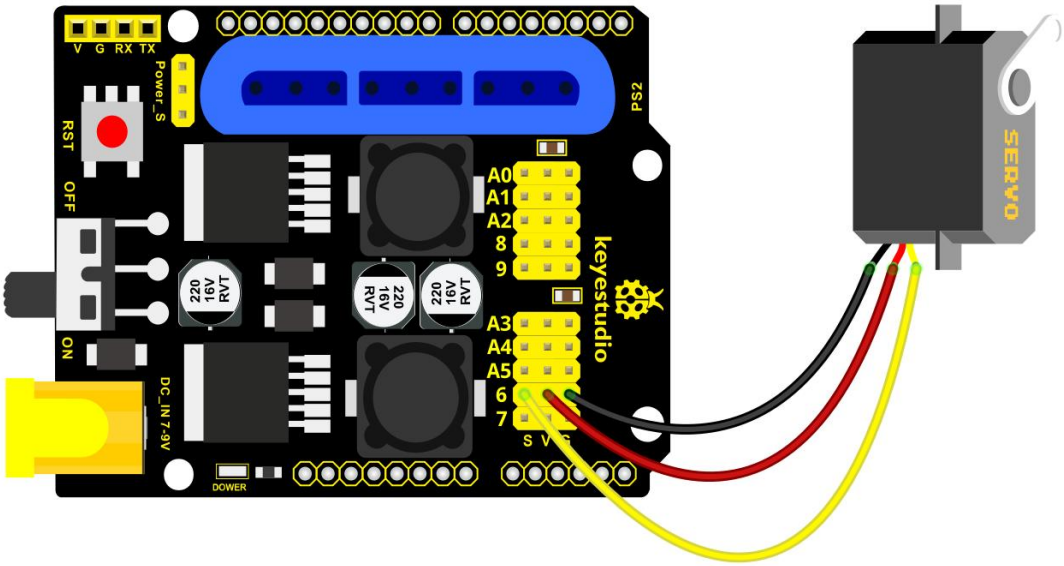
Components Needed:





Initialize the left servo

Attach this left servo to G, V and S（6）of servo motor driver shield, upload the following code, plug in power and press the rest button on the V4.0 board. Then the left servo rotates to 180°



Test Code:

****

```
#include <Servo.h>
Servo myservo;   // create servo object to control a servo

void setup()
{
   Serial.begin(9600);
   delay(1000);
}

void loop()
{
   myservo.attach(6);   // Change pin to adjust one by one
   myservo.write(180);   //Angle
   delay(1000);
}
```

****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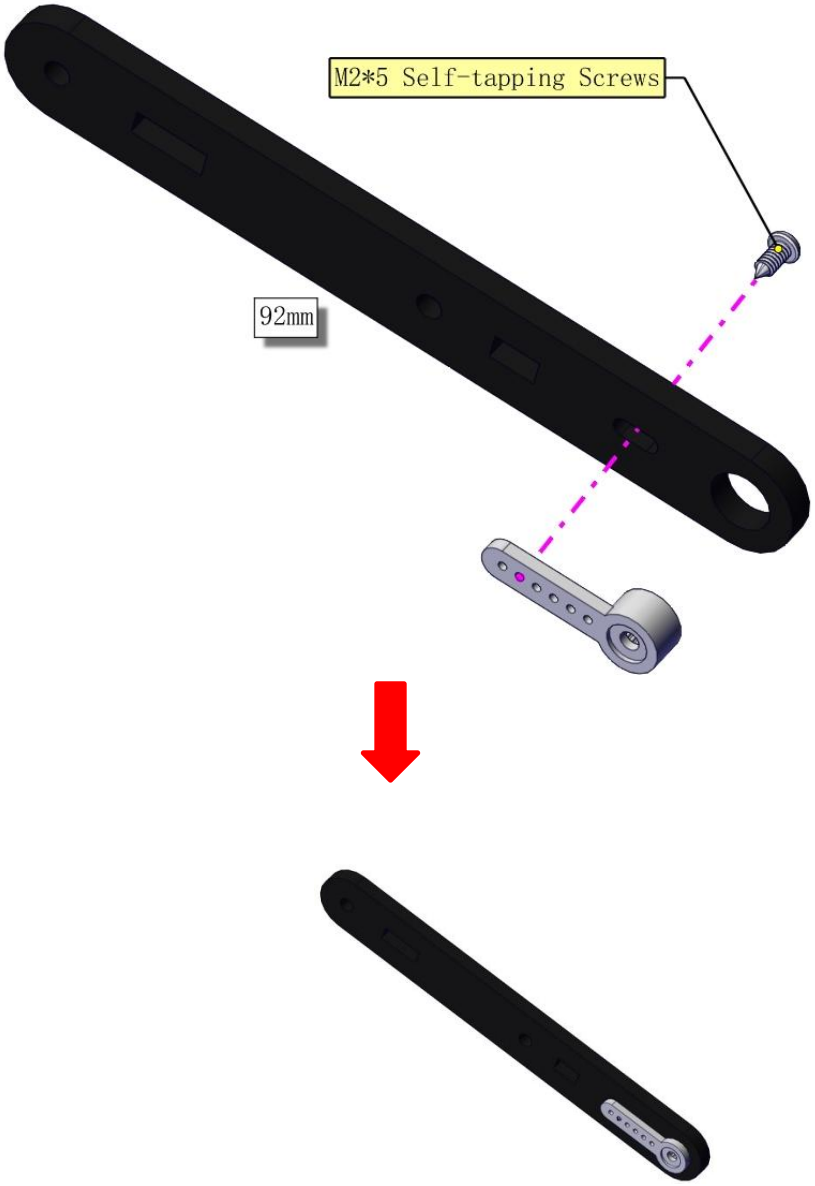
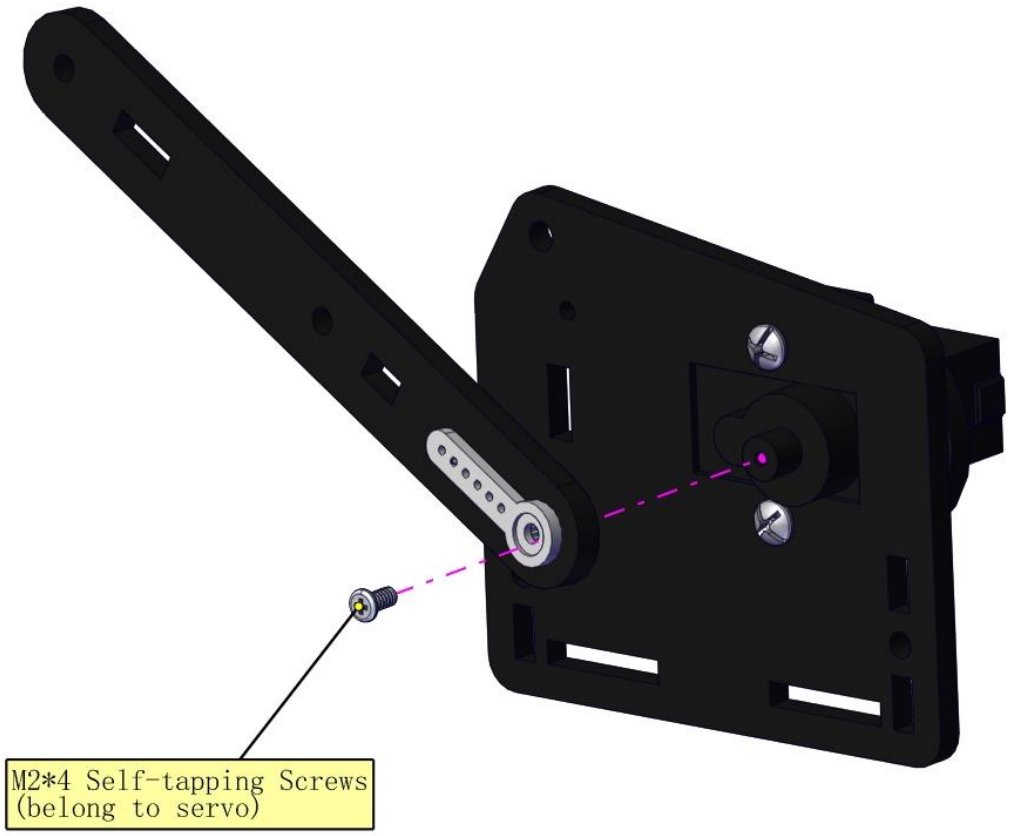
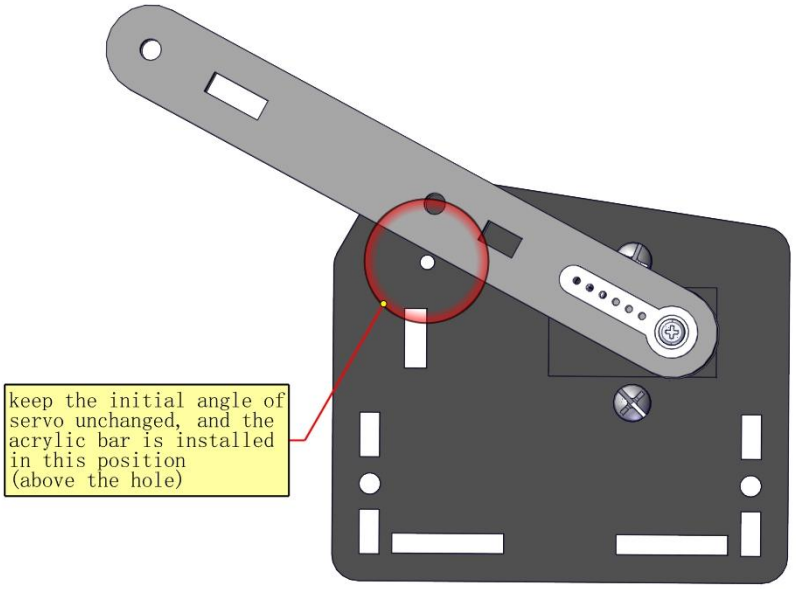
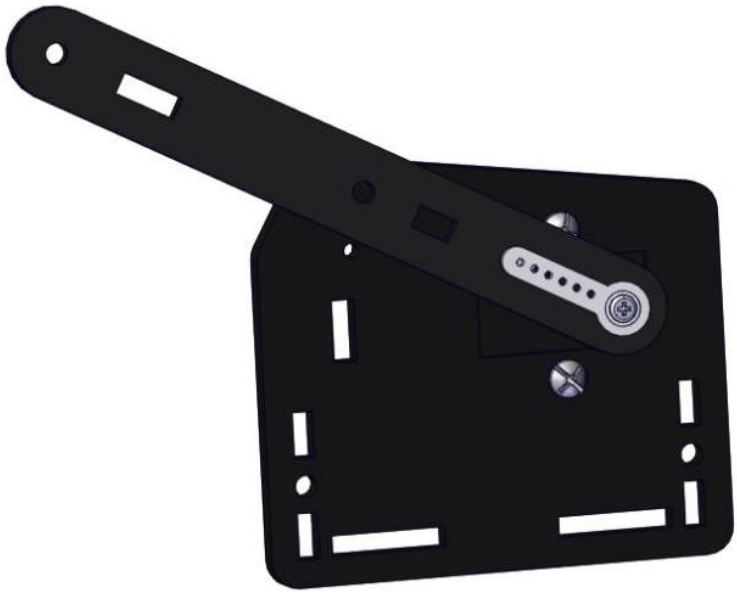
sketch_feb05a §
#include <Servo.h>
Servo myservo; // create servo object to control a servo
void setup()
{
Serial.begin(9600);
delay(1000);
}
void loop()
{
myservo.attach(6); // Change pin to adjust one by one
myservo.write(180); //Angle
delay(1000);
}
Done uploading.
Sketch uses 2660 bytes (8%) of program storage space. Maximum is
Global variables use 225 bytes (10%) of dynamic memory, leaving 1
13
Arduino Uno on COM19

a. Fix the arm:



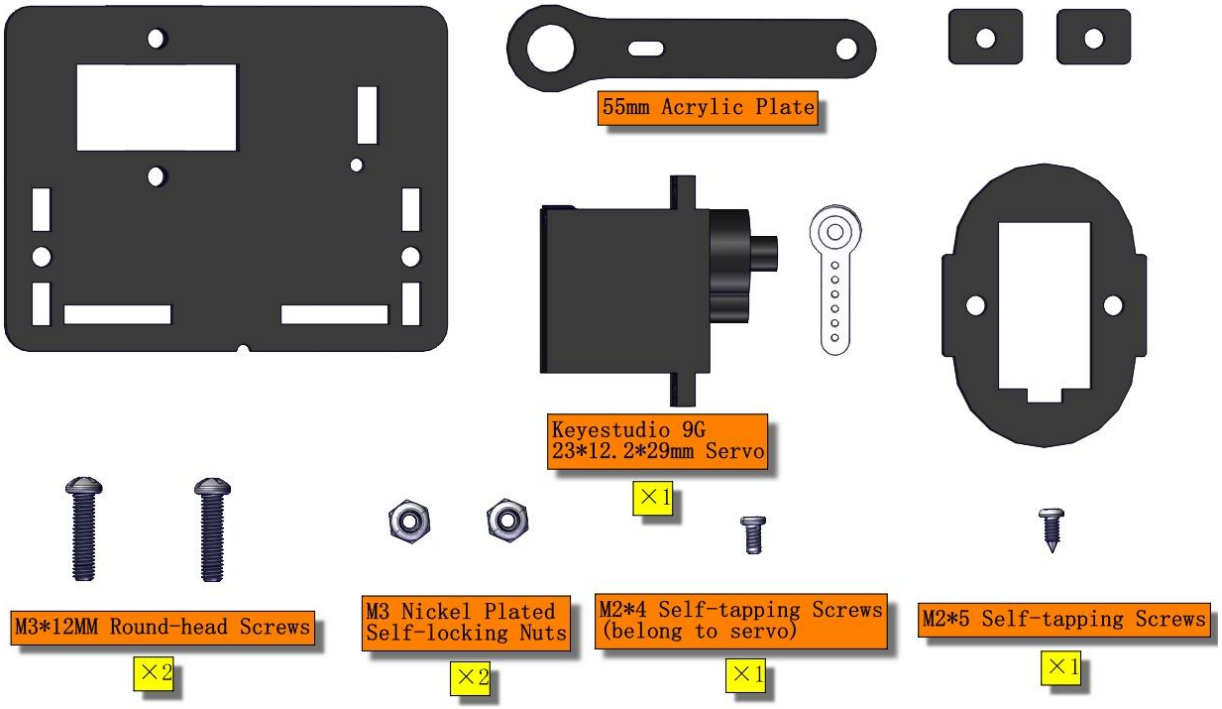

M2*4 Self-tapping Screws
(belong to servo)


keep the initial angle of
servo unchanged, and the
acrylic bar is installed
in this position
(above the hole)

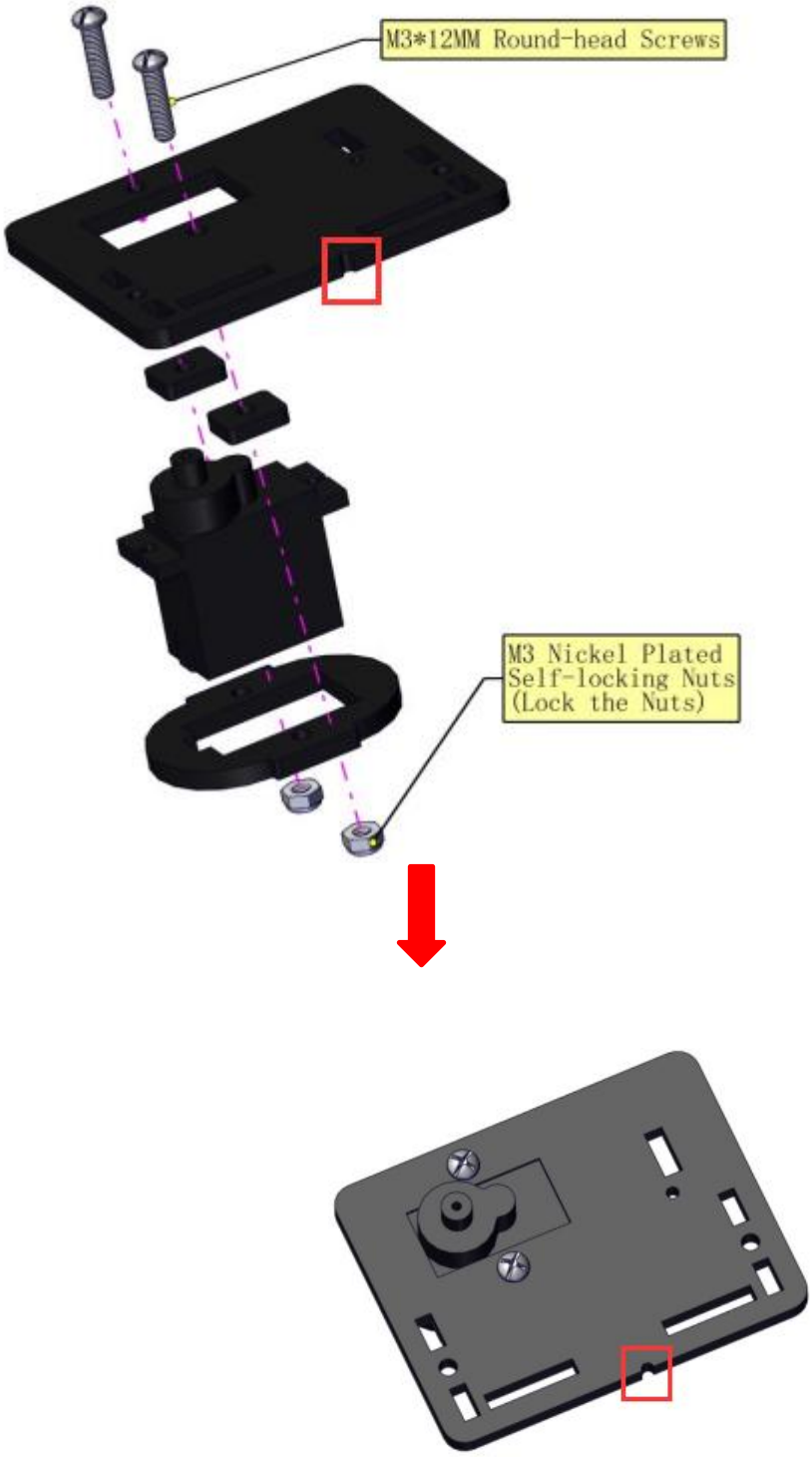


Mount a servo(right) onto the right board

Components Needed

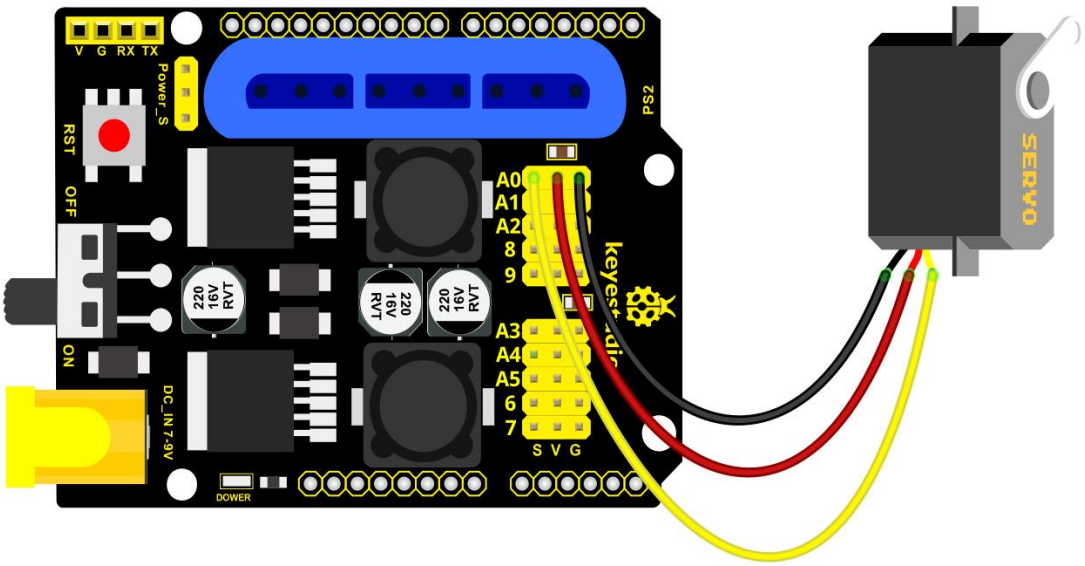


Note the breach direction of acrylic board



b. Initialize the right servo

Attach this left servo to G, V and S（A0）of servo motor driver shield, upload the following code, plug in power and press the rest button on the V4.0 board. Then the left servo rotates to 0°



Set the servo to 0°:

```
**********************************************************************
#include <Servo.h>
Servo myservo;   // create servo object to control a servo
```

```
void setup()
{
   Serial.begin(9600);
   delay(1000);
}

void loop()
{
   myservo.attach(A0);   // Change pin to adjust one by one
   myservo.write(0);   //Angle
   delay(1000);
}
```

****

sketch_feb05a | Arduino 1.8.13

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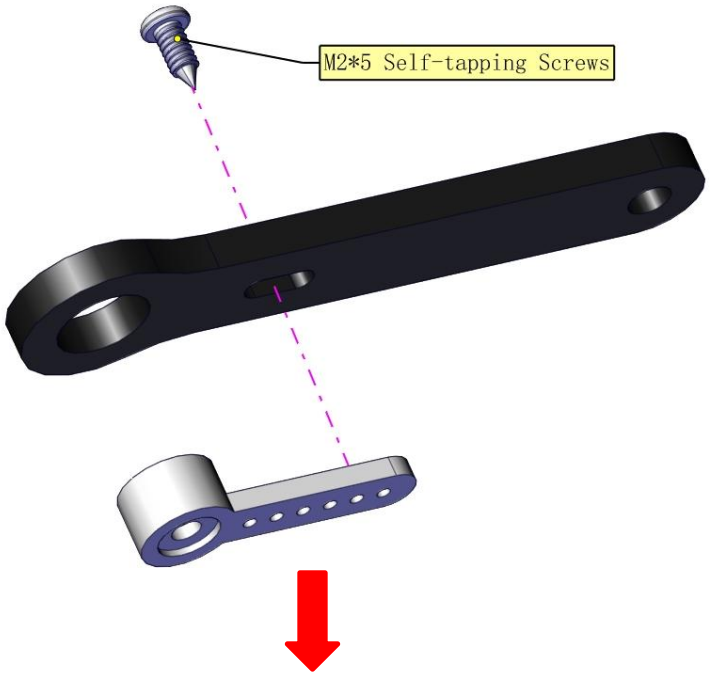
sketch_feb05a §

```
#include <Servo.h>
Servo myservo;  // create servo object to control a servo

void setup()
{
  Serial.begin(9600);
  delay(1000);
}

void loop()
{
  myservo.attach(A0);  // Change pin to adjust one by one
  myservo.write(0);  //Angle
  delay(1000);
}
```

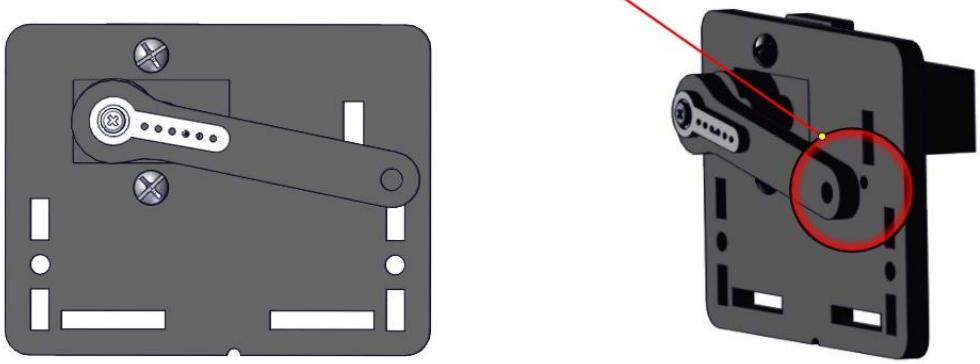
Done uploading.

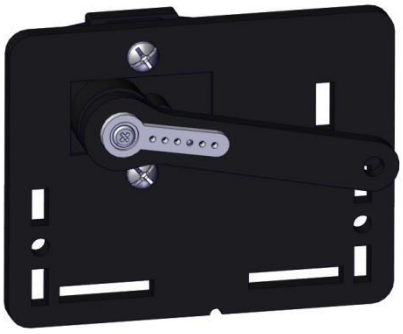
```
Sketch uses 2658 bytes (8%) of program storage space. Maximum is 3
Global variables use 225 bytes (10%) of dynamic memory, leaving 18
```

15 Arduino Uno on COM19

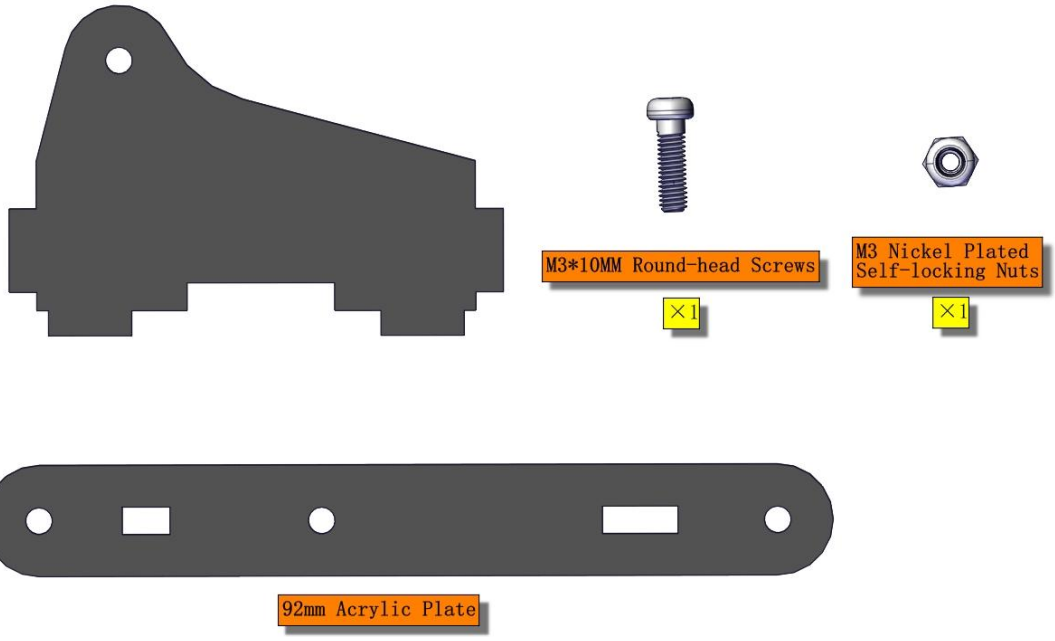


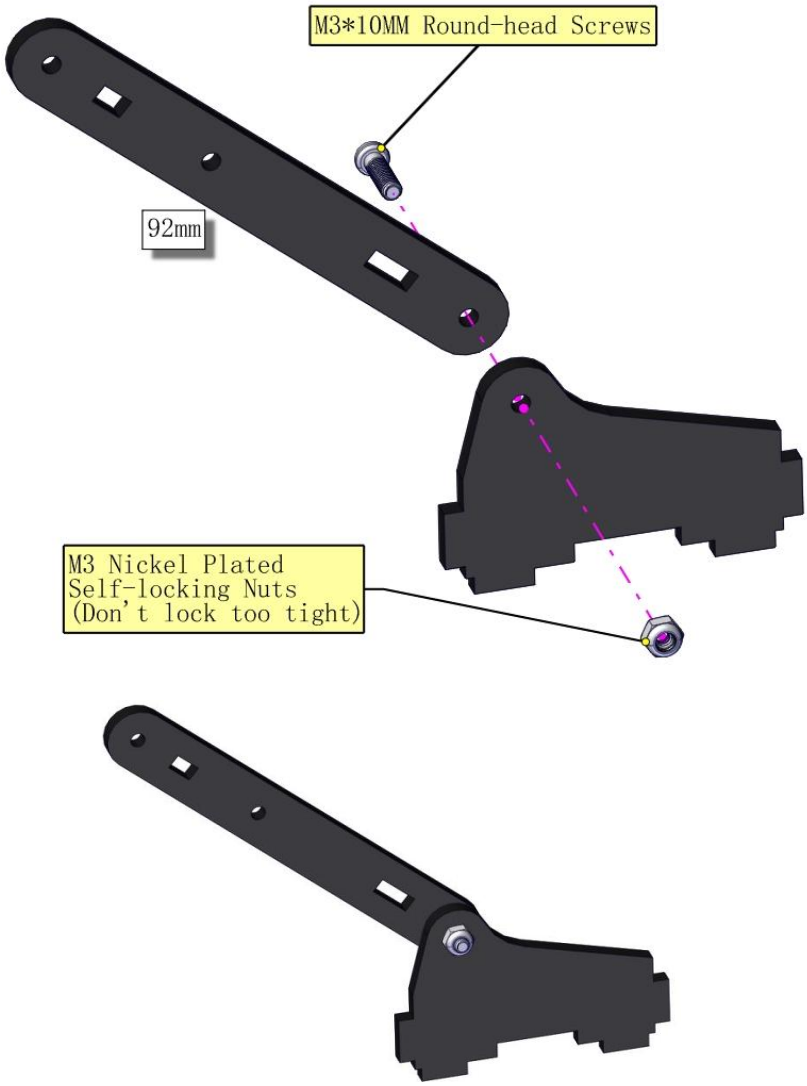
keep the initial angle of servo unchanged, and the acrylic bar is installedin this position (in front of the hole) :



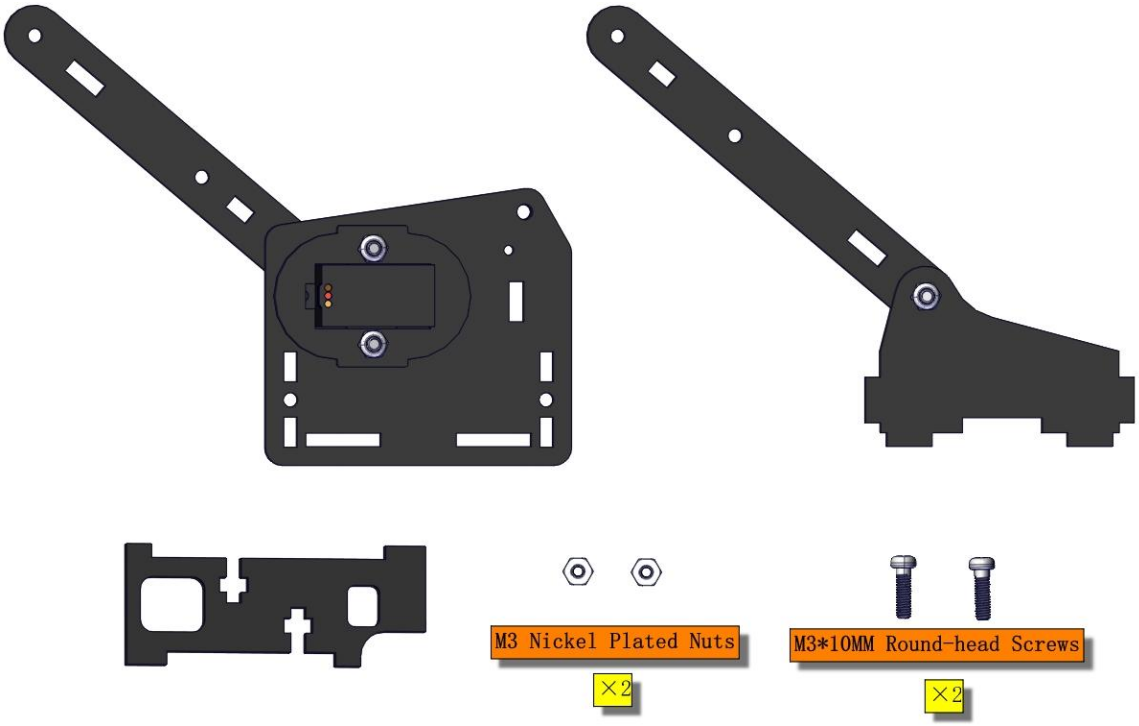


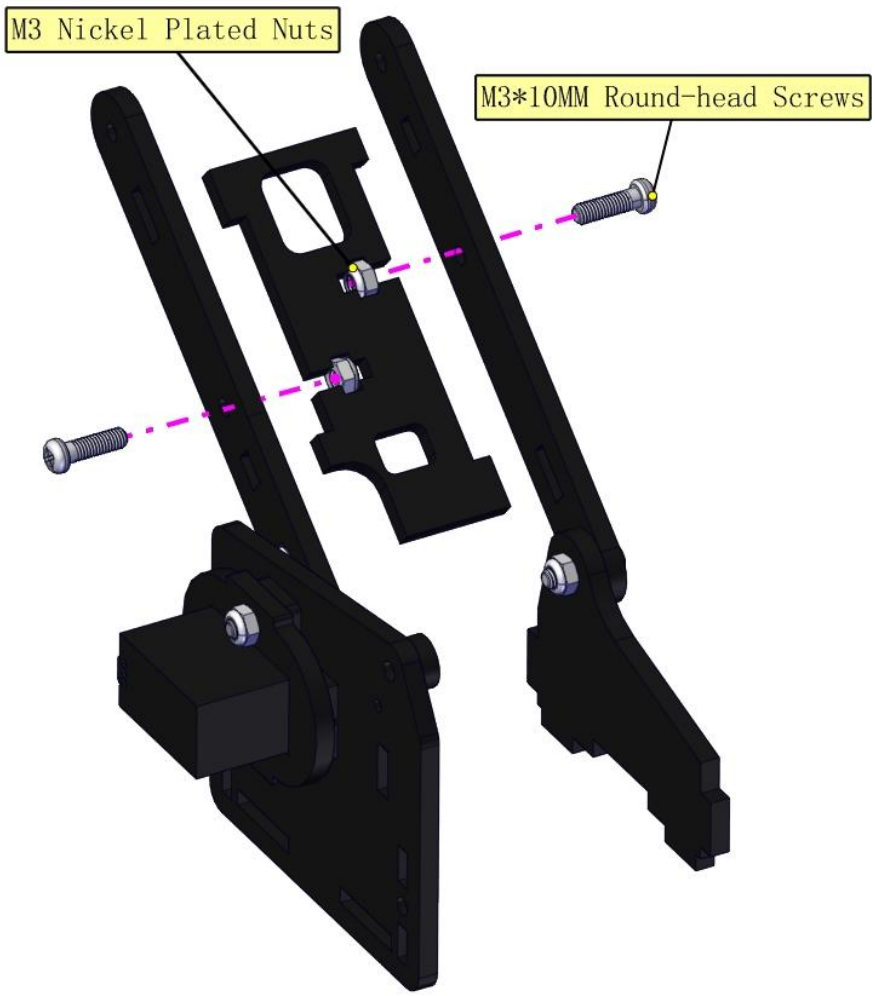
Install the holder part

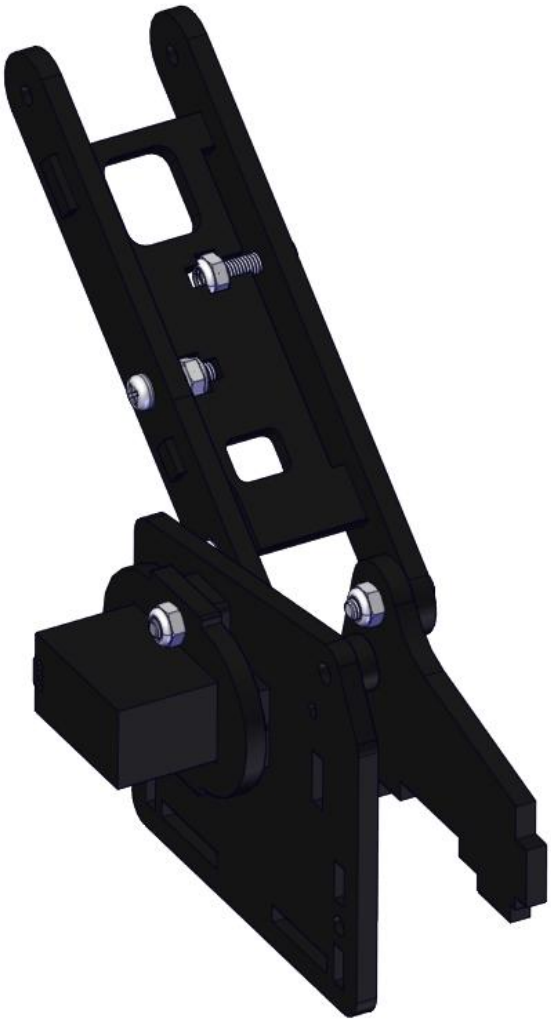




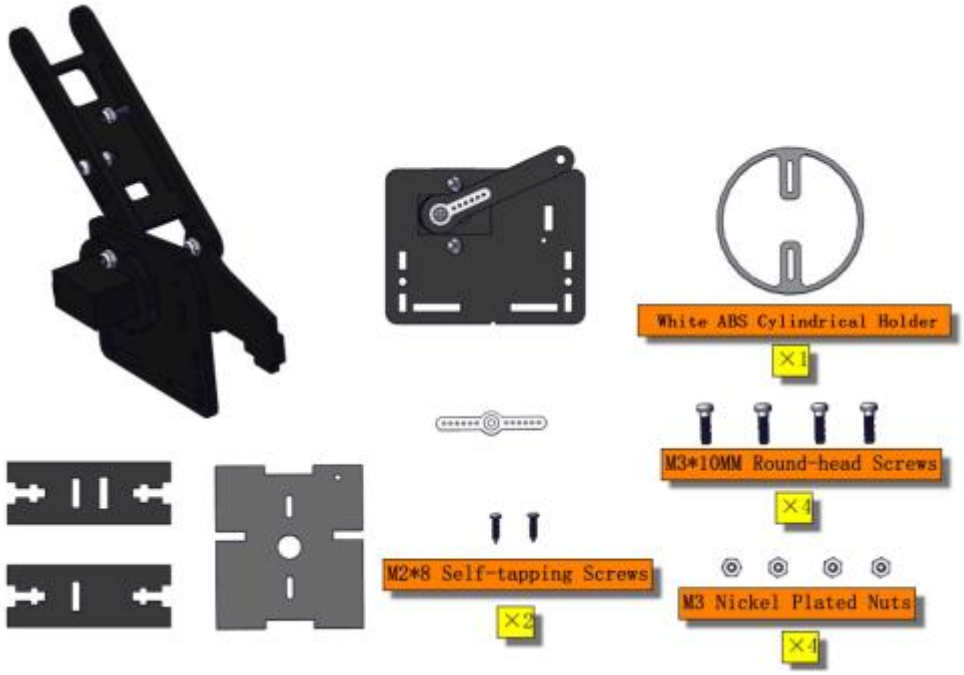
Fix the left part and the mount part together


M3 Nickel Plated Nuts
×2
M3*10MM Round-head Screws
×2

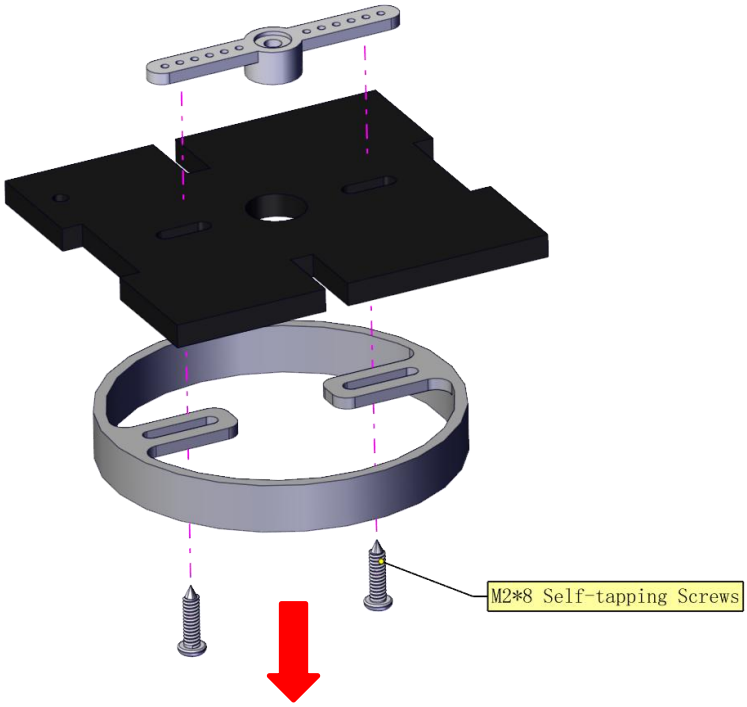

M3 Nickel Plated Nuts
M3*10MM Round-head Screws

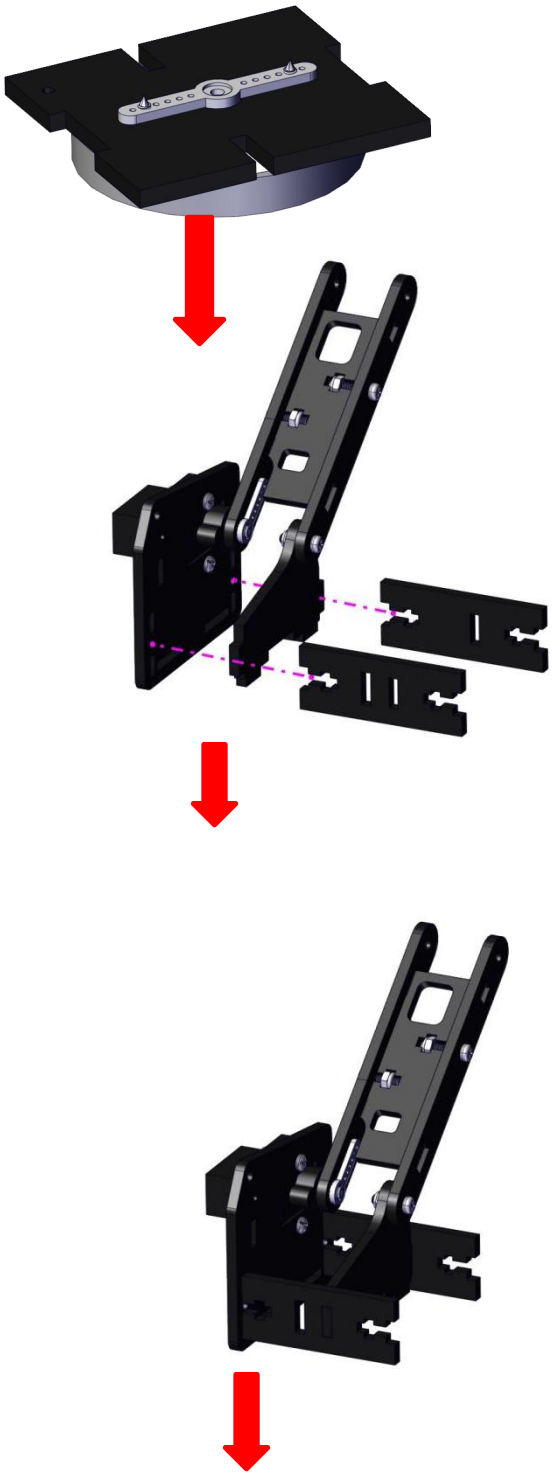


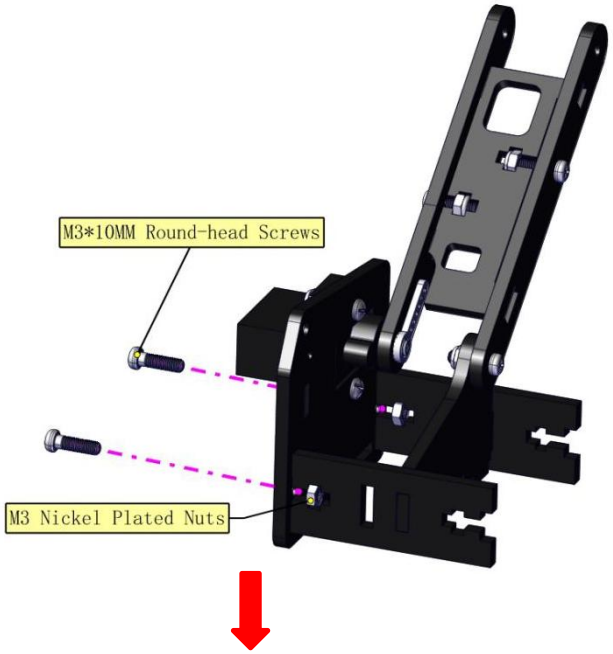
Fix the right part and the ABS holder together

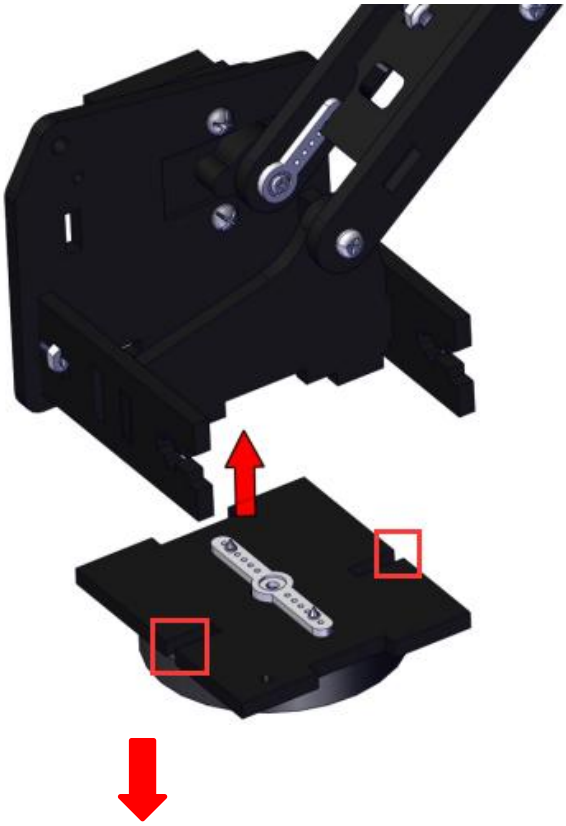


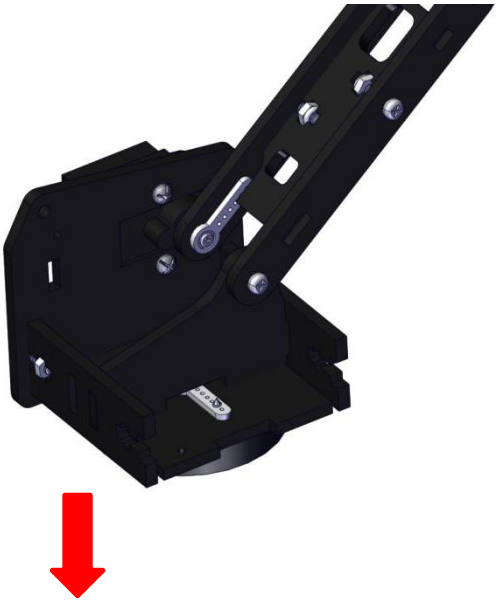
Note the direction of the ABS holder

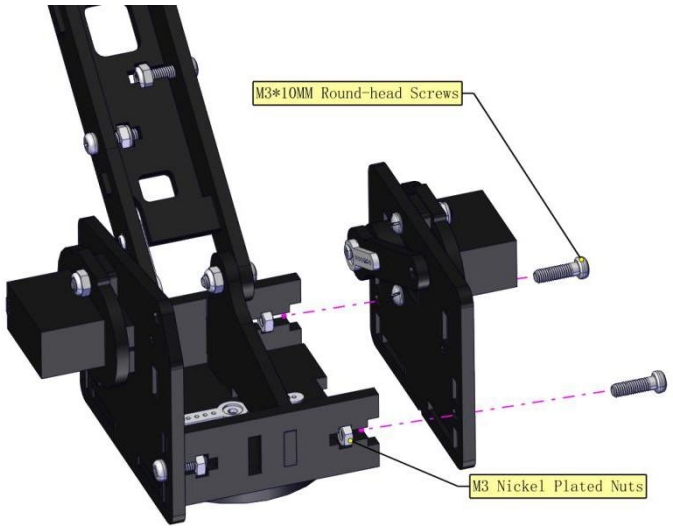




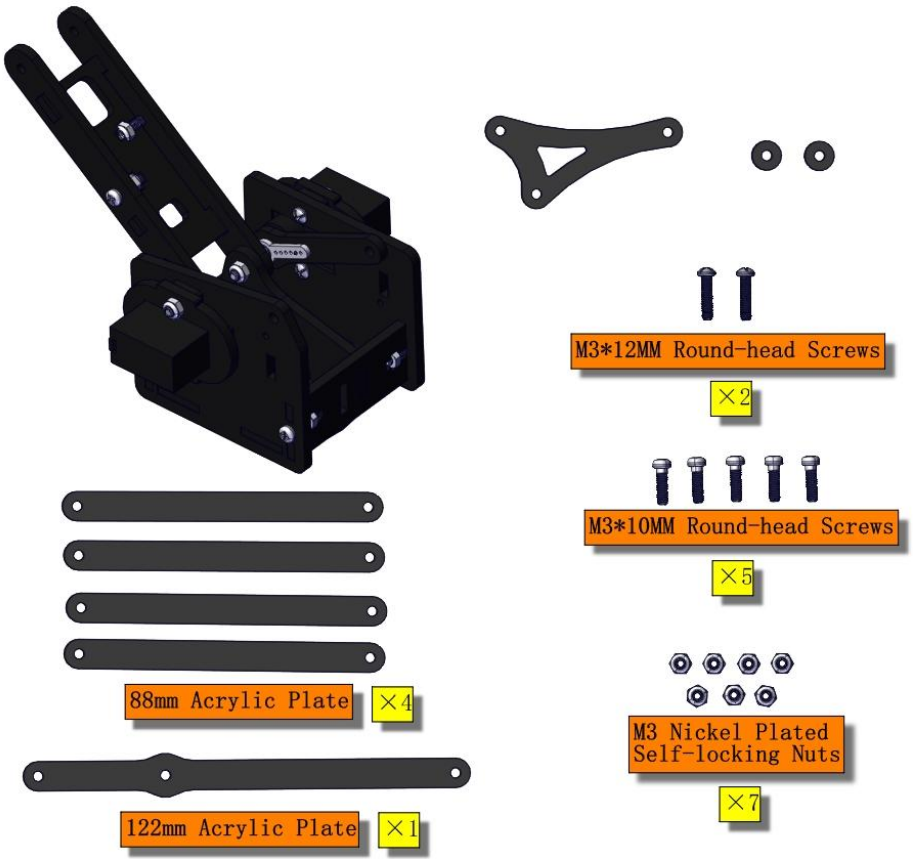

M3*10MM Round-head Screws
M3 Nickel Plated Nuts

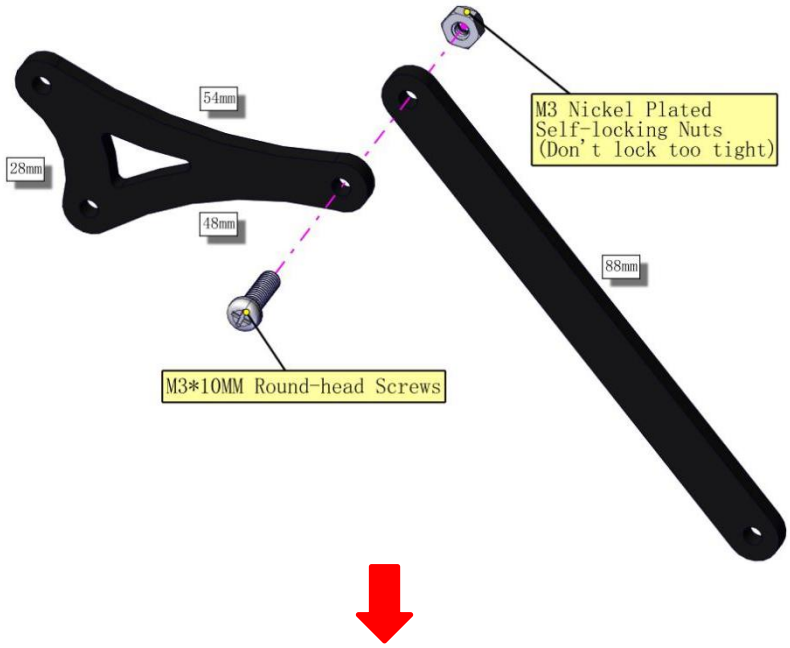


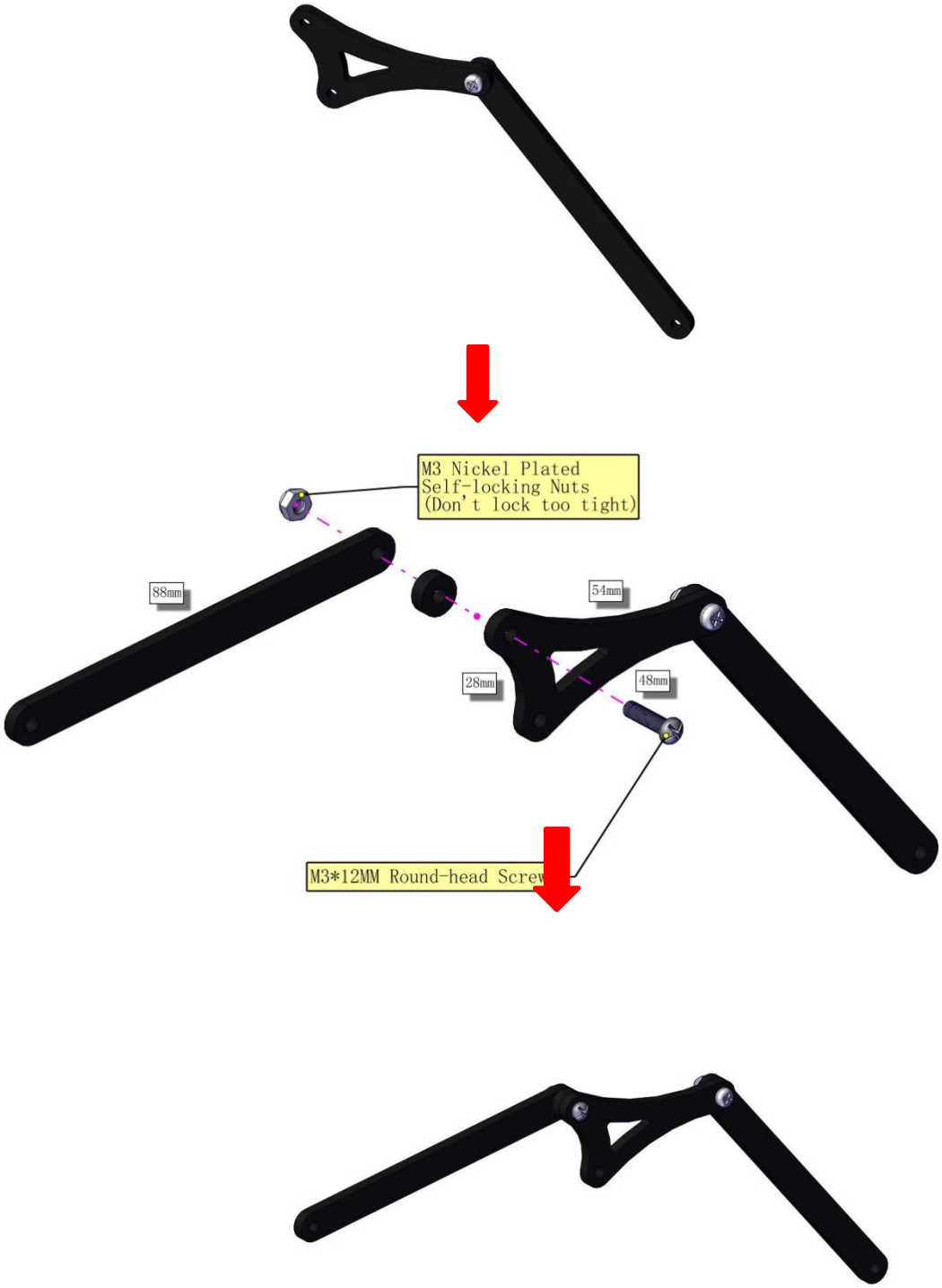


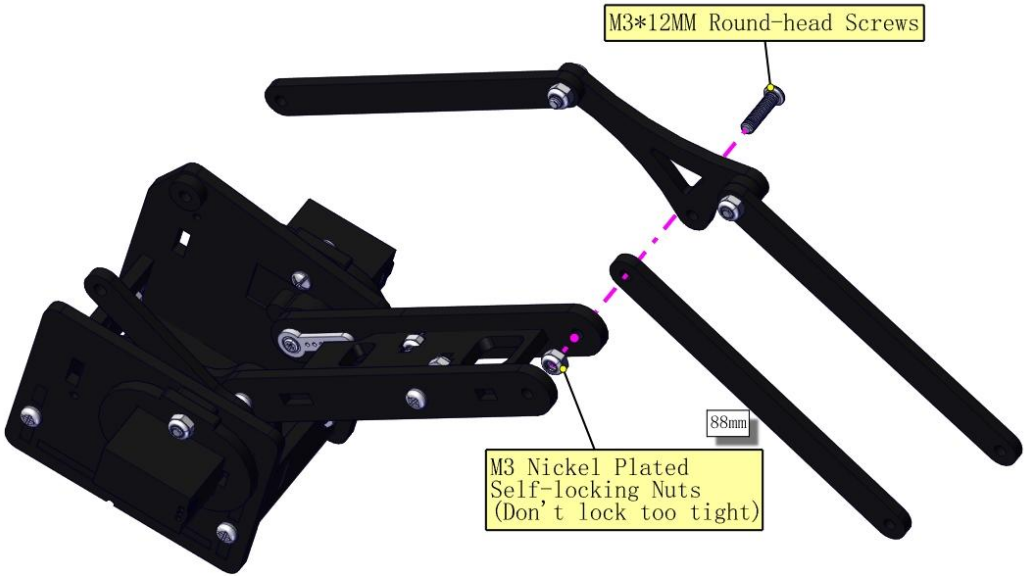


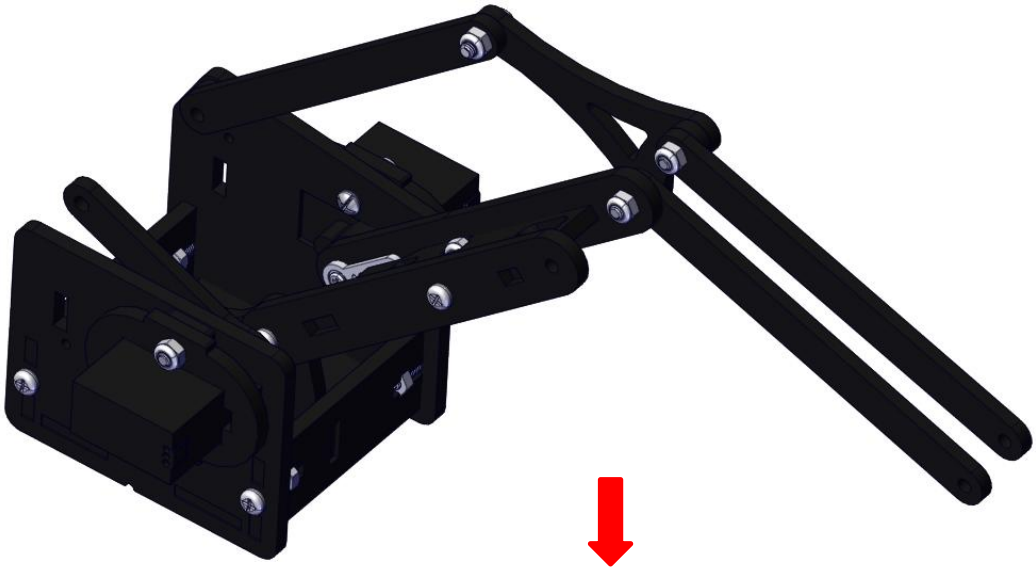
Install the middle part

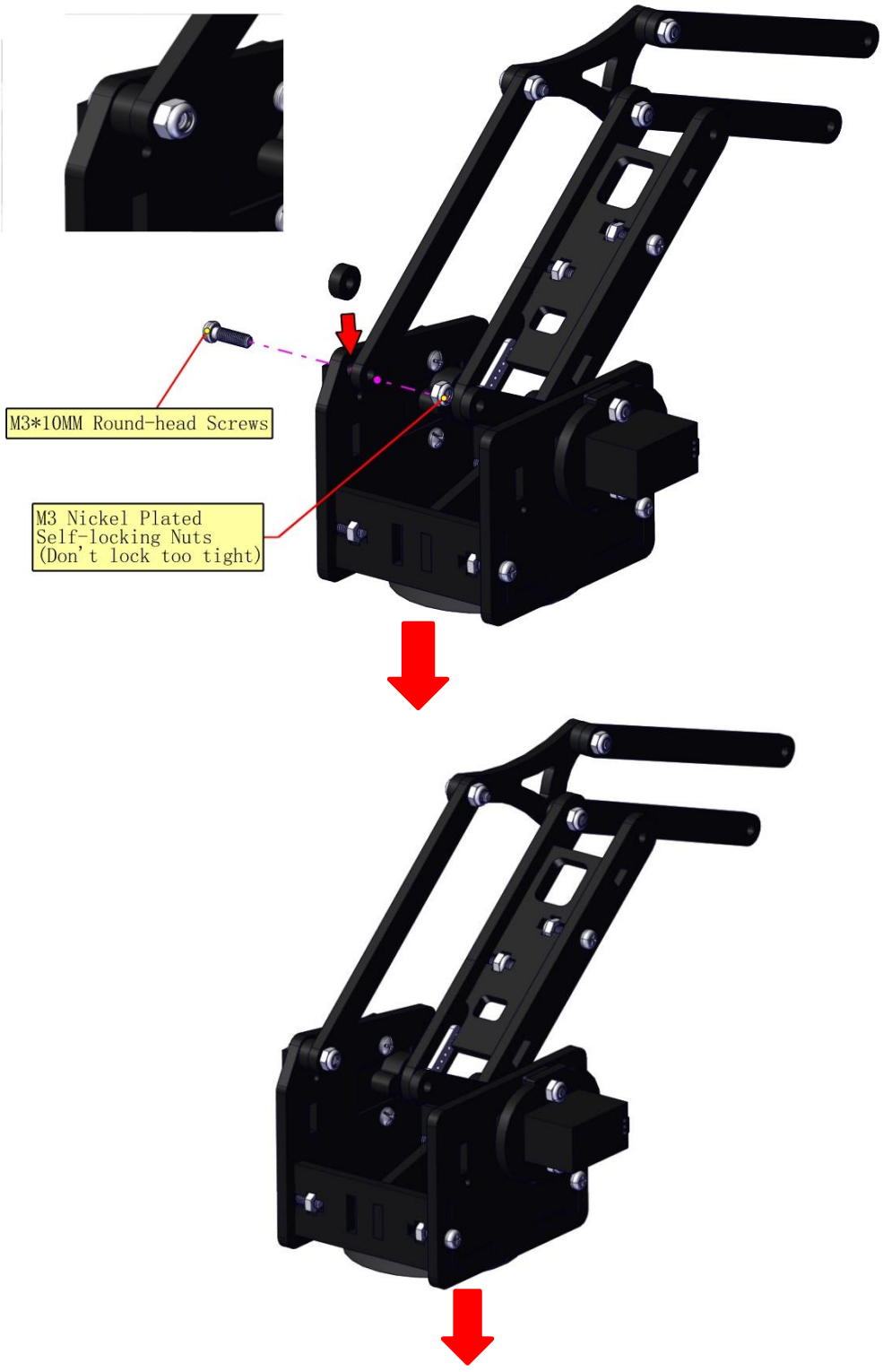

M3*12MM Round-head Screws
×2
M3*10MM Round-head Screws
×5
88mm Acrylic Plate
×4
M3 Nickel Plated
Self-locking Nuts
×7
122mm Acrylic Plate
×1

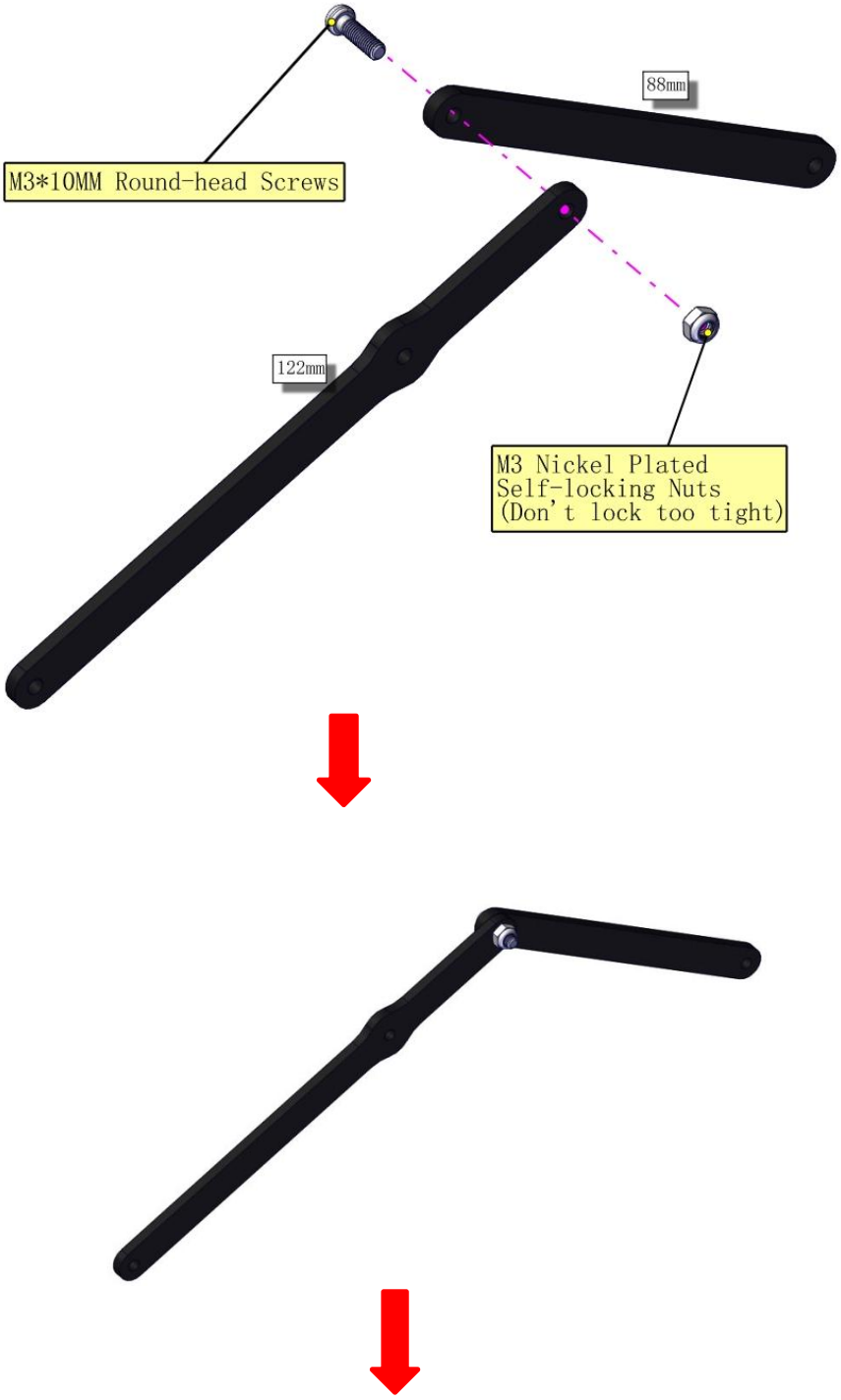

54mm
28mm
48mm
M3 Nickel Plated
Self-locking Nuts
(Don't lock too tight)
88mm
M3*10MM Round-head Screws

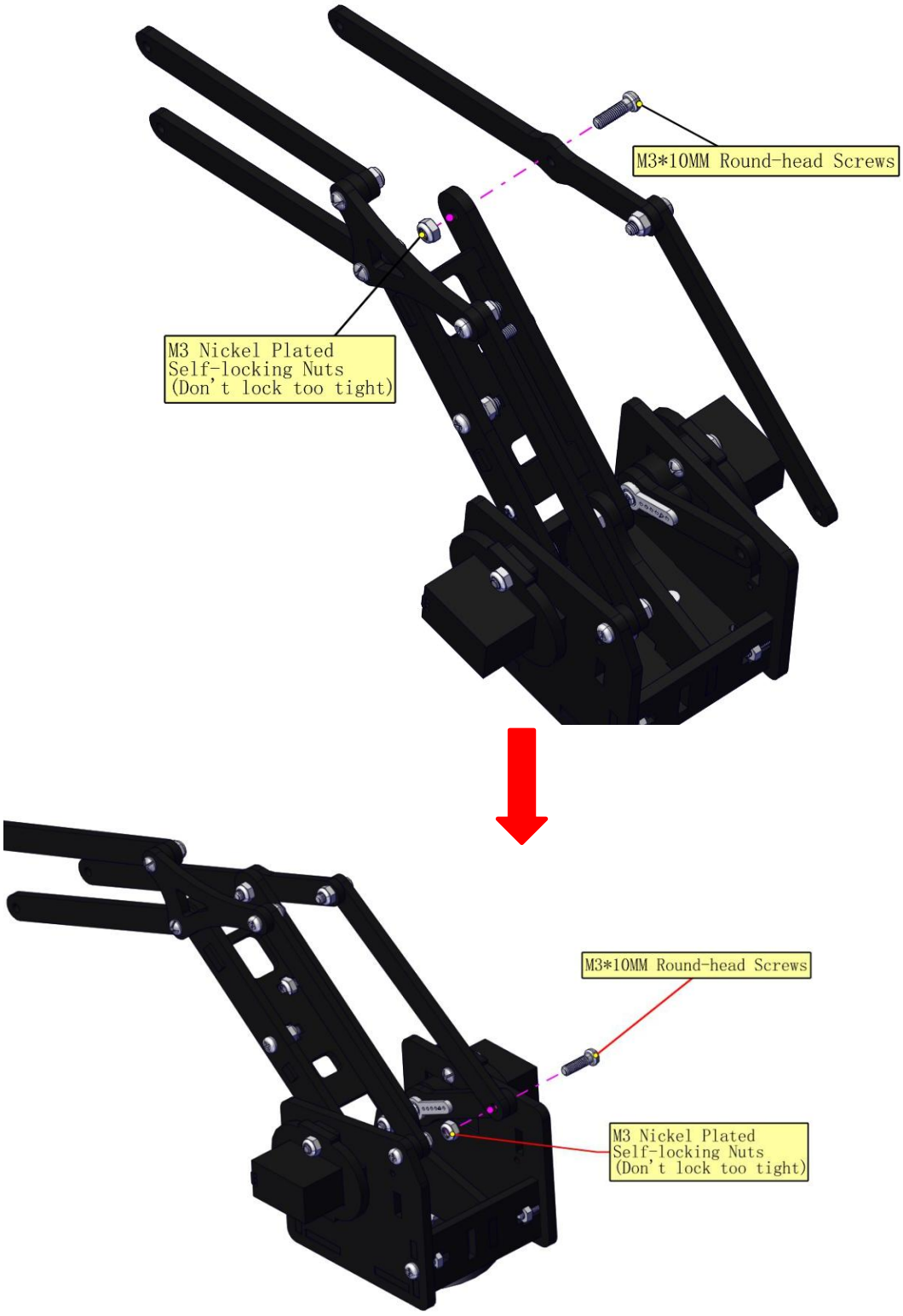

M3 Nickel Plated
Self-locking Nuts
(Don't lock too tight)
88mm
54mm
28mm
48mm
M3*12MM Round-head Screw

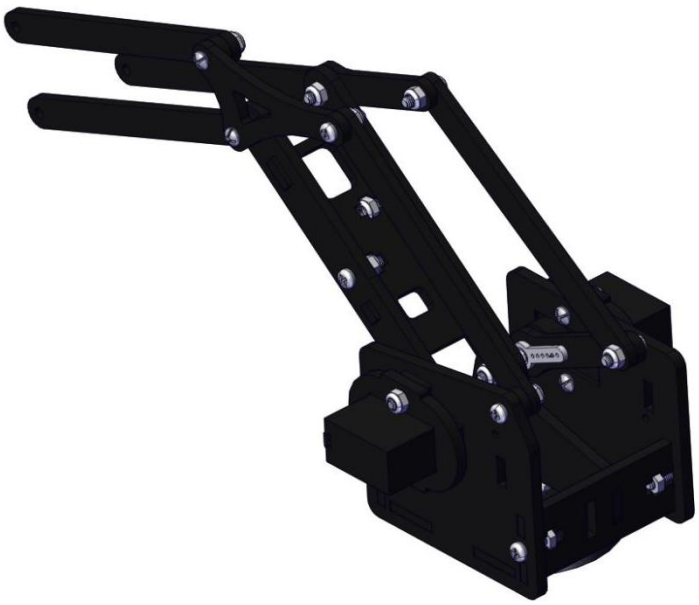

M3*12MM Round-head Screws
88mm
M3 Nickel Plated
Self-locking Nuts
(Don't lock too tight)



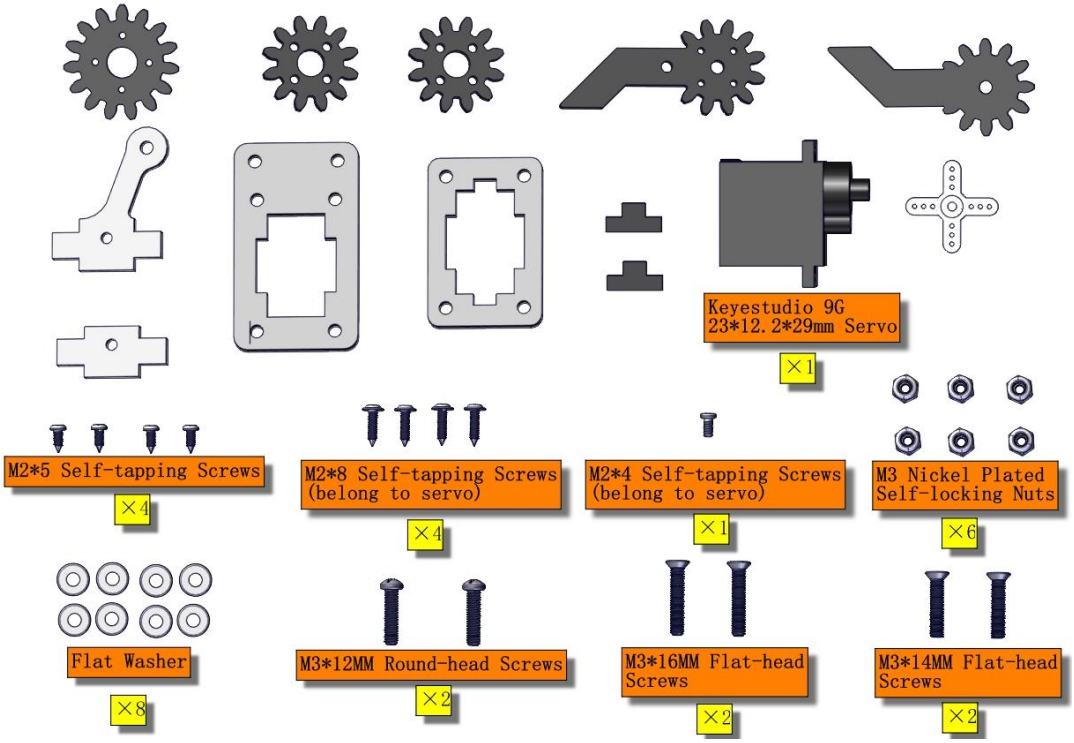

M3*10MM Round-head Screws
M3 Nickel Plated
Self-locking Nuts
(Don't lock too tight)

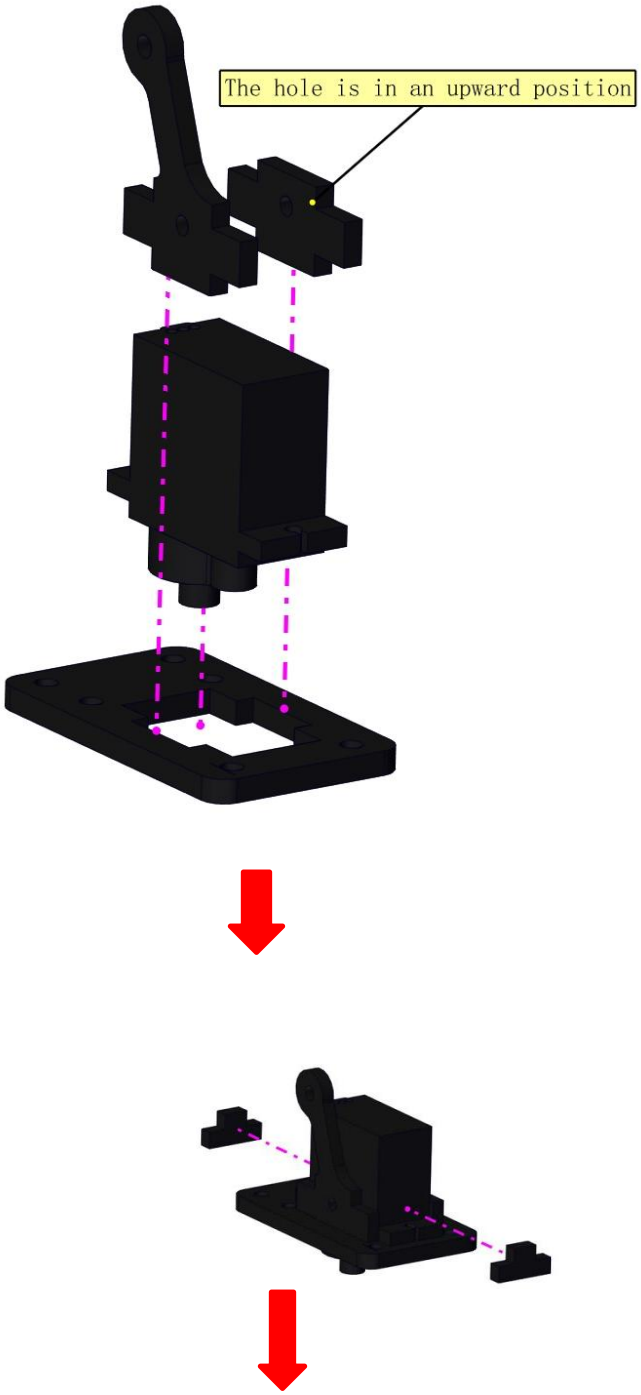

M3*10MM Round-head Screws
88mm
122mm
M3 Nickel Plated
Self-locking Nuts
(Don't lock too tight)

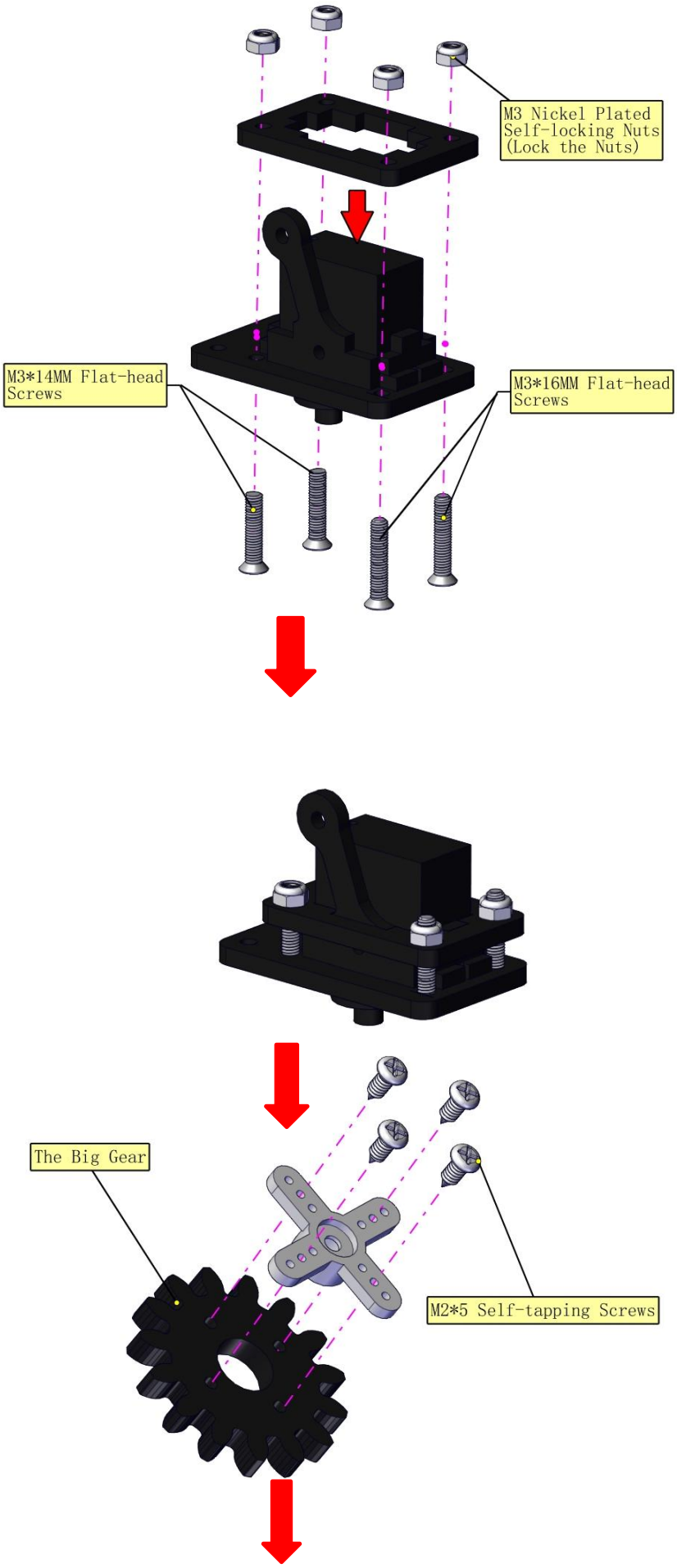

M3*10MM Round-head Screws
M3 Nickel Plated
Self-locking Nuts
(Don't lock too tight)
M3*10MM Round-head Screws
M3 Nickel Plated
Self-locking Nuts
(Don't lock too tight)

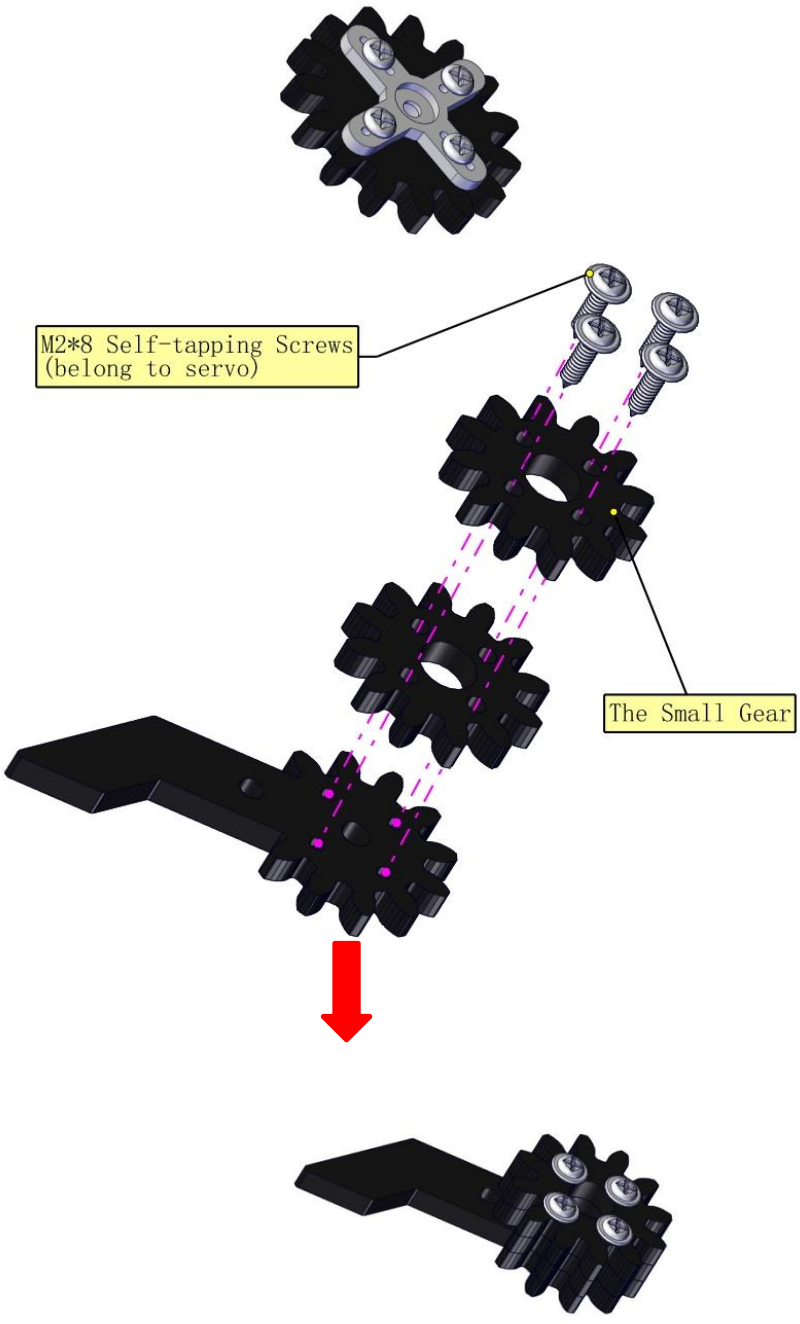


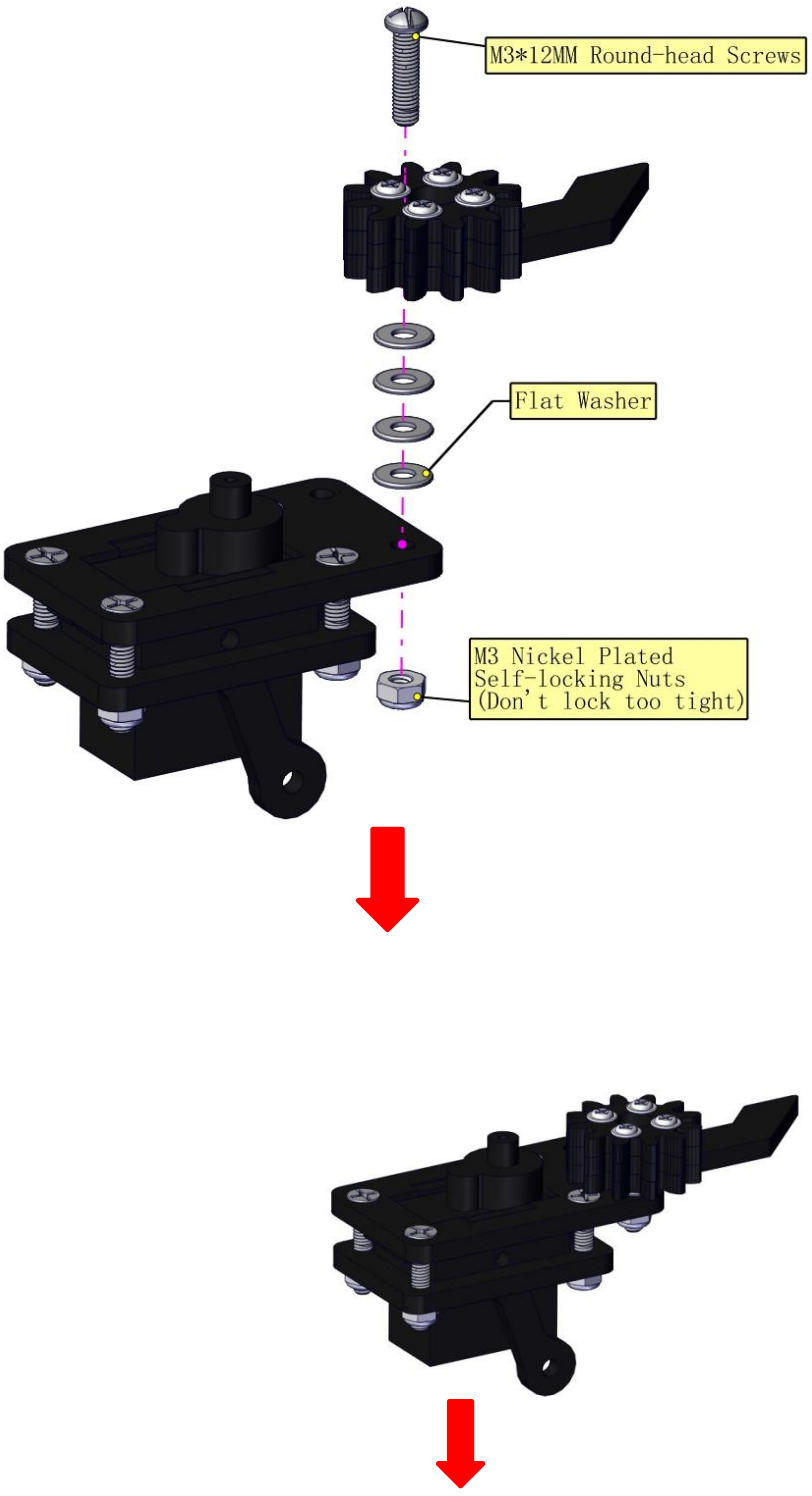
Assemble the claw

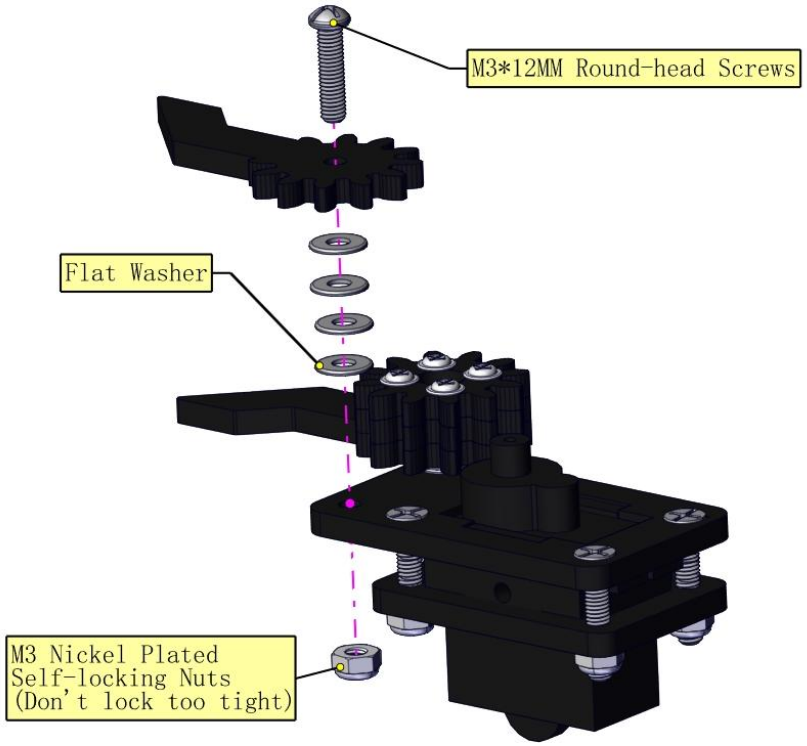



The hole is in an upward position


M3 Nickel Plated Self-locking Nuts (Lock the Nuts)
M3*14MM Flat-head Screws
M3*16MM Flat-head Screws
The Big Gear
M2*5 Self-tapping Screws

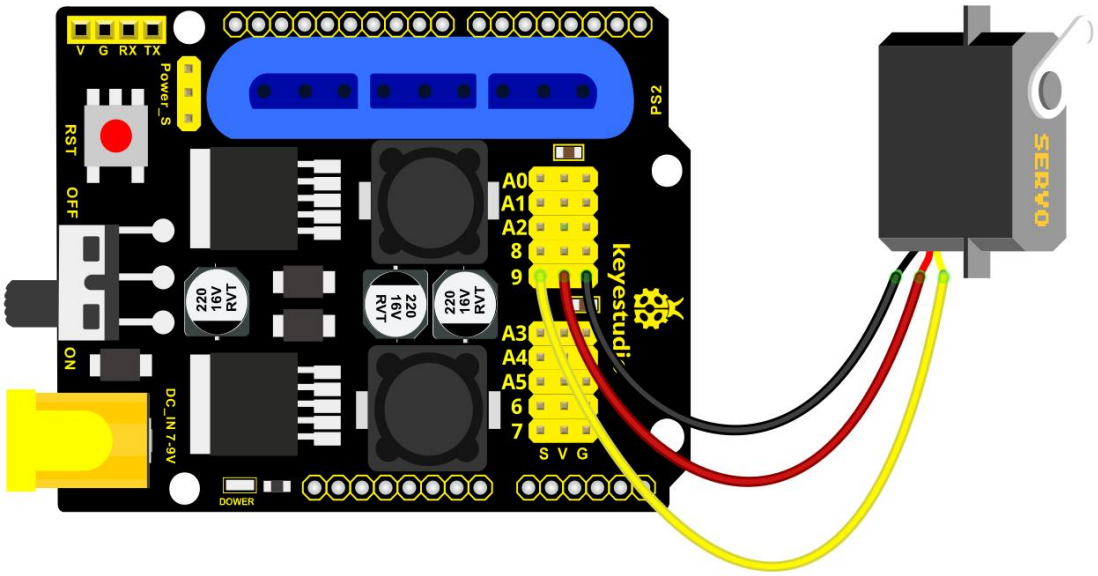

M2*8 Self-tapping Screws
(belong to servo)
The Small Gear


M3*12MM Round-head Screws
Flat Washer
M3 Nickel Plated
Self-locking Nuts
(Don't lock too tight)



c. Initialize the servo

Attach this left servo to G, V and S（9）of servo motor driver shield, upload the following code, plug in power and press the rest button on the V4.0 board. Then the left servo rotates to 0°



Set the servo to 0°:

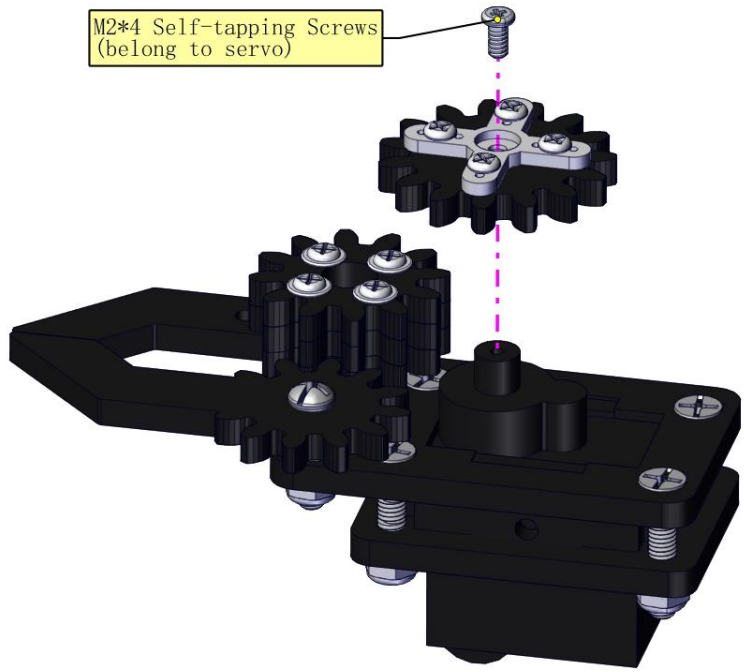
```
**********************************************************************
#include <Servo.h>
Servo myservo;   // create servo object to control a servo


void setup()
{
   Serial.begin(9600);
   delay(1000);
}


void loop()
```

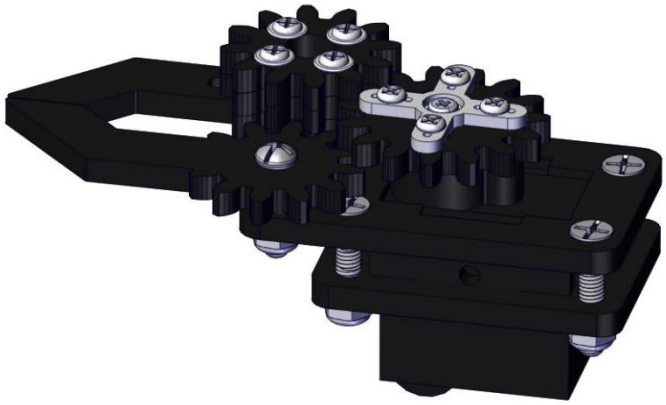
```
{
   myservo.attach(9);   // Change pin to adjust one by one
   myservo.write(0);   //Angle
   delay(1000);
}
```

****

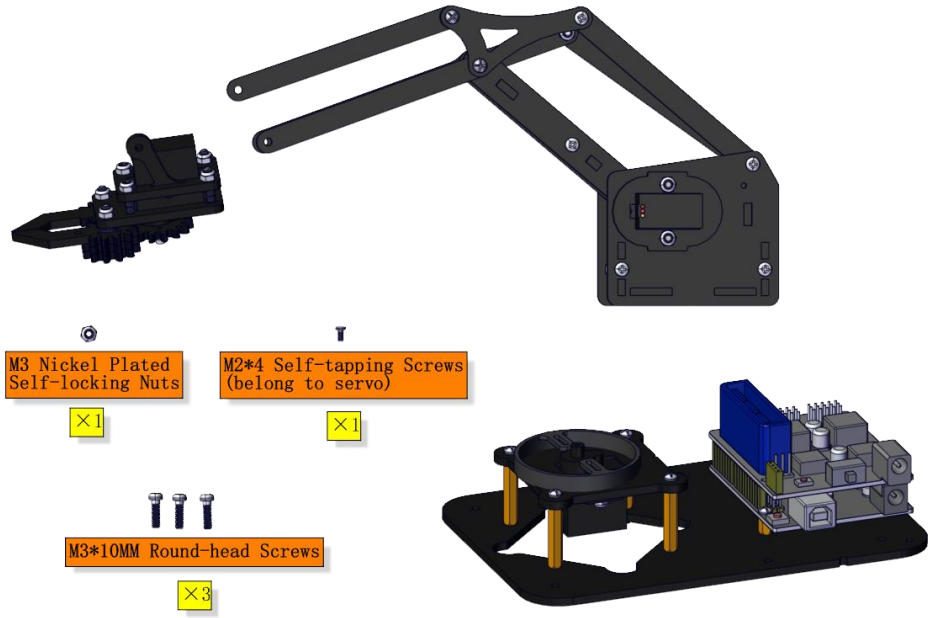
****

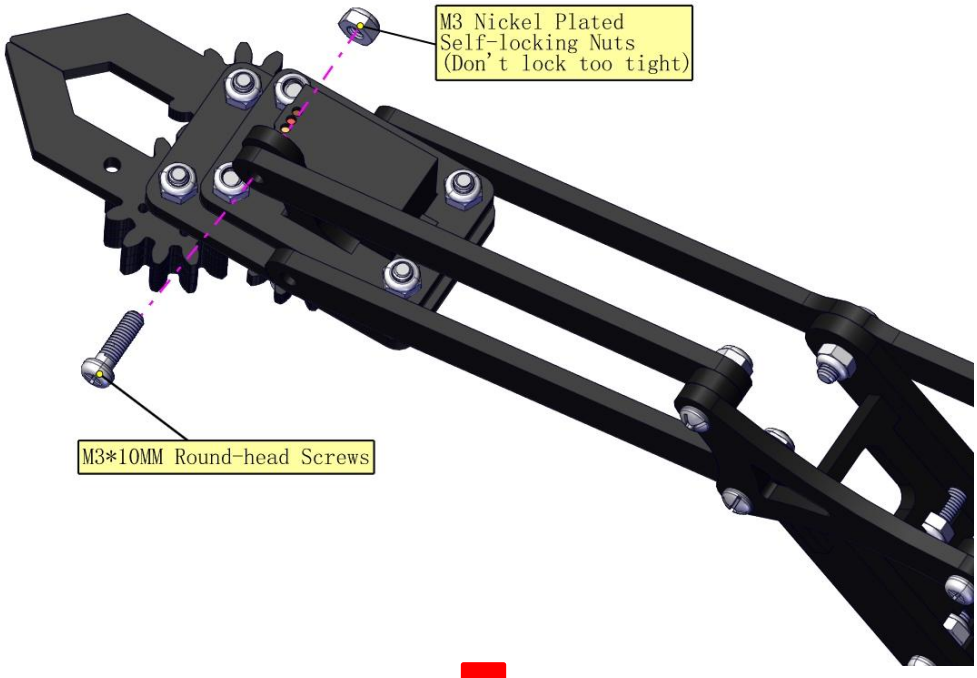
Mount gear wheels:

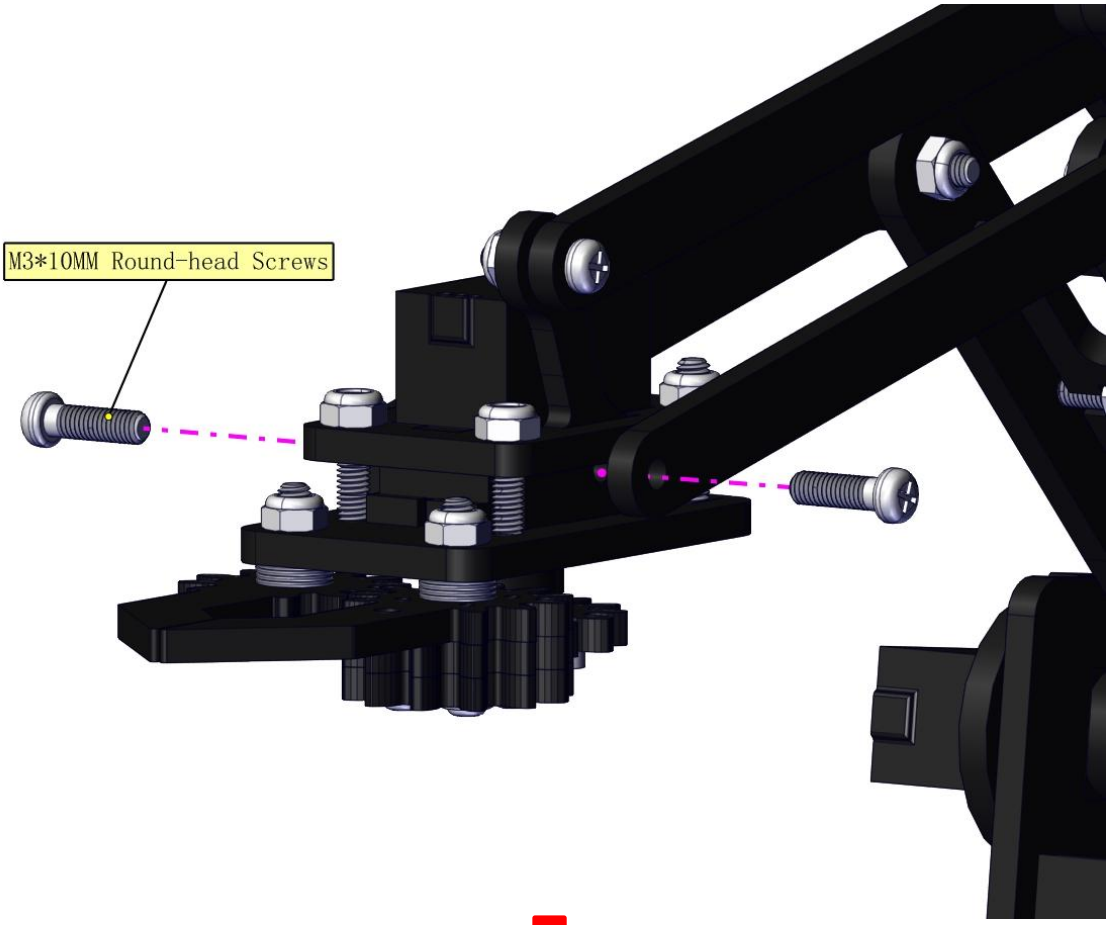

M2*4 Self-tapping Screws
(belong to servo)



Components Needed:

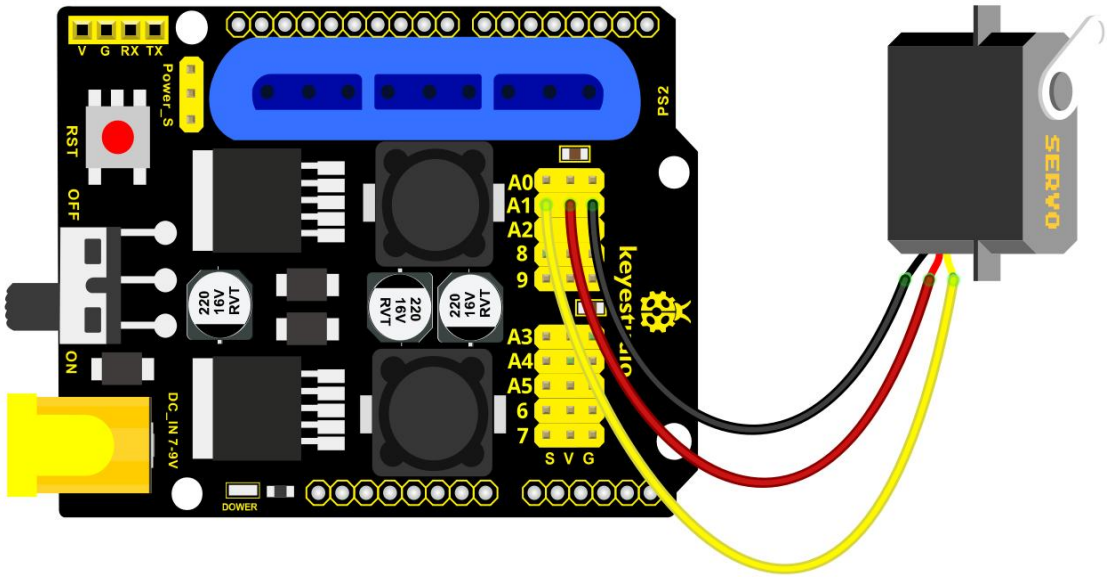





M3*10MM Round-head Screws

Initialize the servo

Attach this left servo to G, V and S（A1）of sevro motor driver shield, upload the following code, plug in power and press the rest button on the V4.0 board. Then the left servo rotates to 80°



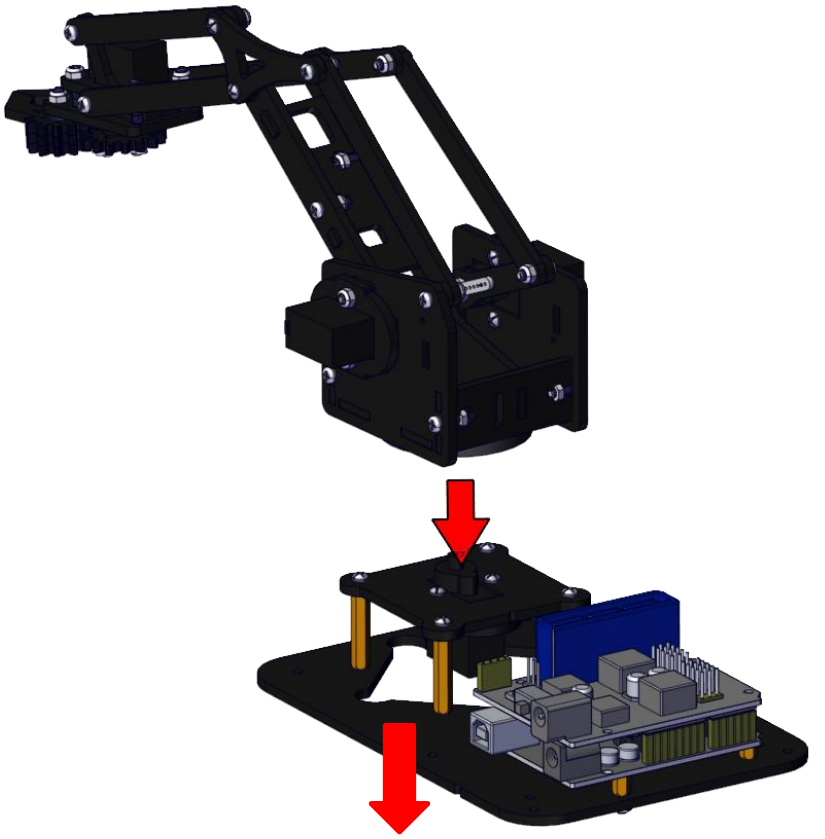
Set the servo to 80°:

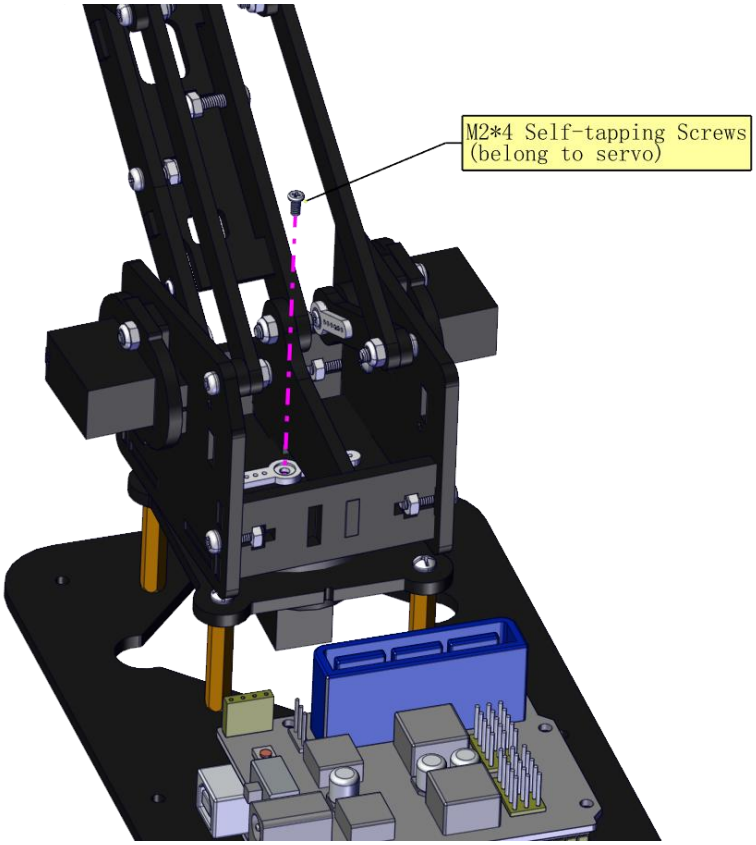
```
**********************************************************************
#include <Servo.h>
Servo myservo;   // create servo object to control a servo


void setup()
{
   Serial.begin(9600);
   delay(1000);
}


void loop()
{
```

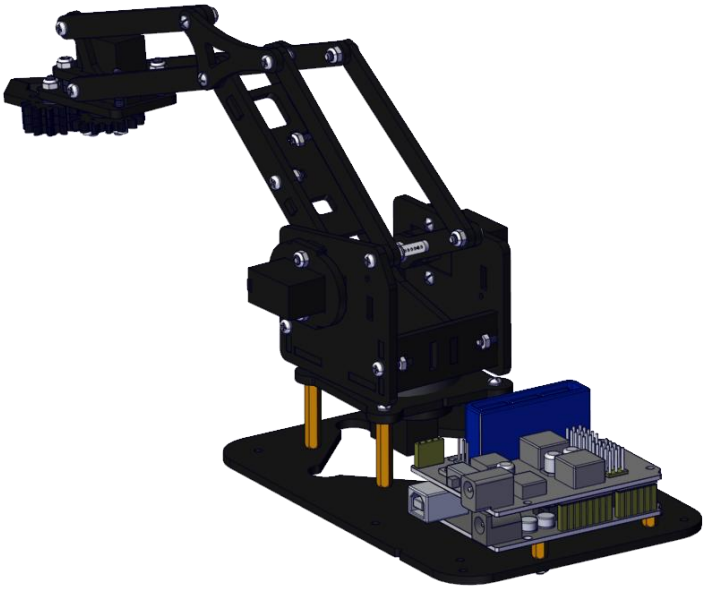
```
    myservo.attach(A1);    // Change pin to adjust one by one
    myservo.write(80);    //Angle
    delay(1000);
}
```

****

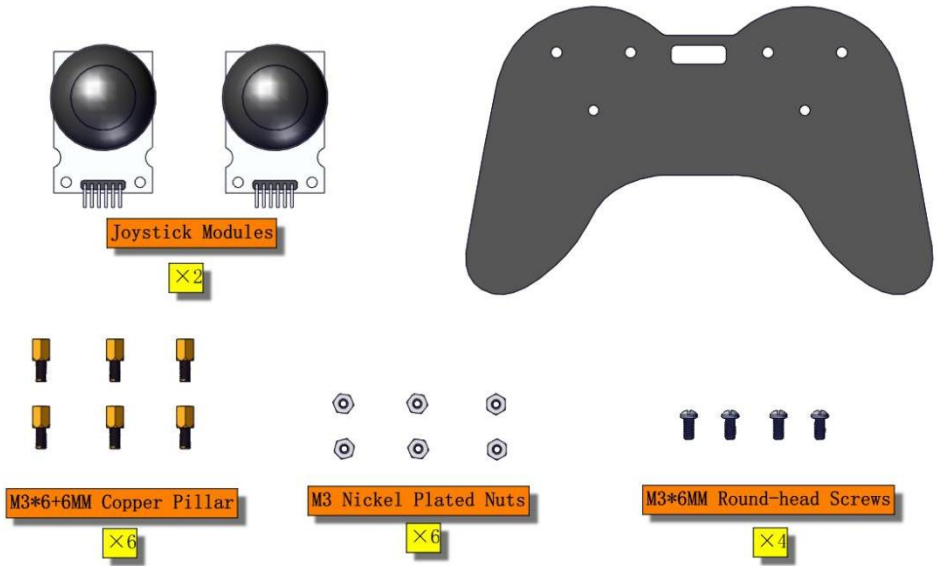
Install the robotic arm:

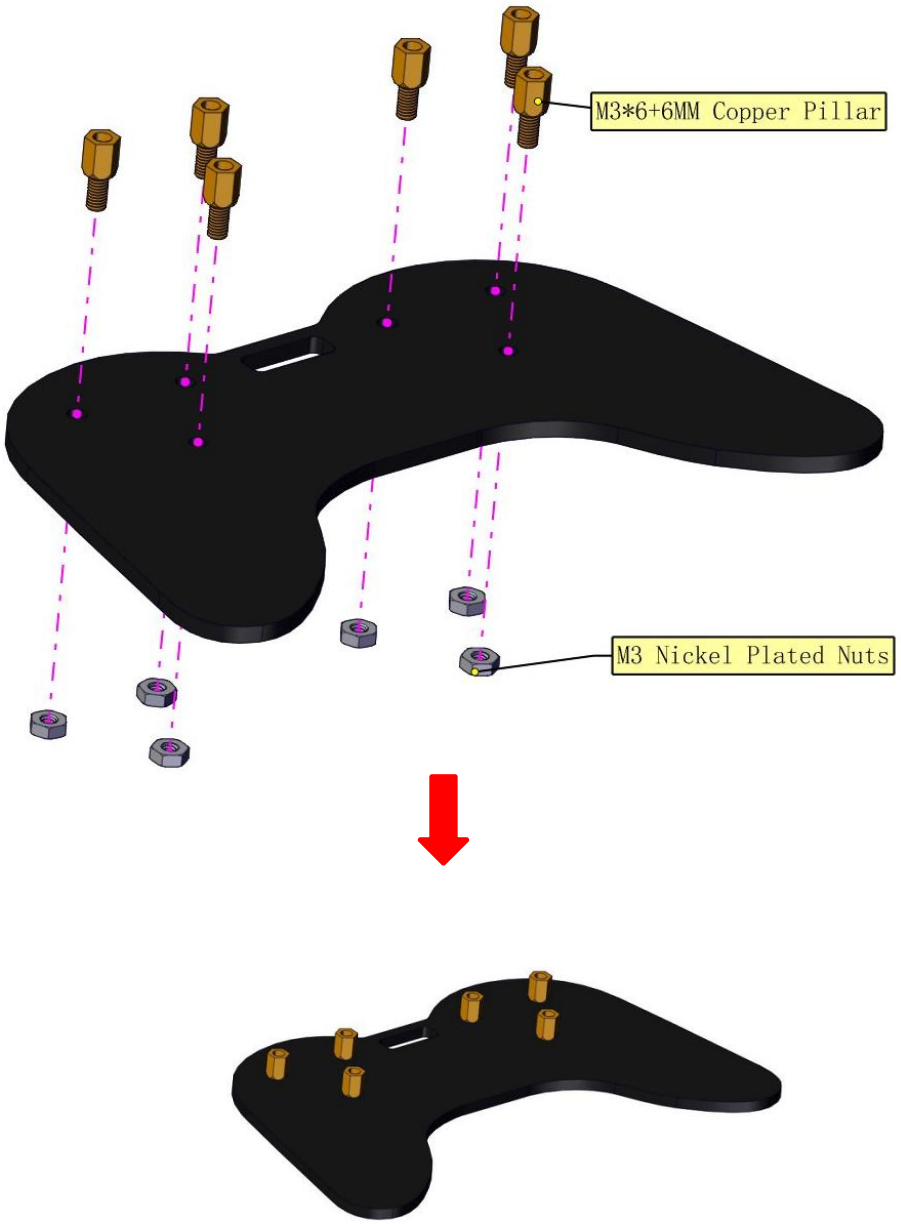


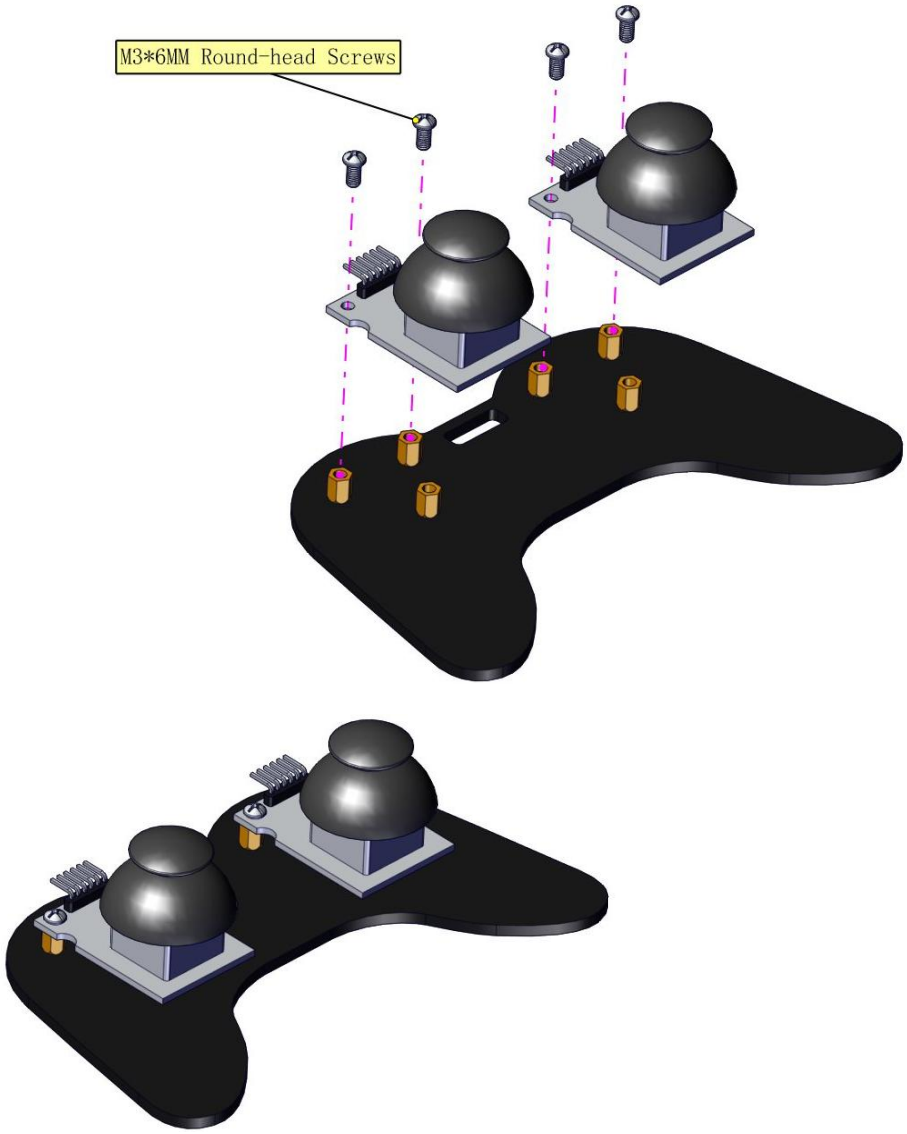

M2*4 Self-tapping Screws
(belong to servo)



Mount the control part

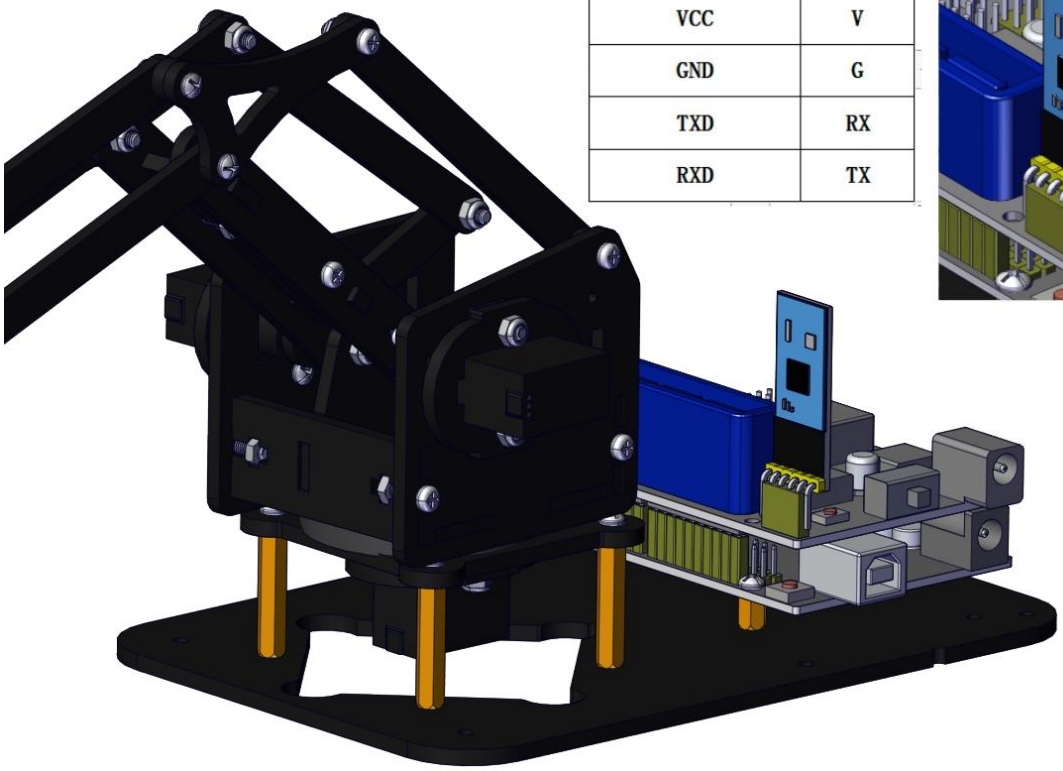



M3*6+6MM Copper Pillar
M3 Nickel Plated Nuts

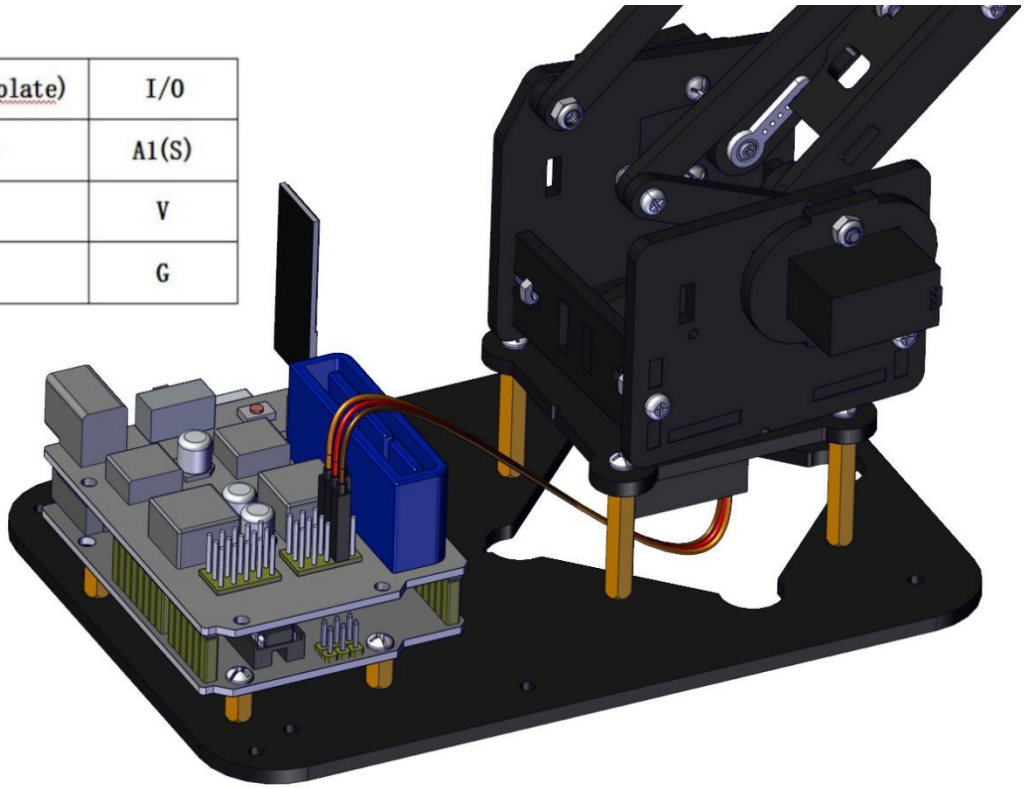


Wiring-up Guide

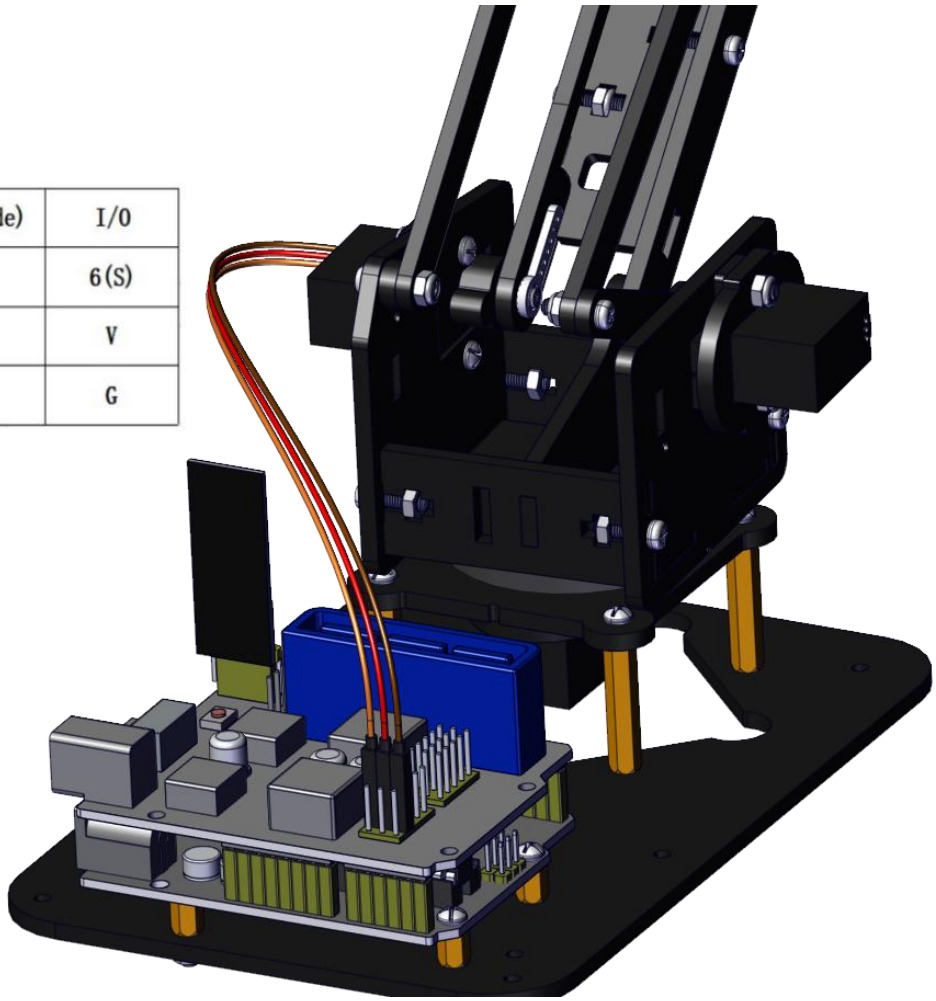
Bluetooth	I/O
VCC	V
GND	G
TXD	RX
RXD	TX



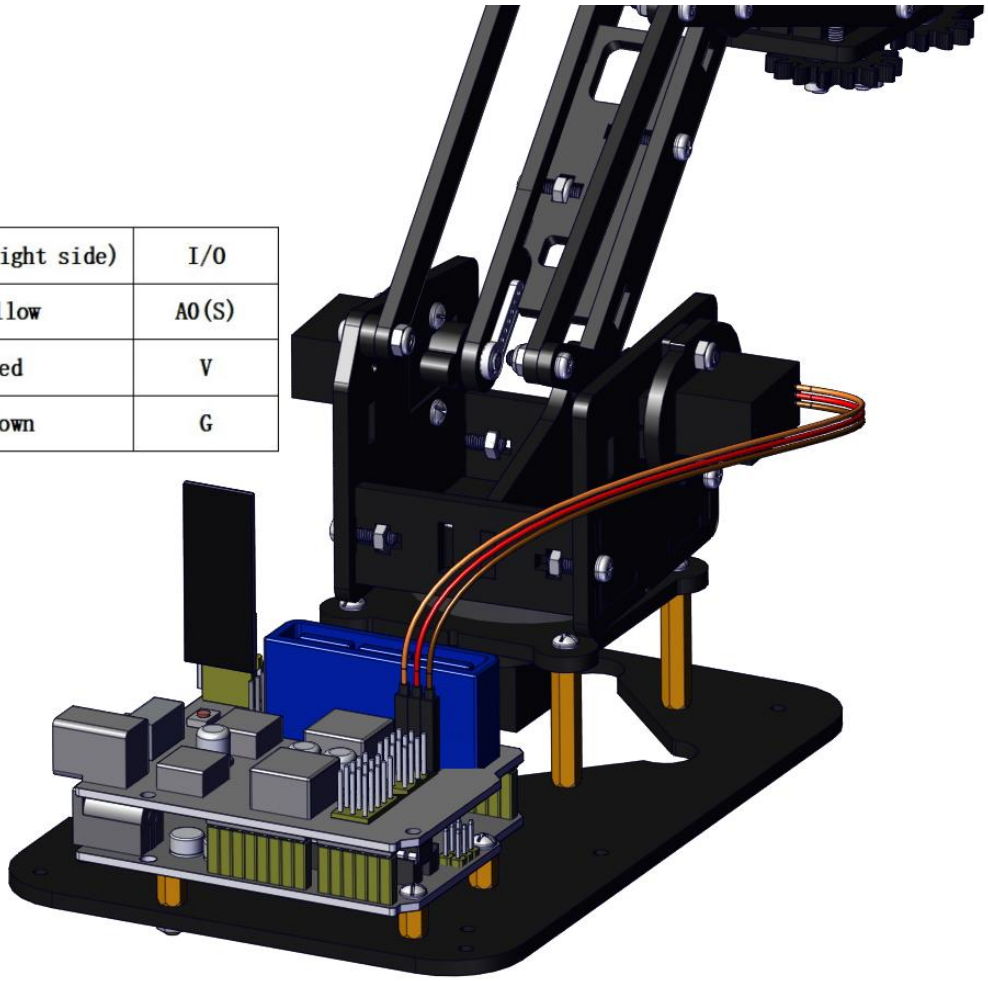
Servo 1(baseplate)	I/O
yellow	A1(S)
red	V
brown	G



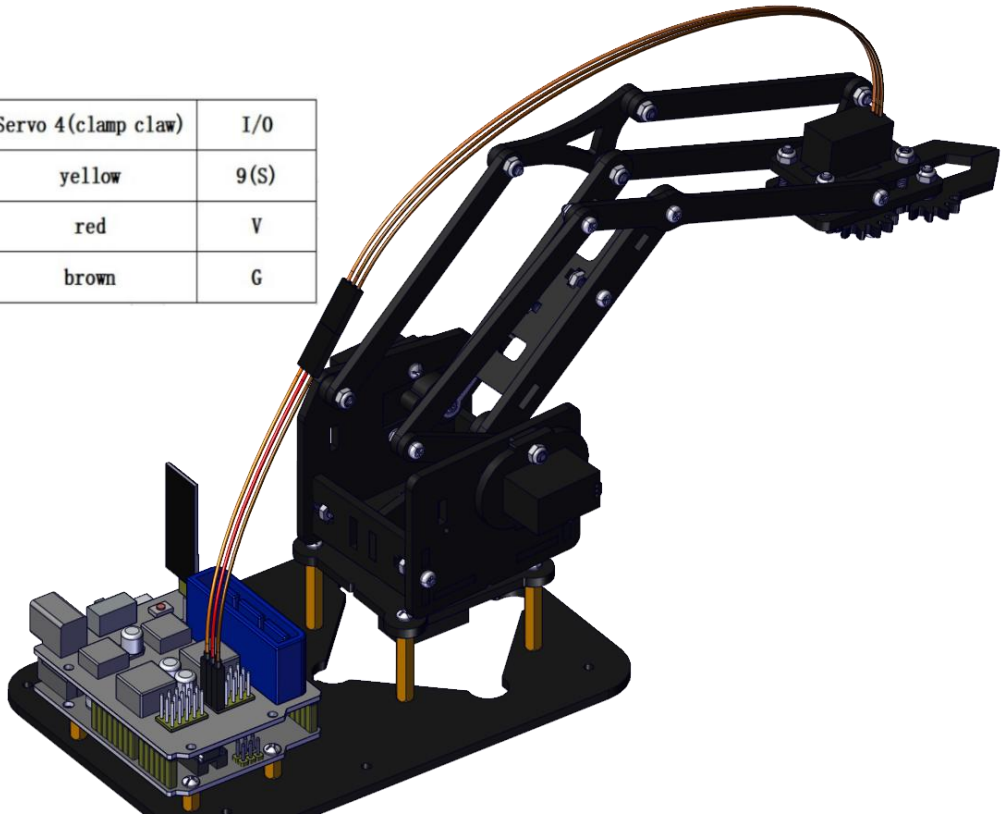
Servo 3(left side)	I/O
yellow	6(S)
red	V
brown	G



Servo 2(right side)	I/O
yellow	A0(S)
red	V
brown	G

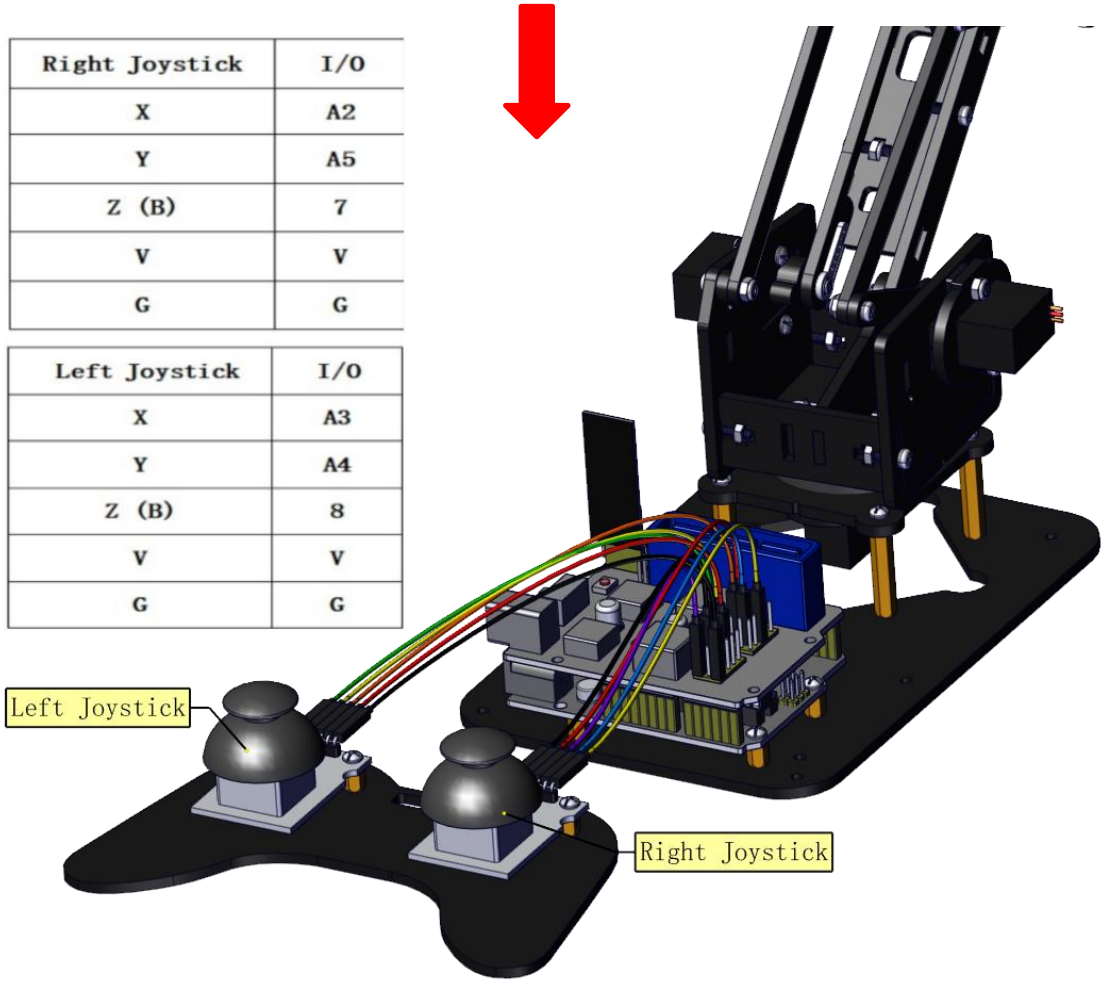


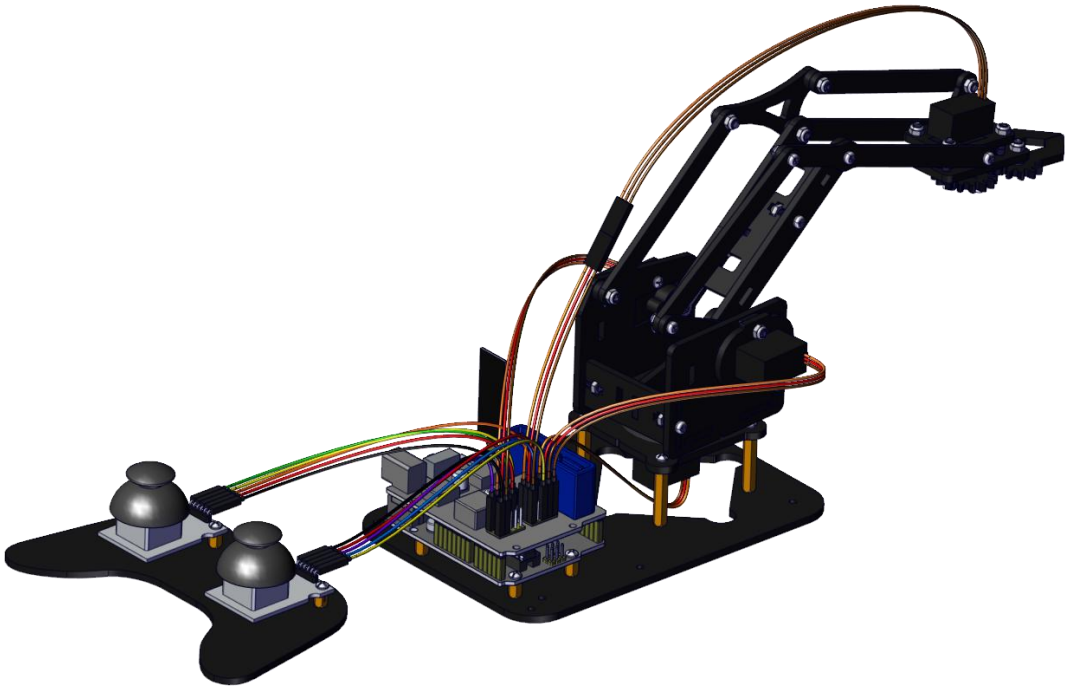
Servo 4(clamp claw)	I/O
yellow	9(S)
red	V
brown	G



Right Joystick	I/O
X	A2
Y	A5
Z (B)	7
V	V
G	G

Left Joystick	I/O
X	A3
Y	A4
Z (B)	8
V	V
G	G

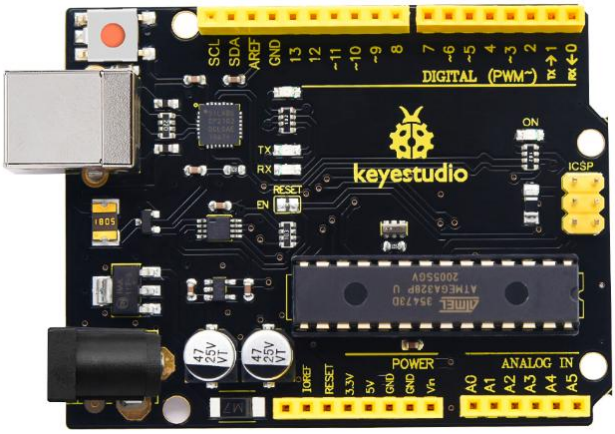




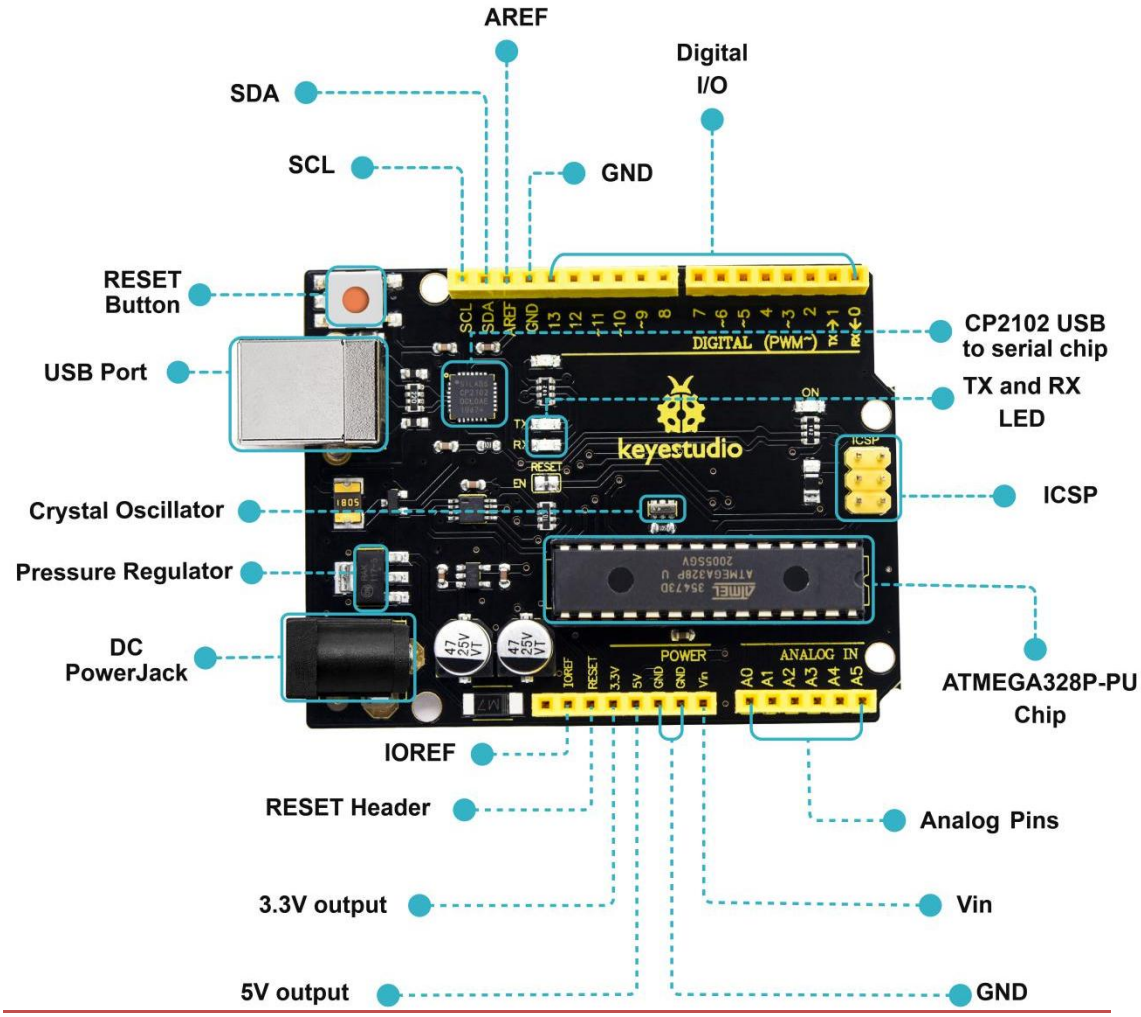
5. Robot Arm Projects

Project 1: Install Arduino IDE and Driver

Keyestudio V4.0 Development Board



Keyestudio V4.0 development board is an Arduino uno-comp atible board, which is based on ATmega328P MCU, and with a cp2102 Chip as a UART-to-USB converter.



1	**ICSP (In-Circuit Serial Programming) Header**	the AVR, an Arduino micro-program header consisting of MOSI, MISO, SCK, RESET, VCC, and GND. It is often called the SPI (serial peripheral interface) and can be considered an "extension" of the output. In fact, slave the output devices to the SPI bus host. When connecting to PC, program the firmware to ATMEGA328P-PU.
2	**Power LED Indicator**	Powering the Arduino, LED on means that your circuit board is correctly powered on. If LED is off, connection is wrong.

3	**Digital I/O**	Arduino MEGA has 14 digital input/output pins (of which 6 can be used as PWM outputs).These pins can be configured as digital input pin to read the logic value (0 or 1). Or used as digital output pin to drive different modules like LED, relay, etc. Using pinMode(), digitalWrite(), and digitalRead() functions.
4	**GND**	GND
5	**AREF**	Reference voltage (0-5V) for analog inputs. Used with analogReference(). Configures the reference voltage used for analog input (i.e. the value used as the top of the input range).
6	**SDA**	IIC communication pin
7	**SCL**	IIC communication pin
8	**RESET Button**	You can reset your Arduino board,
9	**D13 LED**	There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

10	**USB Connection**	Arduino board can be powered via USB connector. All you needed to do is connecting the USB port to PC using a USB cable.
11	**CP2102**	USB serial chip, translate the USB signal of computer into serial signal
12	**TX LED**	Onboard you can find the label: TX (transmit) When Arduino board communicates via serial port, send the message, TX led flashes.
13	**RX LED**	Onboard you can find the label: RX(receive) When Arduino board communicates via serial port, receive the message, RX led flashes.
14	**Crystal Oscillator**	How does Arduino calculate time? by using a crystal oscillator. The number printed on the top of the Arduino crystal is 16.000H9H. It tells us that the frequency is 16,000,000 Hertz or 16MHz.

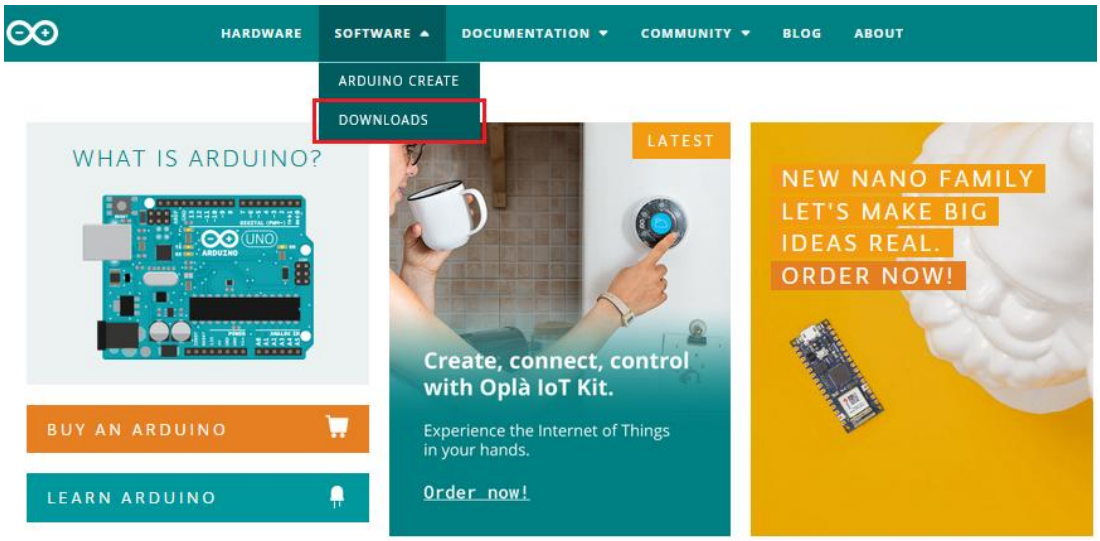
15	**Voltage Regulator**	To control the voltage provided to the Arduino board, as well as to stabilize the DC voltage used by the processor and other components. Convert an external input DC7-12V voltage into DC 5V, then switch DC 5V to the processor and other components.
16	**DC Power Jack**	Arduino board can be supplied with an external power DC7-12V from the DC power jack.
17	**Microcontroller**	Each Arduino board has its own microcontroller. You can regard it as the brain of your board. The main IC (integrated circuit) on the Arduino is slightly different from the panel pair. Microcontrollers are usually from ATMEL. Before you load a new program on the Arduino IDE, you must know what IC is on your board. This information can be checked at the top of IC.

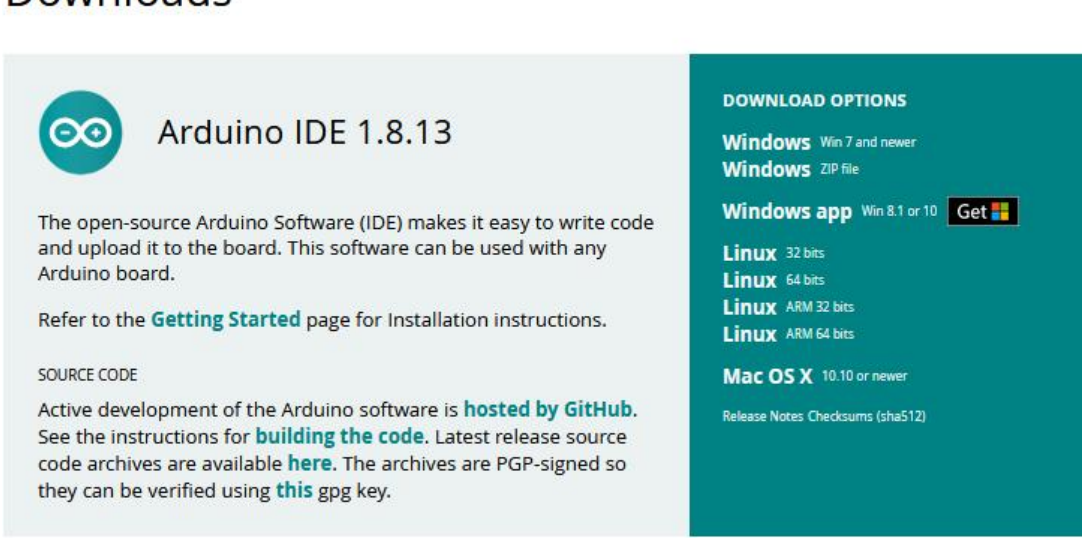
18	**IOREF**	This pin on the board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V.
19	**RESET Header**	Connect an external button to reset the board. The function is the same as reset button.
20	**Power Pin 3V3**	A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
21	**Power Pin 5V**	Provides 5V output voltage
22	**Vin**	You can supply an external power input DC7-12V through this pin to Arduino board.
23	**Analog Pins**	Onboard has 6 analog inputs, labeled A0 to A5.

(1) Installing Arduino IDE

When we get control board, we need to download Arduino IDE and driver firstly.

You could download Arduino IDE from the official website: https://www.arduino.cc/, click the **SOFTWARE** on the browse bar, click "DOWNLOADS" to enter download page, as shown below:





There are two versions of IDE for WINDOWS system, you can choose between the Installer (.exe) and the Zip packages. We suggest you use the first one that installs directly everything you need to use the Arduino Software (IDE), including the drivers. With the Zip package you need to install the drivers manually. The Zip file is also useful if you want to create a portable installation.

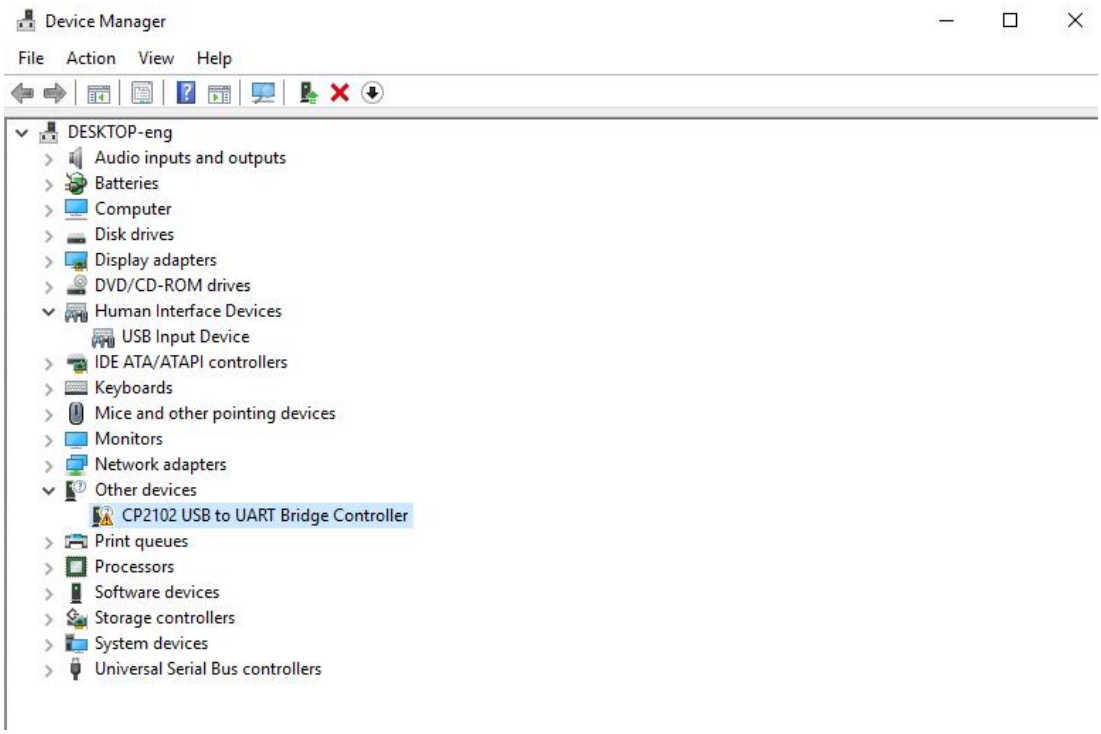
(2) Installing Driver of V4.0 Board

Let’ s install the driver of keyestudio V4.0 board. The USB-TTL chip on V4.0 board adopts CP2102 serial chip. The driver program of this chip is included in Arduino 1.8 version and above, which is convenient. Plugging on USB port of board, the computer can recognize the hardware and automatically install the driver of CP2102.

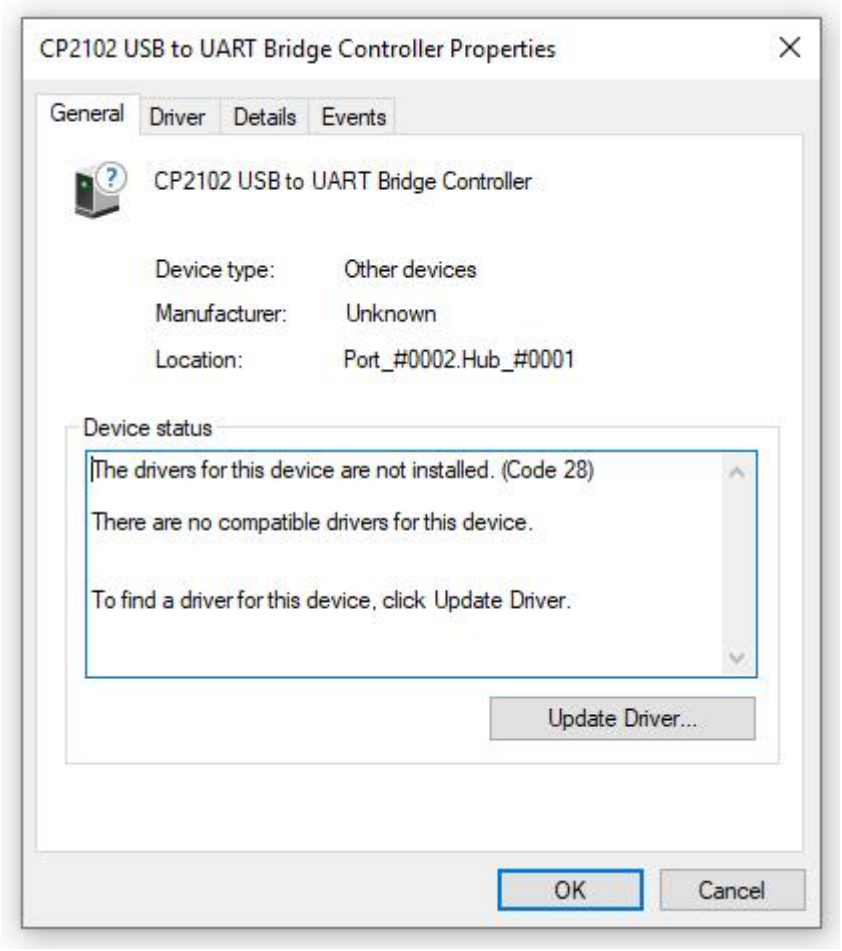
if the version of your Arduino is not above 1.8 version, you can download the driver of CP2102:

https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers

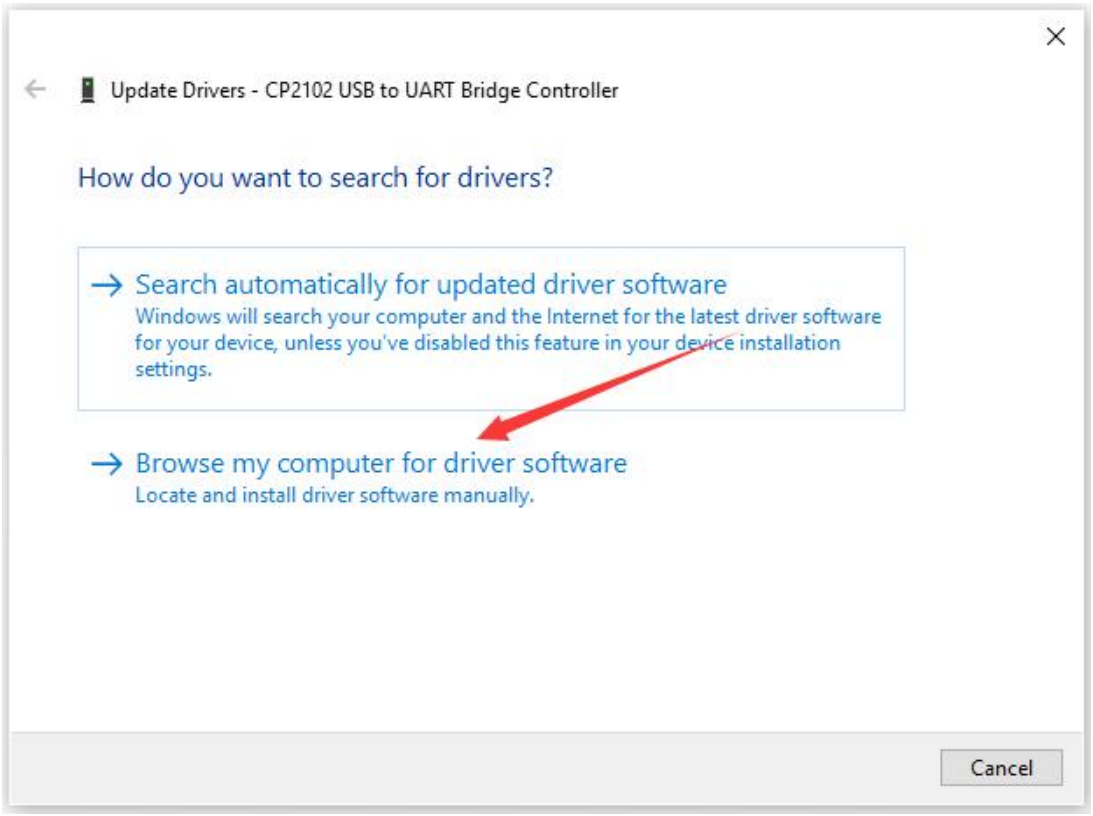
If you install it unsuccessfully, please open the device manager of computer. Right click Computer----- Properties----- Device Manager



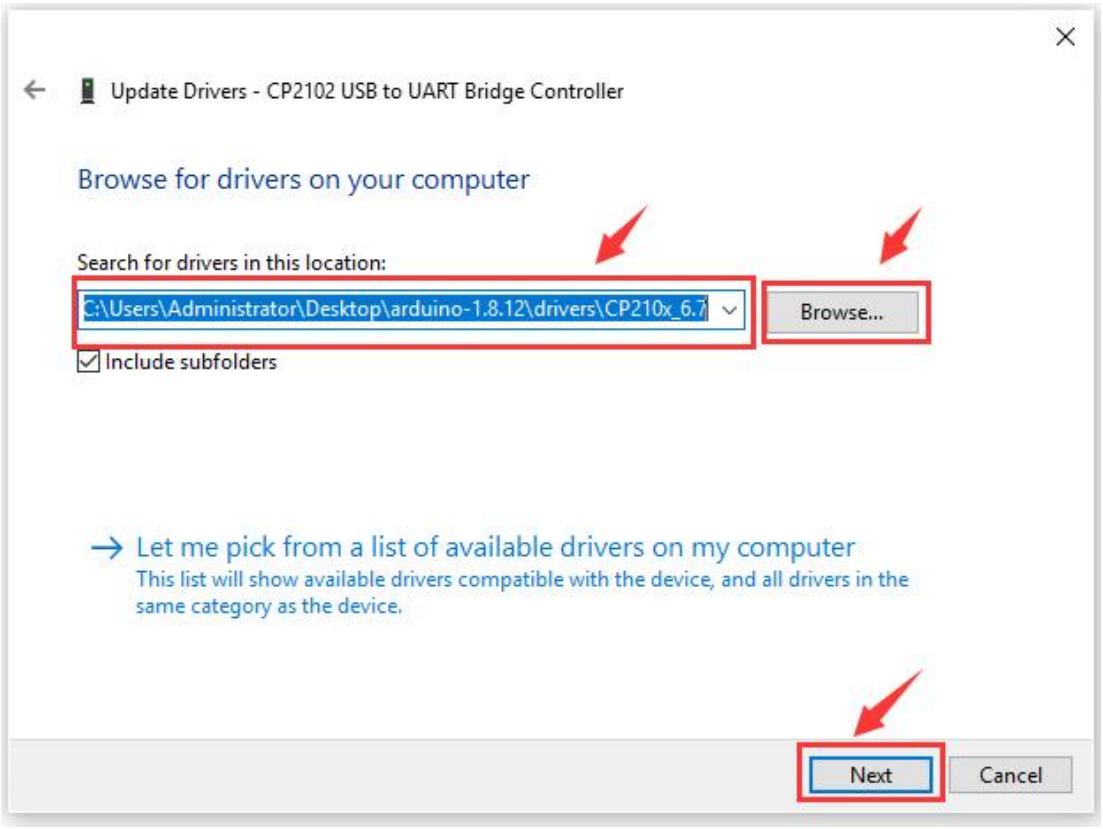
The yellow exclamation mark on the page implies an unsuccessful installation and you should double click the hardware and update the driver.



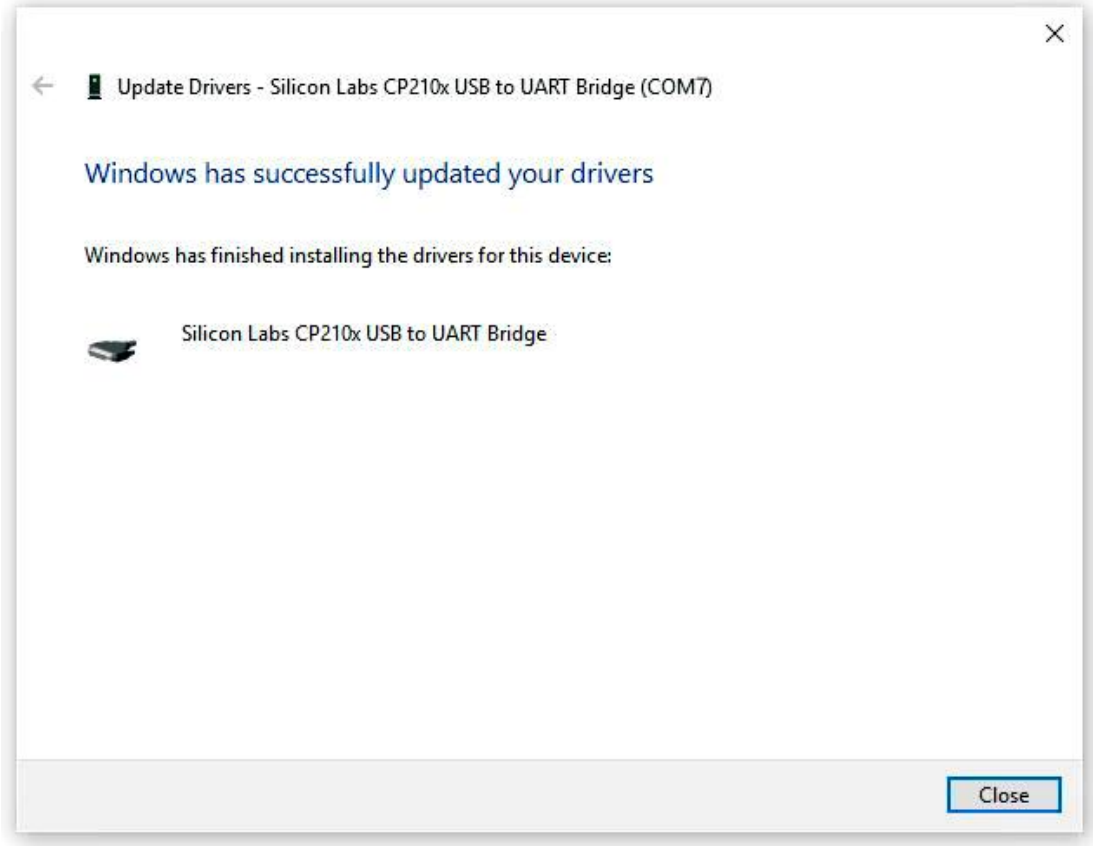
Click “OK” to enter the following page. Click “browse my computer for updated driver software”

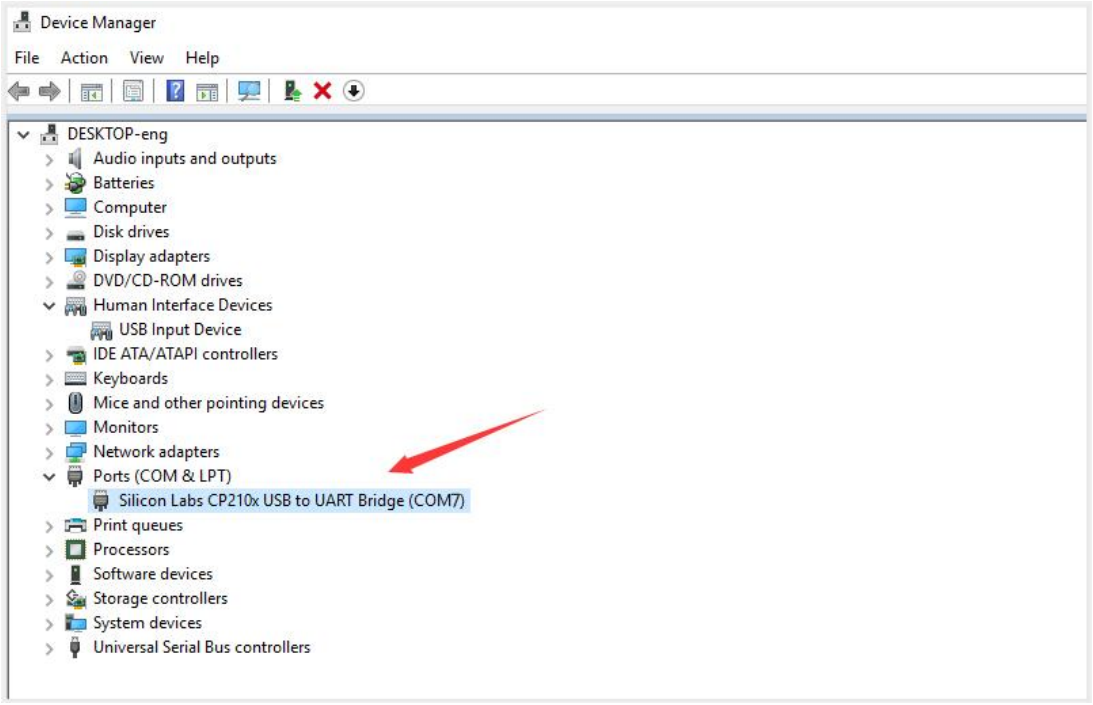


Click “Browse”, then search the driver of CP2102 and click “Next”, There is a DRIVERS folder in Arduino software installed package (arduino-1.8.12) , open driver folder and check the driver of CP210X series chips.



When opening the device manager, we will find the yellow exclamation mark disappear. The driver of CP2102 is installed successfully.

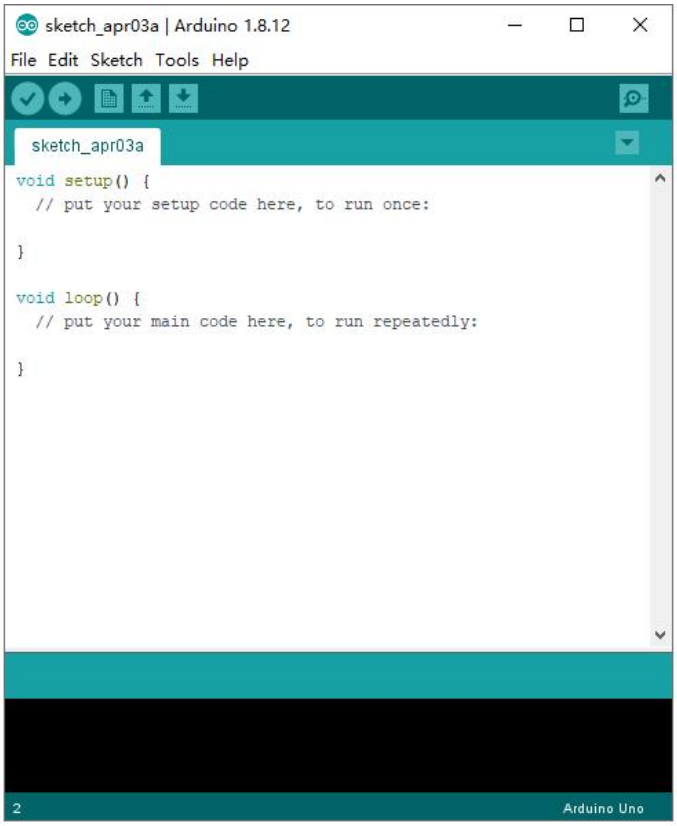




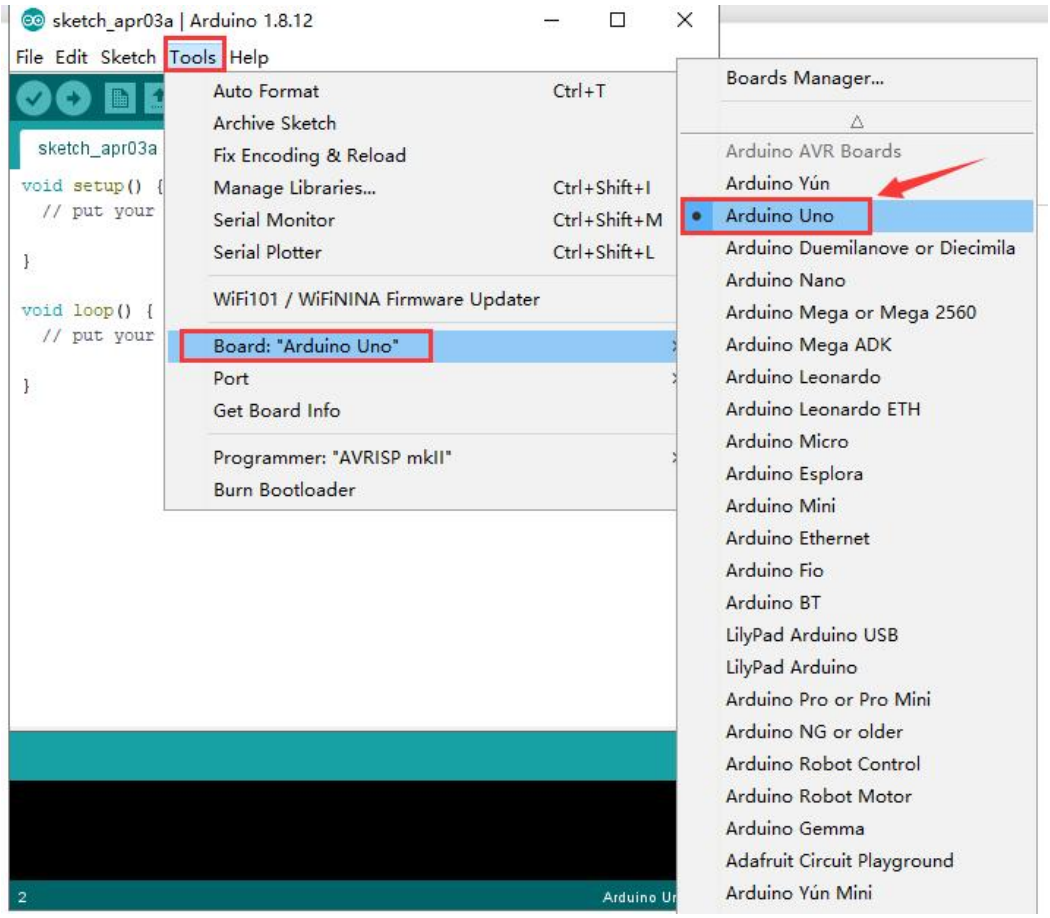
(3) Arduino IDE Setting

Click 

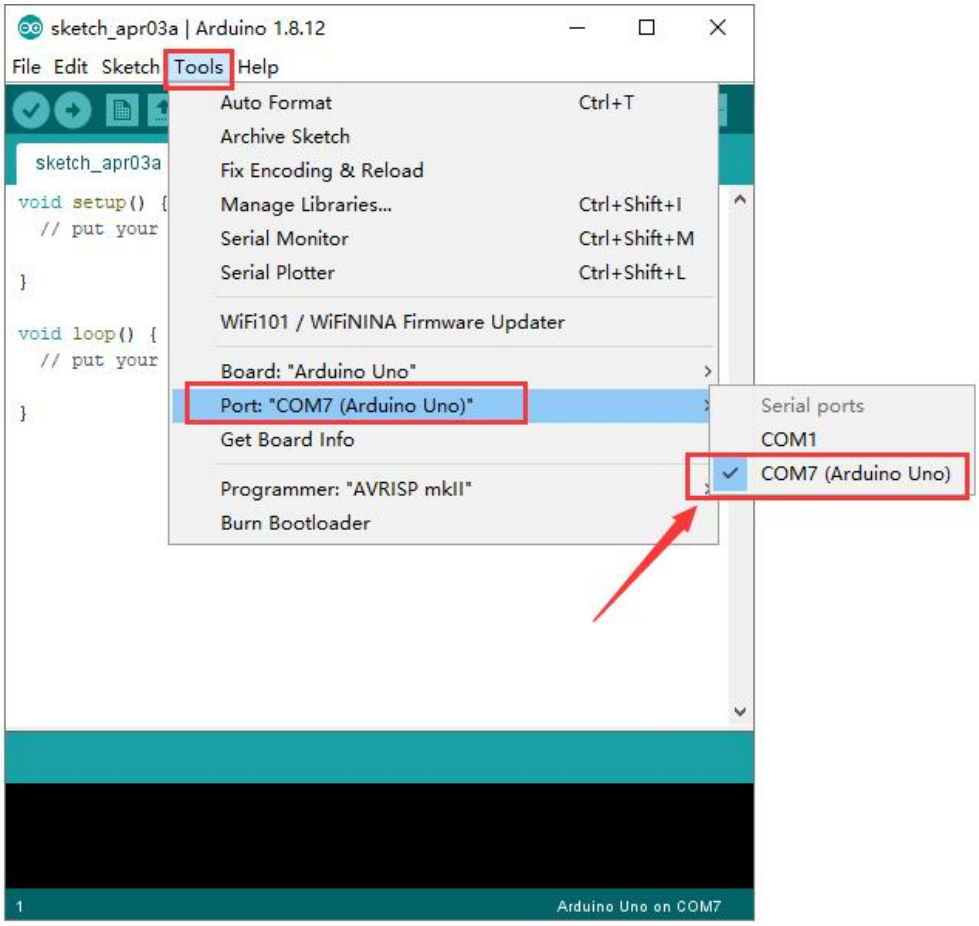
icon，and open Arduino IDE.

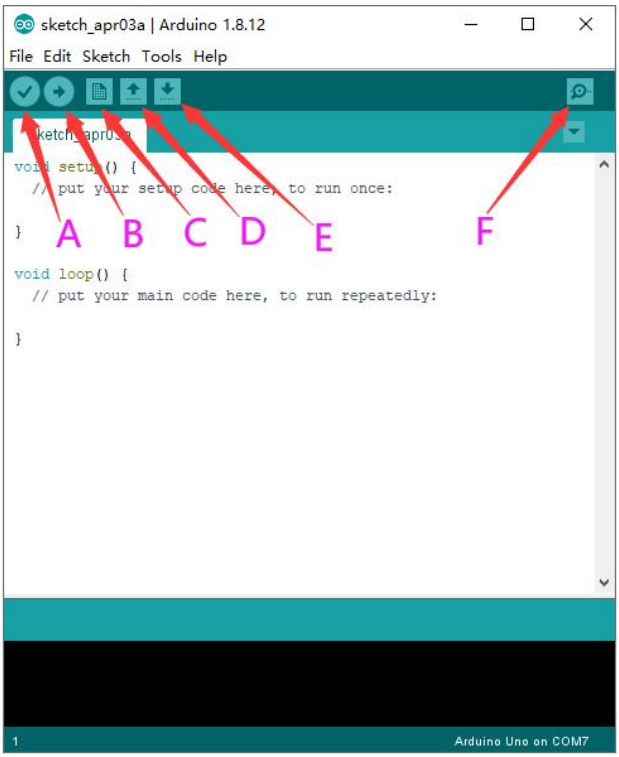


When downloading the sketch to the board, you must select the correct name of Arduino board that matches the board connected to your computer. As shown below;



Then select the correct COM port (you can see the corresponding COM port after the driver is successfully installed)


sketch_apr03a | Arduino 1.8.12
File Edit Sketch Tools Help
sketch_apr03a
void setup() {
// put your
}
void loop() {
// put your
}
Auto Format Ctrl+T
Archive Sketch
Fix Encoding & Reload
Manage Libraries... Ctrl+Shift+I
Serial Monitor Ctrl+Shift+M
Serial Plotter Ctrl+Shift+L
WiFi101 / WiFiNINA Firmware Updater
Board: "Arduino Uno"
Port: "COM7 (Arduino Uno)"
Get Board Info
Programmer: "AVRISP mkII"
Burn Bootloader
Serial ports
COM1
COM7 (Arduino Uno)
1
Arduino Uno on COM7



A- Used to verify whether there is any compiling mistakes or not.

B- B- Used to upload the sketch to your Arduino board.

C- C- Used to create shortcut window of a new sketch.

D- D- Used to directly open an example sketch.

E- E- Used to save the sketch.

F- F- Used to send the serial data received from board to the serial monitor.

Name	0°	180°
Servo 1 (baseplate)	Rotate toward the rightmost	Rotate toward the leftmost
Servo 2 (right side)	Rocker arm connected to Servo 2 draws back	stretch out
Servo 3 (left side)	Rocker arm connected to Servo 3 stretches out	draw back
Servo 4 (clamp claw)	close	open

Project 2: 4DOF Rotation and Pin Control

1) Joint Rotation and Servo Angle Settings

2) Pin Control

Name	IO Pin
Servo 1 (baseplate)	A1
Servo 2 (right side)	A0
Servo 3 (left side)	6
Servo 4 (clamp claw)	9
Right Joystick X	A2
Right Joystick Y	A5
Right Joystick Z (B)	7
Left Joystick X	A3
Left Joystick Y	A4
Left Joystick Z(B)	8
D1/DAT of PS2	12
D0/CMD of PS2	11

CE/SEL of PS2	10
CLK of PS2	13

Project 3: Control the Robot Arm by Joysticks

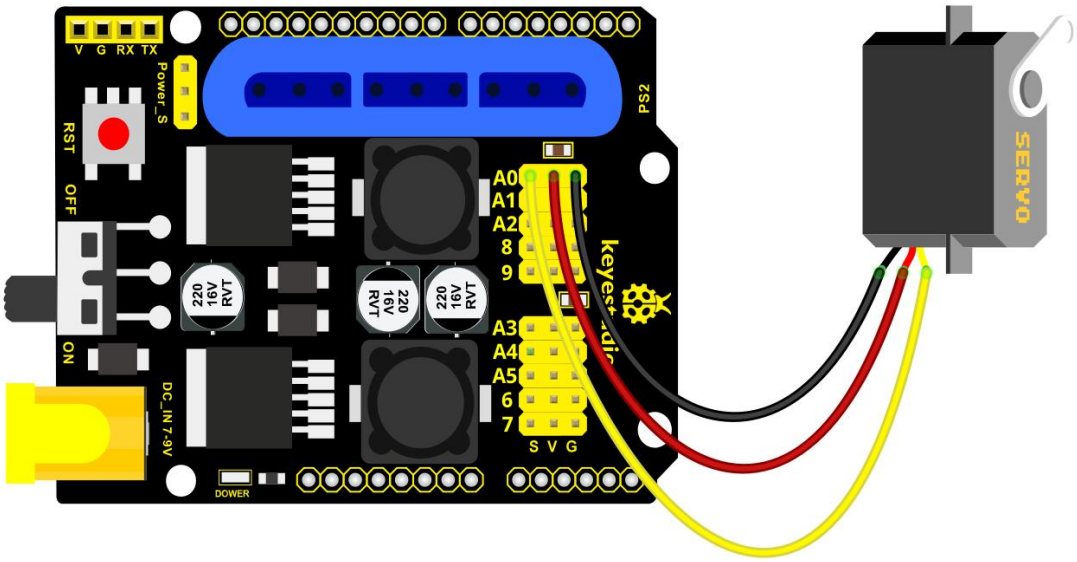
3.1 Servo Control

Description

In the previous projects, we set the square wave and angles of servos.

Now, we use libraries of servos to control the angle of a servo. We only need to put the servo folder in the libraries folder where the Arduino IDE location is installed, then open the Arduino IDE, the library file will take effect.

Connection Diagram



Test Code 1:

```
**********************************************************************************************

    #include <Servo.h>

    Servo myservo;    // create servo object to control a servo


    void setup()

    {

       Serial.begin(9600);

       delay(1000);

    }


    void loop()

    {

       myservo.attach(A0);    // modify each pin to adjust
```

```
    myservo.write(0);    // angle value
    delay(1000);
  }
```

****

Test Result:

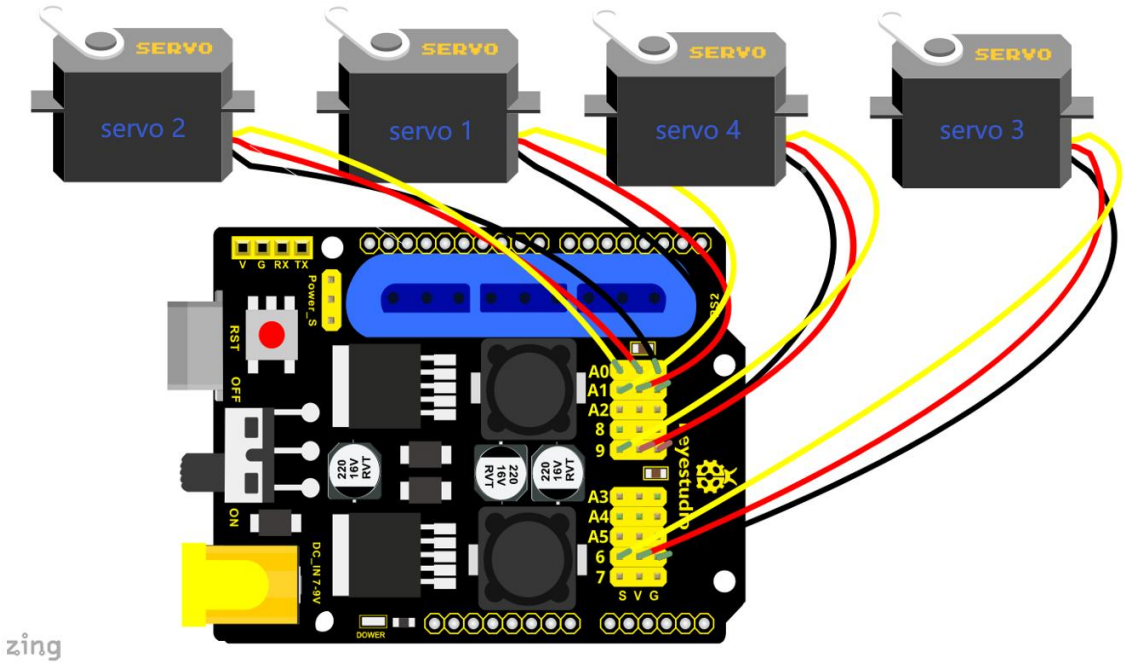
Stack the drive shield onto V4.0 board and connect the servo motor, upload the code, plug in power and press the reset button. Then the servo will automatically rotate to 0°.

❖ Automatic Movement

Description:

In the previous section, you have learned to set the servo angle. In fact, we just need to continually change angles of 4 servo, thus make the 4DOF robot arm operate different motions.

Hookup Guide:



Test Code 2:

```
**********************************************************************************************

#include <Servo.h>

Servo myservo1;   // create servo object to control a servo

Servo myservo2;

Servo myservo3;

Servo myservo4;

int pos1=80, pos2=60, pos3=130, pos4=0;


void setup()

{

  myservo1.attach(A1);   // attaches the servo on pin 9 to the servo object
```

```
    myservo2.attach(A0);
    myservo3.attach(6);
    myservo4.attach(9);

    myservo1.write(pos1);
    delay(1000);
    myservo2.write(pos2);
    myservo3.write(pos3);
    myservo4.write(pos4);
    delay(1500);
}

void loop()
{
    // turn right
    for(pos1;pos1>0;pos1--)
    {
        myservo1.write(pos1);
        delay(5);          // delay 5ms（used to adjust the servo speed）
    }
    delay(1000);
```

```
 // open the claw
for(pos4;pos4<100;pos4++)
{
   myservo4.write(pos4);
}
 delay(1000);

 // right servo rotates to 100 degrees
 for(pos2;pos2>50;pos2--)
 {
    myservo2.write(pos2);
    delay(5);
 }
 // left servo rotates to 5 degrees
 for(pos3;pos3>50;pos3--)
 {
    myservo3.write(pos3);
    delay(5);
 }
 delay(1500);

 // close the claw
```

```
for(pos4;pos4>0;pos4--)
{
   myservo4.write(pos4);
}
delay(1000);

// left servo rotates to100 degrees, rocker arm lifts.
for(pos3;pos3<120;pos3++)
{
   myservo3.write(pos3);
   delay(5);
}
delay(1000);

// turn to left
for(pos1;pos1<180;pos1++)
{
   myservo1.write(pos1);
   delay(5);
}
delay(1000);
```

```
// Lower the arm
for(pos3;pos3>50;pos3--)
{
   myservo3.write(pos3);
   delay(5);
}
delay(1000);

// open the claw
for(pos4;pos4<100;pos4++)
{
   myservo4.write(pos4);
}
delay(1000);

// lift up the arm
for(pos3;pos3<120;pos3++)
{
   myservo3.write(pos3);
   delay(5);
}
delay(1000);
```

```
  // close the claw
  for(pos4;pos4>0;pos4--)
  {
    myservo4.write(pos4);
  }
  delay(1000);
}
```

****

Test Result:

Stack the driver shield onto V4.0 board and connect the servo motor, upload well the code., plug in power and press the reset button. Then the robot arm will rotate to right, stretch out the arm, lower and enable claw; then it will withdraw, lift, , rotate to left, stretch out, lower and make claw open.
This series of actions will be continuous.

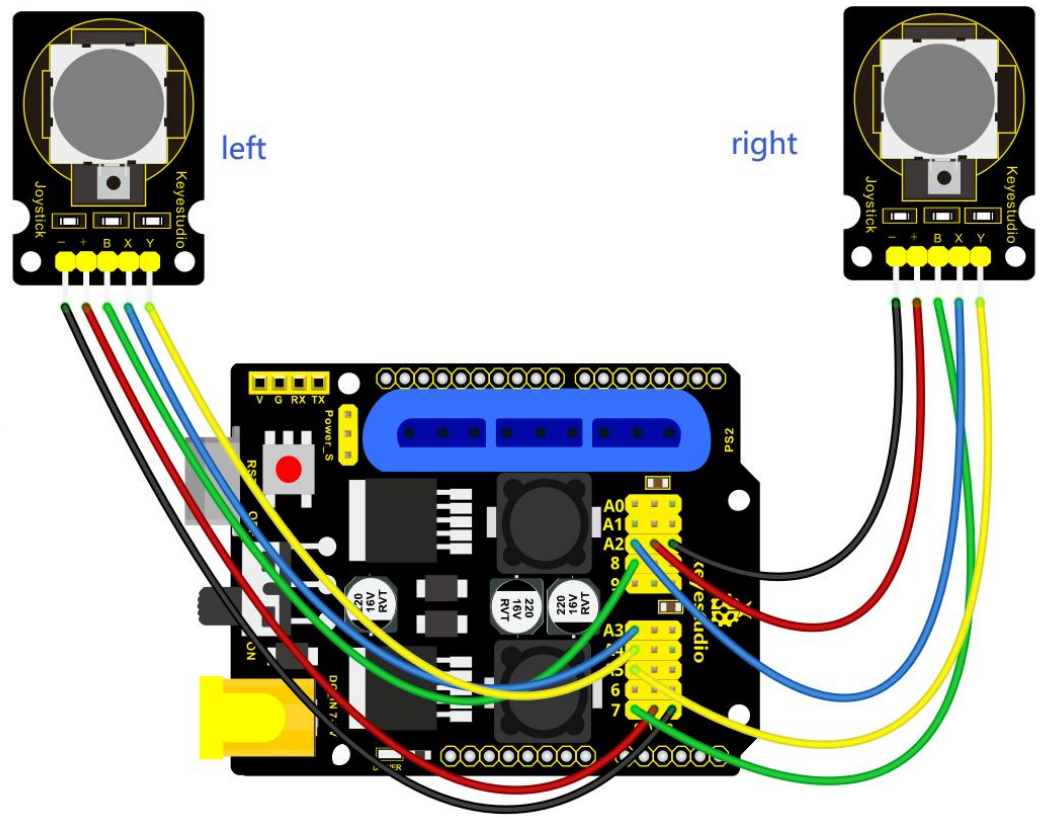
3.2 Read the Joystick Value

Description:

The sensor’ s pin X, Y are for analog sensor, so directly read the measured analog value. Pin Z is a digital button, first should

set the pin to Input status and then read the measured value 1 (pressed down) or 0 (not press). Check out the value printed on the serial monitor.

Connection Diagram:



Test Code 3:

```
**********************************************************************************

const int right_X = A2; // define the right X pin to A2

const int right_Y = A5; // define the right Y pin to A5

const int right_key = 7; //define the right key pin to 7  (that is the value Z)
```

```
const int left_X = A3; //define the left X pin to A3
const int left_Y = A4;   // define the left Y pin to A4
const int left_key = 8; //define the left key pin to 8（that is the value Z）

void setup()
{
  pinMode(right_key, INPUT);     // set the right/left key to INPUT
  pinMode(left_key, INPUT);
  Serial.begin(9600); //    set the baud rate to 9600
}

void loop()
{
  int x1,y1,z1;   // define the variable, used to save the joystick value it reads
  int x2,y2,z2;

  x1 = analogRead(right_X); // read the value of right X
  y1 = analogRead(right_Y);   // read the value of right Y
  z1 = digitalRead(right_key);   //// read the value of right Z

  x2 = analogRead(left_X);   // read the value of left X
  y2 = analogRead(left_Y);   // read the value of left Y
```

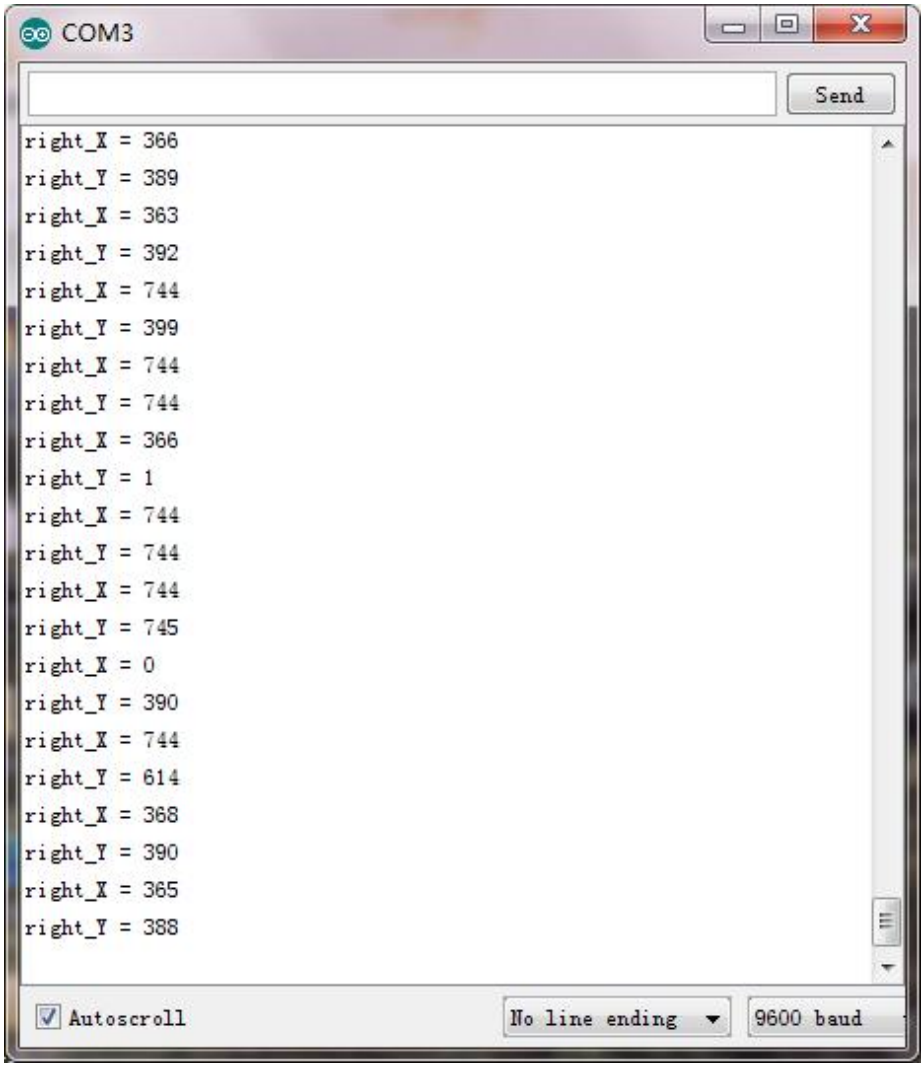
```
  z2 = digitalRead(left_key);    // read the value of left Z


  Serial.print("right_X = "); // on the serial monitor, print out right_X =
  Serial.println(x1 ,DEC);    // print out the value of right X and line wrap
  Serial.print("right_Y = ");
  Serial.println(y1 ,DEC);
  //Serial.print("right_key = ");
  //Serial.println(z1 ,DEC);
 // Serial.println("**********right**********");
  /*Serial.print("left_X = ");
  Serial.println(x2 ,DEC);
  Serial.print("left_Y = ");
  Serial.println(y2 ,DEC);
  Serial.print("left_key = ");
  Serial.println(z2 ,DEC);
  Serial.println("*********left***********");*/
  delay(200);
}
```

****

Test Result:

Hook it up and upload well the code. Connect the V4.0 to computer using a USB cable, then open the serial monitor and

set the baud rate to 9600, you should see the analog value of the right Joystick pin X,Y.



3.3 Dual-Joystick Control

Description:

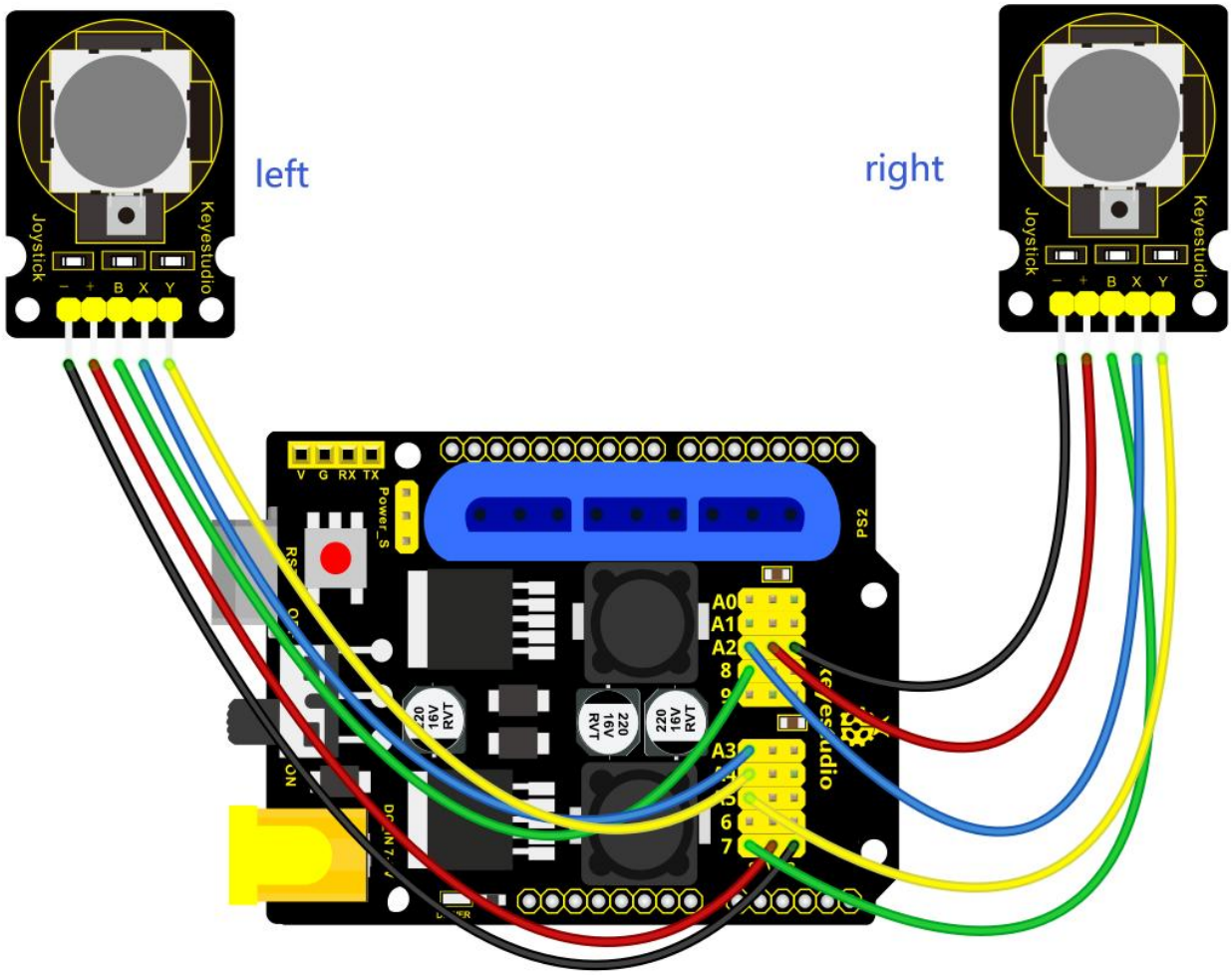
In the previous section, we have introduced how to use 4 Servo to control the robot arm. Next, combine those two experiments. Use two Joystick modules to control 4DOF robot arm realize different motions.

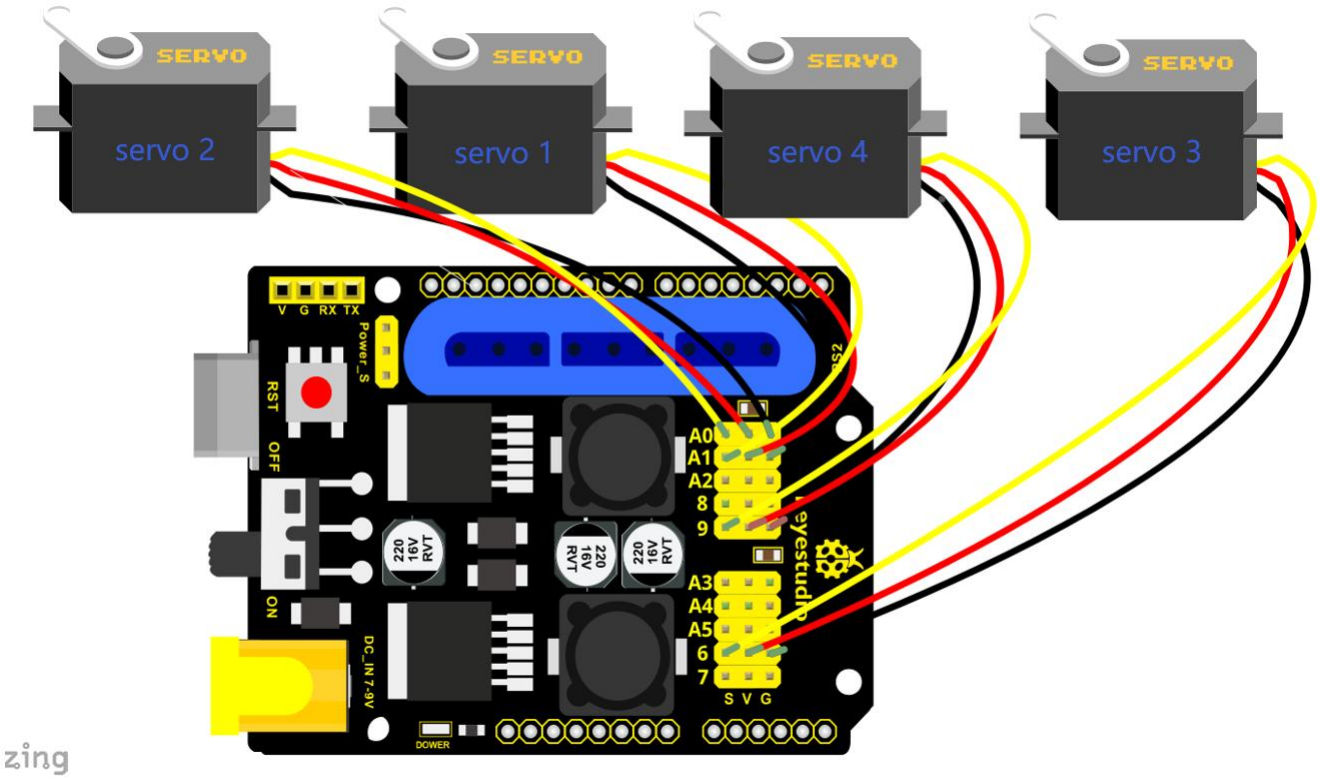
At first, set the boot posture. The Joystick control is shown as below table.

Right Joystick	Servo	Left Joystick	Servo
X1<50	Servo 1 gradually reduces to 0° (push the right joystick to the right, the servo that controls the arm rotation turns right, and stops at 0°)	X2<50	Servo 4 gradually reduces to 0° (push the left joystick to the right, the claw is closed)

X1>1000	Servo 1 gradually increases to 180° (push the right joystick to the left, the servo that controls the arm rotation turns left, and stops at 180°)	X2>1000	Servo 4 gradually increases to 180° (push the left joystick to the left, the claw opens)
Y1>1000	Servo 2 gradually reduces to 0° (that is, lift up the robot upper arm)	Y2>1000	Servo 3 gradually reduces to 35° (that is, stretch out the robot lower arm)
Y1<50	Servo 2 gradually reduces to 180 ° (that is, lower the robot upper arm)	Y2<50	Servo 3 gradually increases to 180° (that is, draw back the robot lower arm)

Hookup Guide:


left
right
Joystick
Keyestudio
B X Y
V G RX TX
Power_S
PS2
A0
A1
A2
A3



Test Code 4:

```
**********************************************************************************************************

 #include <Servo.h>    // add the servo libraries

 Servo myservo1;    // create servo object to control a servo

 Servo myservo2;

 Servo myservo3;

 Servo myservo4;


 int pos1=80, pos2=60, pos3=130, pos4=0;    // define the variable of 4 servo angle,and assign the
```

initial value (that is the boot posture angle value)

```
const int right_X = A2; // define the right X pin to A2
const int right_Y = A5; // define the right Y pin to A5
const int right_key = 7; // define the right key pin to 7  (that is the value of Z)

const int left_X = A3; // define the left X pin to A3
const int left_Y = A4;   // define the left X pin to A4
const int left_key = 8; //define the left key pin to 8  (that is the value of Z)

int x1,y1,z1;   // define the variable, used to save the joystick value it read.
int x2,y2,z2;



void setup()
{

  // boot posture
  myservo1.write(pos1);
  delay(1000);
  myservo2.write(pos2);
  myservo3.write(pos3);
```

```
    myservo4.write(pos4);
    delay(1500);

    pinMode(right_key, INPUT);     // set the right/left key to INPUT
    pinMode(left_key, INPUT);
    Serial.begin(9600); //    set the baud rate to 9600
}

void loop()
{
    myservo1.attach(A1);    // set the control pin of servo 1 to A1
    myservo2.attach(A0);    // set the control pin of servo 2 to A0
    myservo3.attach(6);     //set the control pin of servo 3 to D6
    myservo4.attach(9);     // set the control pin of servo 4 to D9

    x1 = analogRead(right_X); //read the right X value
    y1 = analogRead(right_Y);    // read the right Y value
    z1 = digitalRead(right_key);    //// read the right Z value

    x2 = analogRead(left_X);    //read the left X value
    y2 = analogRead(left_Y);    //read the left Y value
    z2 = digitalRead(left_key);    // read the left Z value
```

```
    //delay(5);    // lower the speed overall


    // claw
    zhuazi();
    // rotate
    zhuandong();
    // upper arm
    xiaobi();
    //lower arm
    dabi();
}


//claw
void zhuazi()
{
      //claw
    if(x2<50) // if push the left joystick to the right
    {
        pos4=pos4-2;    //current angle of servo 4 subtracts 2  (change the value you subtract, thus
change the closed speed of claw)
        //Serial.println(pos4);
        myservo4.write(pos4);    // servo 4 operates the action, claw is gradually closed.
```

```
        delay(5);
        if(pos4<2)    // if pos4 value subtracts to 2, the claw in 37 degrees we have tested is closed.
        {                  //  (should change the value based on the fact)
           pos4=2;     // stop subtraction when reduce to 2
        }
     }
   if(x2>1000) //// if push the left joystick to the left
   {
        pos4=pos4+8; // current angle of servo 4 plus 8  (change the value you plus, thus change
the open speed of claw)
        //Serial.println(pos4);
        myservo4.write(pos4); // servo 4 operates the motion, the claw gradually opens.
        delay(5);
        if(pos4>108)    // limit the largest angle when open the claw
        {
           pos4=108;
        }
   }
}
//*****************************************************
 // turn
void zhuandong()
```

```
{
  if(x1<50)  // if push the right joystick to the right
  {
    pos1=pos1-1;  //pos1 subtracts 1
    myservo1.write(pos1);  // servo 1 operates the motion, the arm turns right.
    delay(5);
    if(pos1<1)    // limit the angle when turn right
    {
      pos1=1;
    }
  }
  if(x1>1000)  // if push the right joystick to the let
  {
    pos1=pos1+1;  //pos1 plus 1
    myservo1.write(pos1);  // arm turns left
    delay(5);
    if(pos1>180)  // limit the angle when turn left
    {
      pos1=180;
    }
  }
}
```

```
//*********************************************************/
//upper arm
void xiaobi()
{
    if(y1>1000) // if push the right joystick upward
  {
    pos2=pos2-1;
    myservo2.write(pos2); // the upper arm will lift
    delay(5);
    if(pos2<0)   // limit the lifting angle
    {
      pos2=0;
    }
  }
  if(y1<50)   // if push the right joystick downward
  {
    pos2=pos2+1;
    myservo2.write(pos2);   // upper arm will go down
    delay(5);
    if(pos2>180)   // limit the angle when go down
    {
```

```
        pos2=180;
      }
    }
}

//*************************************************************/
// lower arm
void dabi()
{
    if(y2<50)   // if push the left joystick upward
  {
    pos3=pos3+1;
    myservo3.write(pos3);   // lower arm will stretch out
    delay(5);
    if(pos3>180)     // limit the stretched angle
    {
      pos3=180;
    }
  }
  if(y2>1000)   // if push the left joystick downward
  {
    pos3=pos3-1;
```

```
        myservo3.write(pos3);   // lower arm will draw back
        delay(5);
        if(pos3<35)   // limit the retracted angle
        {
          pos3=35;
        }
      }
  }
  ********************************************************************************************************
```

Test Result:

Upload the code to main board and stack the shield onto it and wire them up, then 4DOF robot arm will keep the initial position. You can control the robot arm with Joysticks

3.4 Add Memory Function

❖ Memorize One Posture

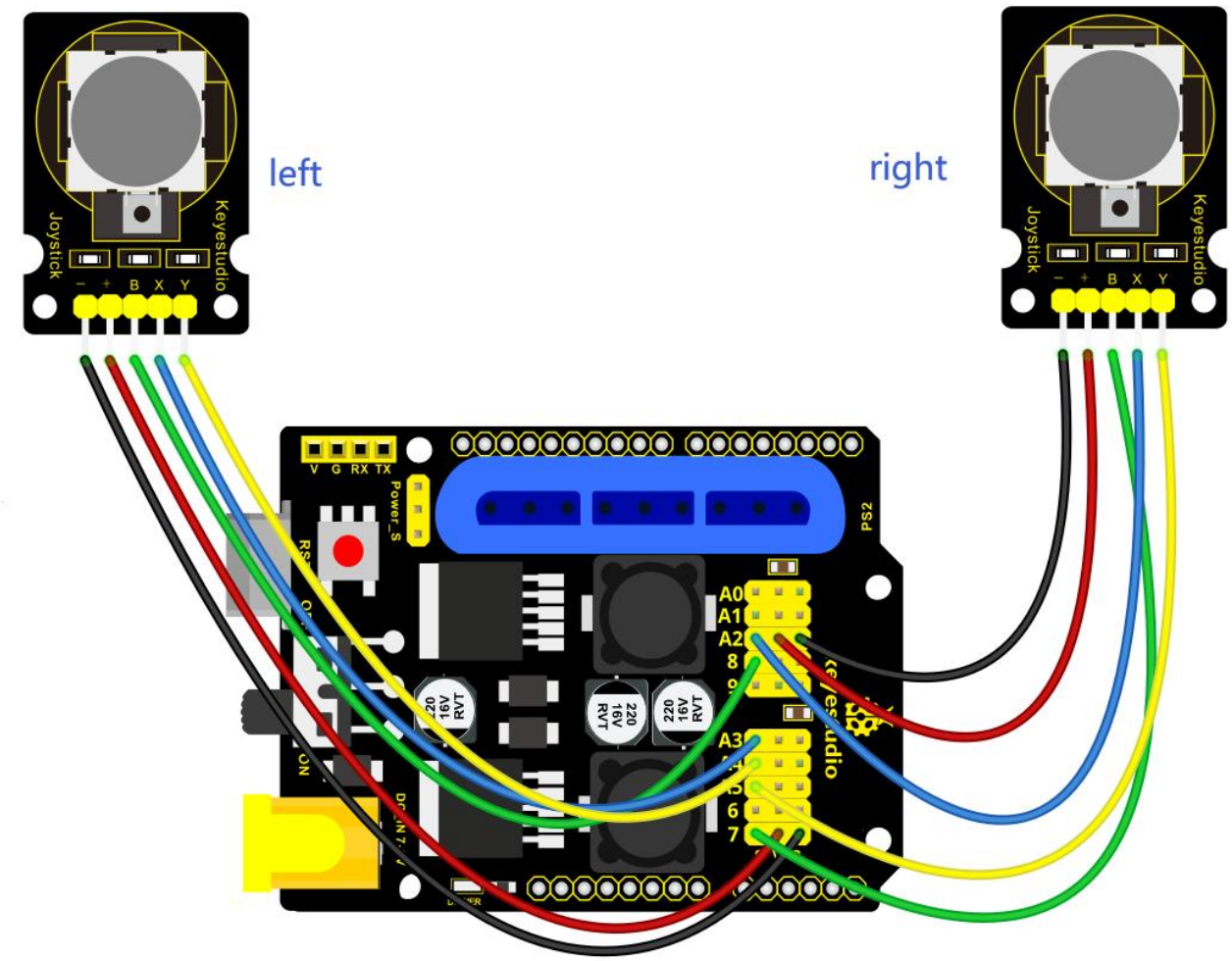
Description:

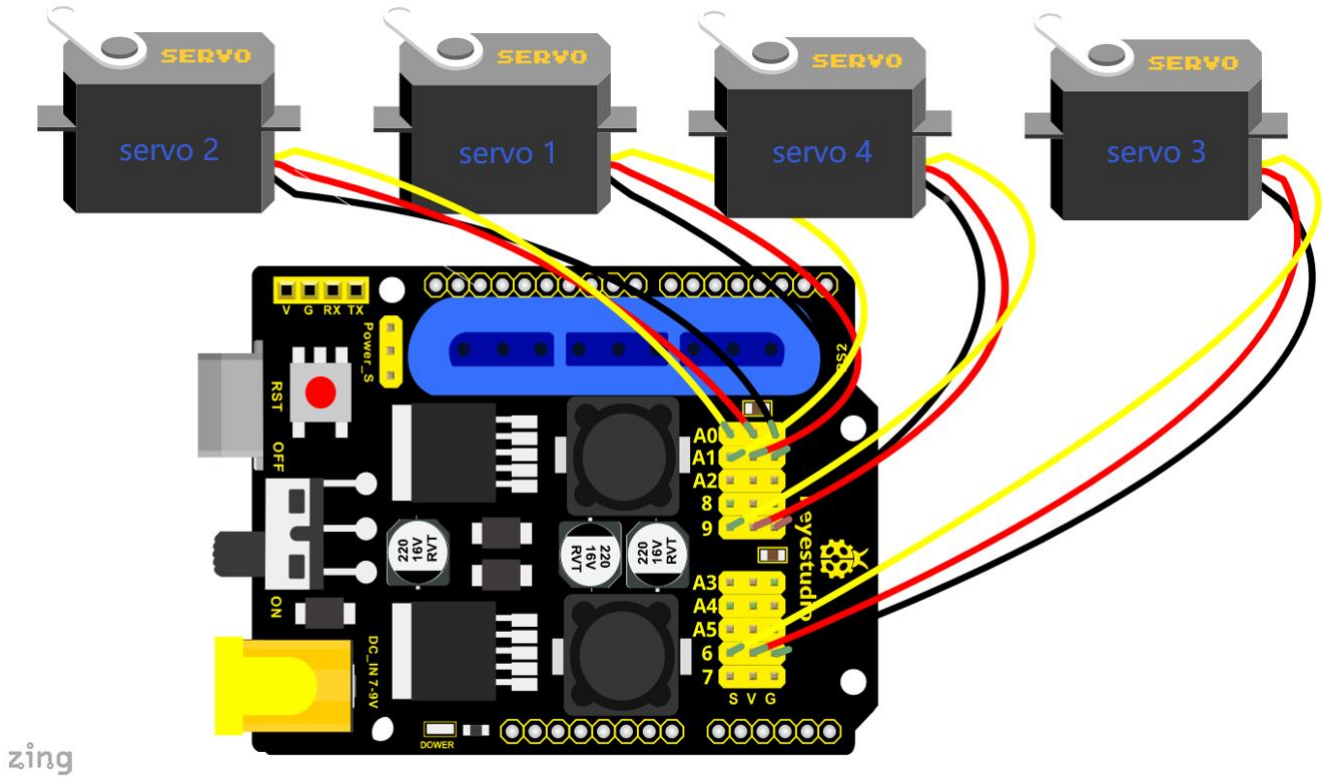
In the previous section, use the analog value of pin X,Y of 2 Joystick modules to control the robot arm.

In the following experiment, we add a memory function for the robot arm,

making it remember a posture then operate. Set 4 variables for saving the angle value of 4 servos, use the Joystick to control a posture. Press the key Z1 of right Joystick to save the angle value of 4 servos; press the key Z2 of left Joystick to make the servo operate a posture saved in the variable.

Connection Diagram





Test Code 5:

****

```
#include <Servo.h>    // add servo libraries

Servo myservo1;    // create servo object to control a servo

Servo myservo2;

Servo myservo3;

Servo myservo4;

int pos1=80, pos2=60, pos3=130, pos4=0;    // define the variable of 4 servo angle and assign the

initial value( that is the boot posture angle value)


const int right_X = A2; // define the right X pin to A2
```

```
const int right_Y = A5; // define the right Y pin to A3

const int right_key = 7; // define the right key pin to 7  (that is Z value)


const int left_X = A3; // define the left X pin to A3

const int left_Y = A4;   // define the left Y pin to A4

const int left_key = 8; // define the left key pin to 8  (that is Z value)


int x1,y1,z1;   // define the variable, used to save the joystick value.

int x2,y2,z2;

int s1,s2,s3,s4;


void setup()

{

  // boot posture

  myservo1.write(pos1);

  delay(1000);

  myservo2.write(pos2);

  myservo3.write(pos3);

  myservo4.write(pos4);

  delay(1500);
```

```
    pinMode(right_key, INPUT);     // set the right/left key to INPUT
    pinMode(left_key, INPUT);
    Serial.begin(9600); //    set the baud rate to 9600
}

void loop()
{
    myservo1.attach(A1);    // set the control pin of servo 1 to A1
    myservo2.attach(A0);    // set the control pin of servo 2 to A0
    myservo3.attach(6);     //set the control pin of servo 3 to D6
    myservo4.attach(9);     //set the control pin of servo 4 to D9

    x1 = analogRead(right_X); // read the right X value
    y1 = analogRead(right_Y);    // read the right Y value
    z1 = digitalRead(right_key);    //// read the right key Z value

    x2 = analogRead(left_X);    // read the left X value
    y2 = analogRead(left_Y);    //read the left Y value
    z2 = digitalRead(left_key);    //read the left key Z value
    //delay(5);    // reduce the speed overall
    if(z1==1)    // if the right joystick key is pressed
    {
```

```
    delay(10);   // delay for eliminating shake
    if(z1==1)      // judge again if the right key is pressed
    {
      s1=myservo1.read();   // read the angle value of each servo
      s2=myservo2.read();
      s3=myservo3.read();
      s4=myservo4.read();
    }
}
if(z2==1) // if the left key is pressed
{
    delay(10);
    if(z2==1)
    {
        pos1=myservo1.read();   // record the angle value of 4 servos in current posture
        pos2=myservo2.read();
        pos3=myservo3.read();
        pos4=myservo4.read();

        if(pos1<s1)   // if angle of servo 1 is smaller than variable s1 value
        {
```

```
            while(pos1<s1)   //while loop，rotate the servo to the position of the value stored in
the array.
              {
                myservo1.write(pos1); // servo 1 operates the motion
                pos1++;   //pos1 plus 1
                delay(5);   // delay for 5ms，controlling the rotation speed of servo.
              }


          }
          else   // if angle of servo 1 is greater than the value stored in array 1.
          {
            while(pos1>s1)       //while loop,rotate the servo to the position of the value stored in
the array.
              {
                myservo1.write(pos1);   //   servo 1 operates the motion
                pos1--;       //pos1 subtracts 1
                delay(5);    // delay for 5ms，controlling the rotation speed of servo.
              }
          }
        //************************************************
        // the explanation is the same as servo 1
          if(pos2<s2)
```

```
    {
      while(pos2<s2)
      {
        myservo2.write(pos2);
        pos2++;
        delay(5);
      }
    }
    else
    {
      while(pos2>s2)
      {
        myservo2.write(pos2);
        pos2--;
        delay(5);
      }
    }
//*************************************************
  // the explanation is the same as servo 1
    if(pos3<s3)
    {
      while(pos3<s3)
```

```
    {
      myservo3.write(pos3);
      pos3++;
      delay(5);
    }
  }
  else
  {
    while(pos3>s3)
    {
      myservo3.write(pos3);
      pos3--;
      delay(5);
    }
  }
//*************************************************
// the explanation is the same as servo 1
  if(pos4<s4)
  {
    while(pos4<s4)
    {
      myservo4.write(pos4);
```

```
            pos4++;
            delay(5);
          }
        }
        else
        {
          while(pos4>s4)
          {
            myservo4.write(pos4);
            pos4--;
            delay(5);
          }
        }

    }
}

//claw
zhuazi();
//turn
zhuandong();
// upper arm
```

```
    xiaobi();
    // lower arm
    dabi();
}



//claw
void zhuazi()
{
      //claw
    if(x2<50) // if push the left joystick to the right
    {
        pos4=pos4-2;    // current angle of servo 4 subtracts 2  (change the value you subtract, thus
change the closed speed of claw)
        //Serial.println(pos4);
        myservo4.write(pos4);    //servo 4 operates the action, claw is gradually closed
        delay(5);
        if(pos4<2)    // if pos4 value subtracts to 2, the claw in 37 degrees we have tested is closed.)
        {                  //  (should change the value based on the fact)
          pos4=2;     // stop subtraction when reduce to 2
        }
     }
```

```
    if(x2>1000) //// if push the left joystick to the left
    {
        pos4=pos4+8; // current angle of servo 4 plus 8（change the value you plus, thus change
the open speed of claw）
        //Serial.println(pos4);
        myservo4.write(pos4); //    servo 4 operates the motion, the claw gradually opens.
        delay(5);
        if(pos4>90)    // limit the largest angle when open
        {
           pos4=90;
        }
    }
}
//*******************************************************
 // turn
void zhuandong()
{
    if(x1<50)    // if push the right joystick to the right
    {
       pos1=pos1-1;    //pos1 subtracts 1
       myservo1.write(pos1);    // servo 1 operates the motion, the arm turns right.
       delay(5);
```

```
      if(pos1<1)     //    limit the angle when turn right
      {
         pos1=1;
      }
    }
    if(x1>1000)    // if push the right joystick to the left
    {
      pos1=pos1+1;    //pos1 plus 1
      myservo1.write(pos1);    // robot arm turns left
      delay(5);
      if(pos1>180)    // limit the angle when turn left
      {
         pos1=180;
      }
    }
}

//*************************************************************/
// upper arm
void xiaobi()
{
      if(y1>1000) // if push the right joystick upward
```

```
    {
      pos2=pos2-1;
      myservo2.write(pos2); // the upper arm will lift
      delay(5);
      if(pos2<0)    // limit the lifting angle
      {
        pos2=0;
      }
    }
    if(y1<50)    // if push the right joystick downward
    {
      pos2=pos2+1;
      myservo2.write(pos2);    // the upper arm will go down
      delay(5);
      if(pos2>180)    // limit the angle when go down
      {
        pos2=180;
      }
    }
}

//*************************************************************/
```

```
// lower arm
void dabi()
{
  if(y2>1000)   // if push the left joystick upward
  {
    pos3=pos3-1;
    myservo3.write(pos3);   // the lower arm will stretch out
    delay(5);
    if(pos3<35)   //   limit the stretched angle
    {
      pos3=35;
    }
  }

  if(y2<50)   // if push the left joystick downward
  {
    pos3=pos3+1;
    myservo3.write(pos3);   // the lower arm will draw back
    delay(5);
    if(pos3>180)     // limit the retracted angle
    {
      pos3=180;
```

```
        }
      }
    }
```

****

Test Result:

Stack the shield onto V4.0, wire them up, upload the code, plug in power and press the key Z1 of right Joystick to save the angle value of 4 servos control and press the key Z2 of left Joystick to operate a servo posture saved in the variable.

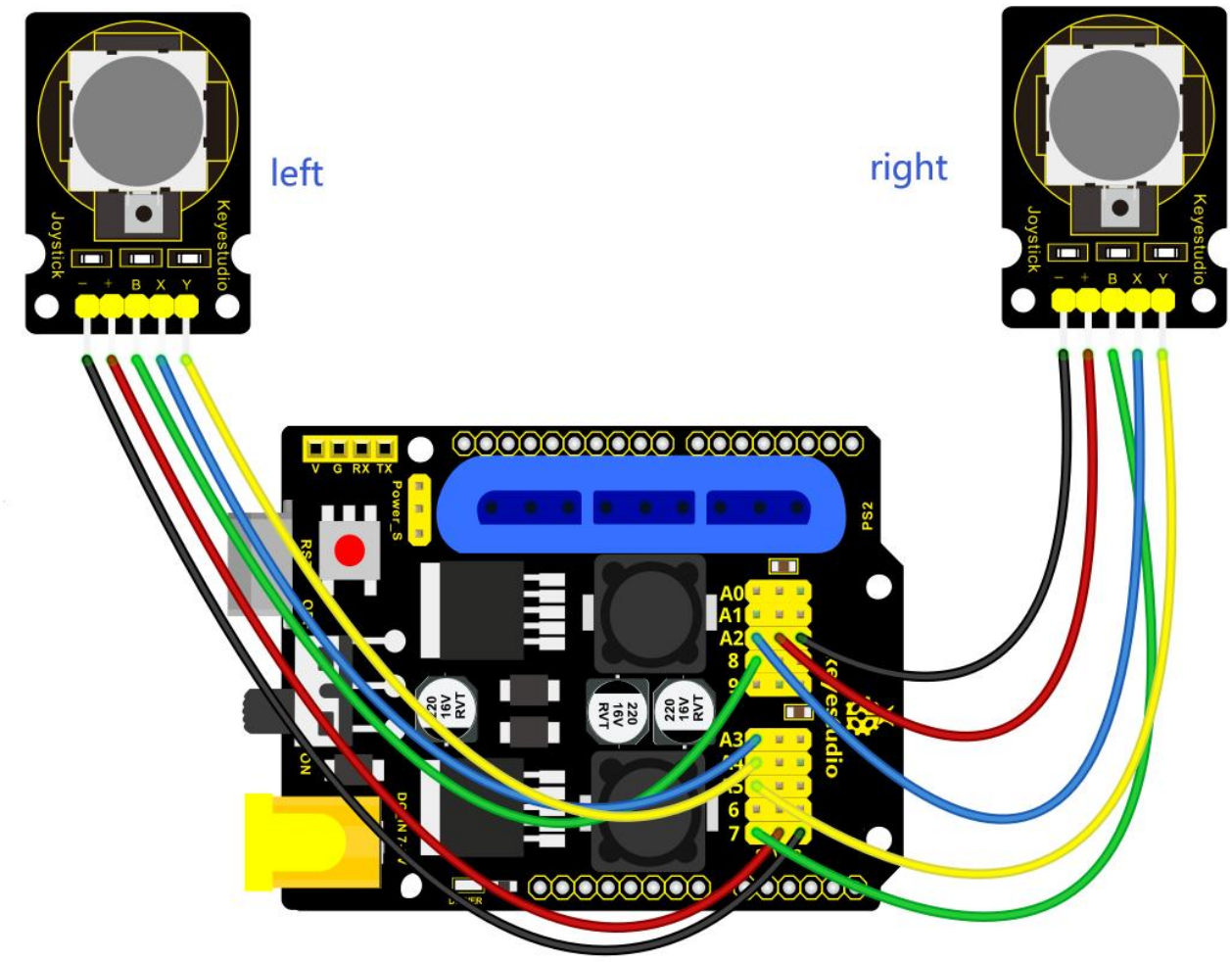
❖ Memorize Multiple Postures

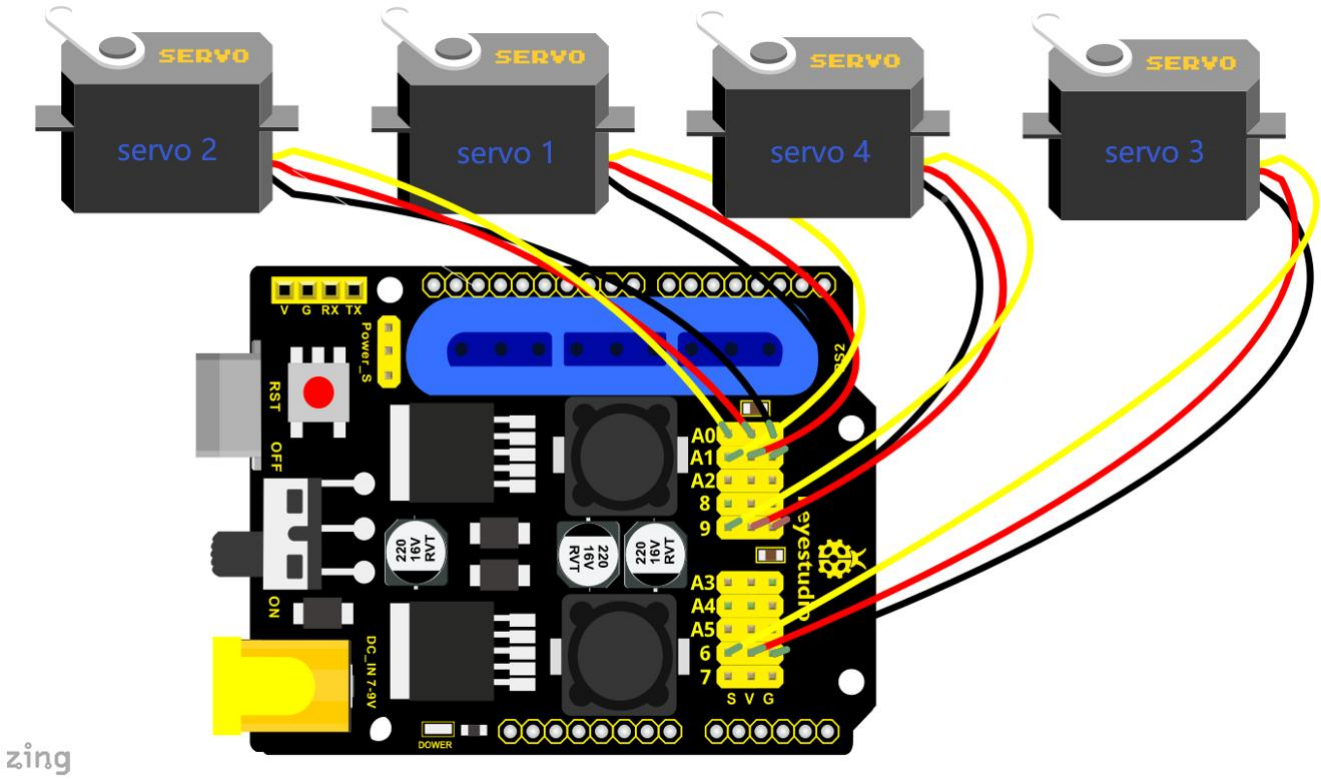
Description:

In the previous section, we have set the angle of 4 servos to make the robot arm remember and operate a posture. To extend the experiment, next make it remember several postures, at most 10 (you can set it in the code), then make 4DOF robot arm continually operate the posture in memory.

That is, make robot arm memorize a group of actions, and you can set the memorizing speed in the code.

Connection Diagram





Test Code 6:

```
#include <Servo.h>    // add the servo libraries

Servo myservo1;    // create servo object to control a servo

Servo myservo2;

Servo myservo3;

Servo myservo4;

int pos1=80, pos2=60, pos3=130, pos4=0;    //    define the variable of 4 servo angle and assign the

initial value( that is the boot posture angle value)


const int right_X = A2; //    define the right X pin to A2
```

```
const int right_Y = A5; // define the right Y pin to A5

const int right_key = 7; // define the right key pin to 7（that is Z value）


const int left_X = A3; //   define the left X pin to A3

const int left_Y = A4;   //   define the left Y pin to A4

const int left_key = 8; // define the left key pin to 8（that is Z value）


int x1,y1,z1;   //define the variable, used to save the joystick value.

int x2,y2,z2;

int s1,s2,s3,s4;

int jiyi1[10];   // define 4 array, separately used to save the angle of four servo.

int jiyi2[10];   //（array length is 10，namely can save angle data of 0~10 servo ）

int jiyi3[10];   // if need to save more data, just change the number 10 to be more larger number.

int jiyi4[10];

int i=0; // for loop

int j=0; // save the last value of i


void setup()

{

  // boot posture

  myservo1.write(pos1);

  delay(1000);
```

```
    myservo2.write(pos2);
    myservo3.write(pos3);
    myservo4.write(pos4);
    delay(1500);



    pinMode(right_key, INPUT);     // set the right/left key to INPUT
    pinMode(left_key, INPUT);
    Serial.begin(9600); //    set baud rate to 9600
}

void loop()
{
    myservo1.attach(A1);    // set the control pin of servo 1 to A1
    myservo2.attach(A0);    // set the control pin of servo 2 to A0
    myservo3.attach(6);     // set the control pin of servo 3 to D6
    myservo4.attach(9);     // set the control pin of servo 4 to D9

    x1 = analogRead(right_X); // read the right X value
    y1 = analogRead(right_Y);    // read the right Y value
    z1 = digitalRead(right_key);    // read the right Z value
```

```
x2 = analogRead(left_X);   // read the left X value
y2 = analogRead(left_Y);   // read the left Y value
z2 = digitalRead(left_key);   // read the left Z value
//delay(5);   // reduce the speed overall
if(z1==1)     // if the right joystick key is pressed
{
   delay(10);     // delay for eliminating shake
   if(z1==1)     // judge again if the right key is pressed
   {
      s1=myservo1.read();       // read the angle value of each servo
      delay(100);
      Serial.println(s1);
      s2=myservo2.read();
      delay(100);
      Serial.println(s2);
      s3=myservo3.read();
      delay(100);
      Serial.println(s3);
      s4=myservo4.read();
      delay(100);
      Serial.println(s4);
```

```
      jiyi1[i]=s1;     // Save the read servo value to the array sequentially
      jiyi2[i]=s2;
      jiyi3[i]=s3;
      jiyi4[i]=s4;
      i++;        //i value plus 1
      j=i;        // assign the last value of i to j
      delay(100);
      Serial.println(i);     // on the serial monitor, print out the value i
    }
}

if(z2==1) // if the left joystick key is pressed
{
   delay(10);
   if(z2==1)     // judge again if the left key is pressed
   {
      i=0;   // assign i to 0，prepare for the next memory
      pos1 = myservo1.read();       // memorize the angle value of 4 servo posture
      pos2 = myservo2.read();
      pos3 = myservo3.read();
      pos4 = myservo4.read();
```

```
for(int k=0;k<j;k++)     // loop for j times, perform all actions saved.
{
  if(pos1<jiyi1[k])      // if the current servo 1 angle is less than the value stored in array 1.
  {
    while(pos1<jiyi1[k])   //while loop, make servo turn to the position of value stored in the
array.
    {
      myservo1.write(pos1);   // servo 1 performs the action
      delay(5);      // delay 5ms，controlling the servo rotating speed
      pos1++;   //pos1 plus 1
      //Serial.println(pos1);
    }
  }
  else      // if the current servo 1 angle is greater than the value stored in array 1.
  {
   while(pos1>jiyi1[k])        //while loop, make servo turn to the position of value stored in
the array.
    {
      myservo1.write(pos1);     // servo 1 performs the action
      delay(5);      //delay 5ms，controlling the servo rotating speed
      pos1--;        //pos1 subtracts 1
      //Serial.println(pos1);
```

```
        }
      }
//*************************************************************
  //the explanation is the same as the previous servo
      if(pos2<jiyi2[k])
      {
        while(pos2<jiyi2[k])
        {
          myservo2.write(pos2);
          delay(5);
          pos2++;
          //Serial.println(pos1);
        }
      }
      else
      {
       while(pos2>jiyi2[k])
        {
          myservo2.write(pos2);
          delay(5);
          pos2--;
          //Serial.println(pos1);
```

```
        }
      }
//*************************************************************
  // the explanation is the same as the previous servo

      if(pos3<jiyi3[k])
      {
        while(pos3<jiyi3[k])
        {
          myservo3.write(pos3);
          delay(5);
          pos3++;
          //Serial.println(pos1);
        }
      }
      else
      {
       while(pos3>jiyi3[k])
        {
          myservo3.write(pos3);
          delay(5);
          pos3--;
```

```
            //Serial.println(pos1);
          }
        }
//*************************************************************
  //the explanation is the same as the previous servo

        if(pos4<jiyi4[k])
        {
          while(pos4<jiyi4[k])
          {
            myservo4.write(pos4);
            delay(5);
            pos4++;
            //Serial.println(pos1);
          }
        }
        else
        {
         while(pos4>jiyi4[k])
          {
            myservo4.write(pos4);
            delay(5);
```

```
                pos4--;
                //Serial.println(pos1);
              }
            }
          }
        }
    }

    //claw
    zhuazi();
    //turn
    zhuandong();
    //upper arm
    xiaobi();
    // lower arm
    dabi();
}



//claw
void zhuazi()
{
```

```
    //claw
  if(x2<50) // if push the left joystick to the right
  {
      pos4=pos4-2;    // angle of servo 4, subtract 2 (change the value you subtract, thus change the closed speed of claw)
      //Serial.println(pos4);
      myservo4.write(pos4);    // servo 4 operates the motion and claw is gradually closed.
      delay(5);
      if(pos4<2)    // if pos4 value subtracts to 2, the claw in 37 degrees we have tested is closed.)
      {                  //  (should change the value based on the fact)
        pos4=2;     // stop subtraction when reduce to 2
      }
   }
  if(x2>1000) //// if push the left joystick to the left
  {
      pos4=pos4+8; // current angle of servo 4 plus 8  (change the value you plus, thus change the open speed of claw)
      //Serial.println(pos4);
      myservo4.write(pos4); //    servo 4 operates the action, claw gradually opens.
      delay(5);
      if(pos4>90)    // limit the largest angle opened
      {
```

```
            pos4=90;
        }
    }
}
//*****************************************************
 // turn
void zhuandong()
{
   if(x1<50)    // if push the right joystick to the right
   {
      pos1=pos1-1;   //pos1 subtracts 1
      myservo1.write(pos1);    // servo 1 operates the motion and robot arm turns right
      delay(5);
      if(pos1<1)     // limit the angle when turn right
      {
         pos1=1;
      }
   }
   if(x1>1000)    // if push the right joystick to the left
   {
      pos1=pos1+1;   //pos1 plus 1
      myservo1.write(pos1);    // robot arm turns left
```

```
      delay(5);
      if(pos1>180)    // limit the angle when turn left
      {
         pos1=180;
      }
   }
}


//*************************************************************/
// upper arm
void xiaobi()
{
      if(y1>1000) // if push the right joystick upward
   {
      pos2=pos2-1;
      myservo2.write(pos2); // the upper arm will lift
      delay(5);
      if(pos2<0)    // limit the lifting angle
      {
         pos2=0;
      }
   }
```

```
  if(y1<50)   // if push the right joystick downward
  {
    pos2=pos2+1;
    myservo2.write(pos2);   // the upper arm will go down
    delay(5);
    if(pos2>180)   // limit the declining angle
    {
      pos2=180;
    }
  }
}

//*************************************************************/
// lower arm
void dabi()
{
  if(y2>1000)   // if push the left joystick upward
  {
    pos3=pos3-1;
    myservo3.write(pos3);   // the lower arm will stretch out
    delay(5);
    if(pos3<35)   // limit the stretched angle
```

```
      {
        pos3=35;
      }
    }

    if(y2<50)    // if push the left joystick downward
    {
      pos3=pos3+1;
      myservo3.write(pos3);    // the lower arm will draw back
      delay(5);
      if(pos3>180)     // limit the retracted angle
      {
        pos3=180;
      }
    }
}
```

****

Test Result:

Wire it up, stack the shield onto V4.0, upload the code. Powered on, press the key Z1 of right Joystick to save the angle value of 4 servos. Press down the key Z1 to memorize different postures, at most 10 postures in the code.

If need to memorize more postures, you can set it in the code. When memorizing successfully, press down the key Z2 of left Joystick to make the robot arm carry out several postures stored successively.

Move the thumbsticks and press the button of right thumbstick, then move them and press the right button again. That indicates that actions of the arm are memorized. Next, you can press the left button to perform actions saved.

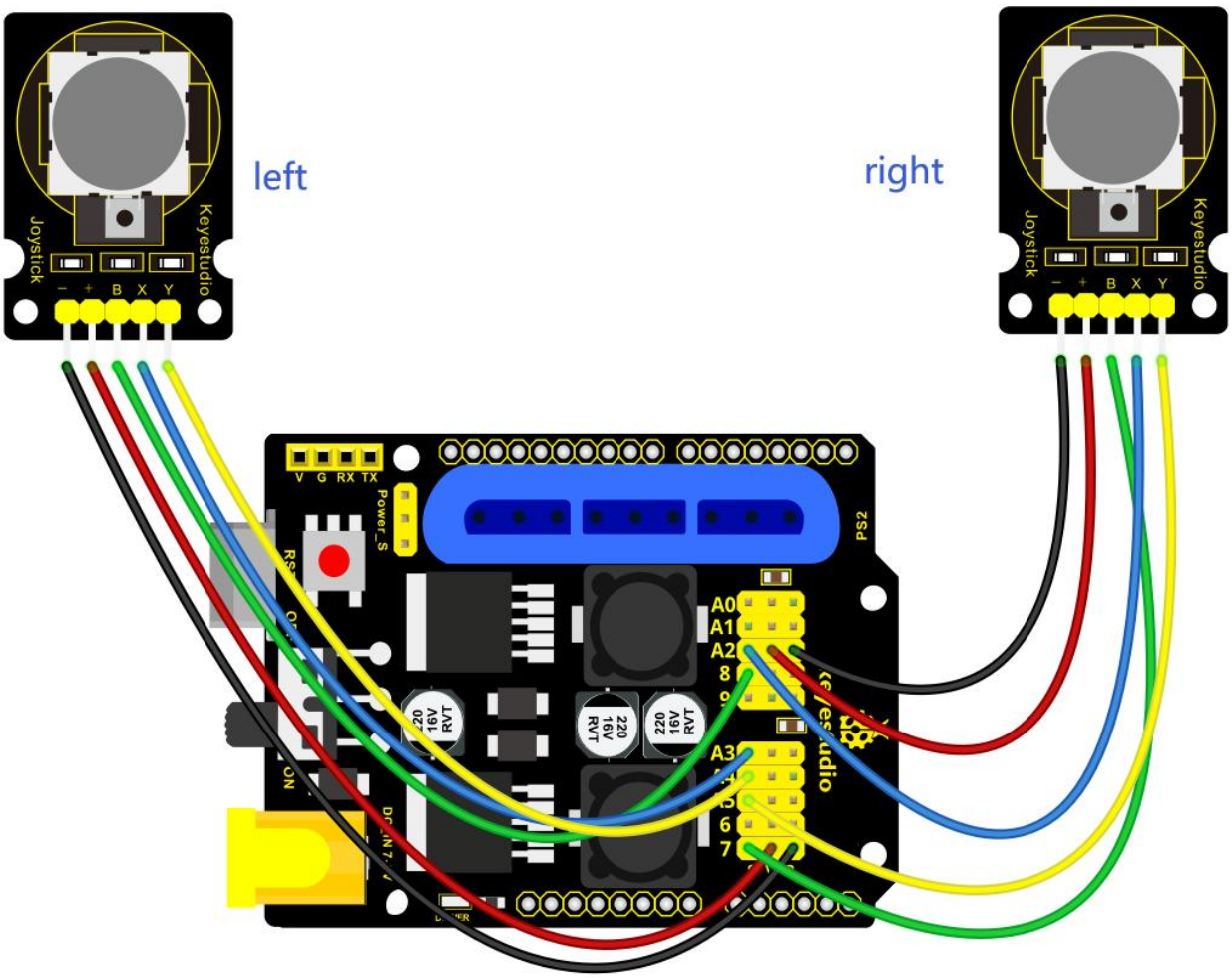
❖ Memorize Several Postures And Loop

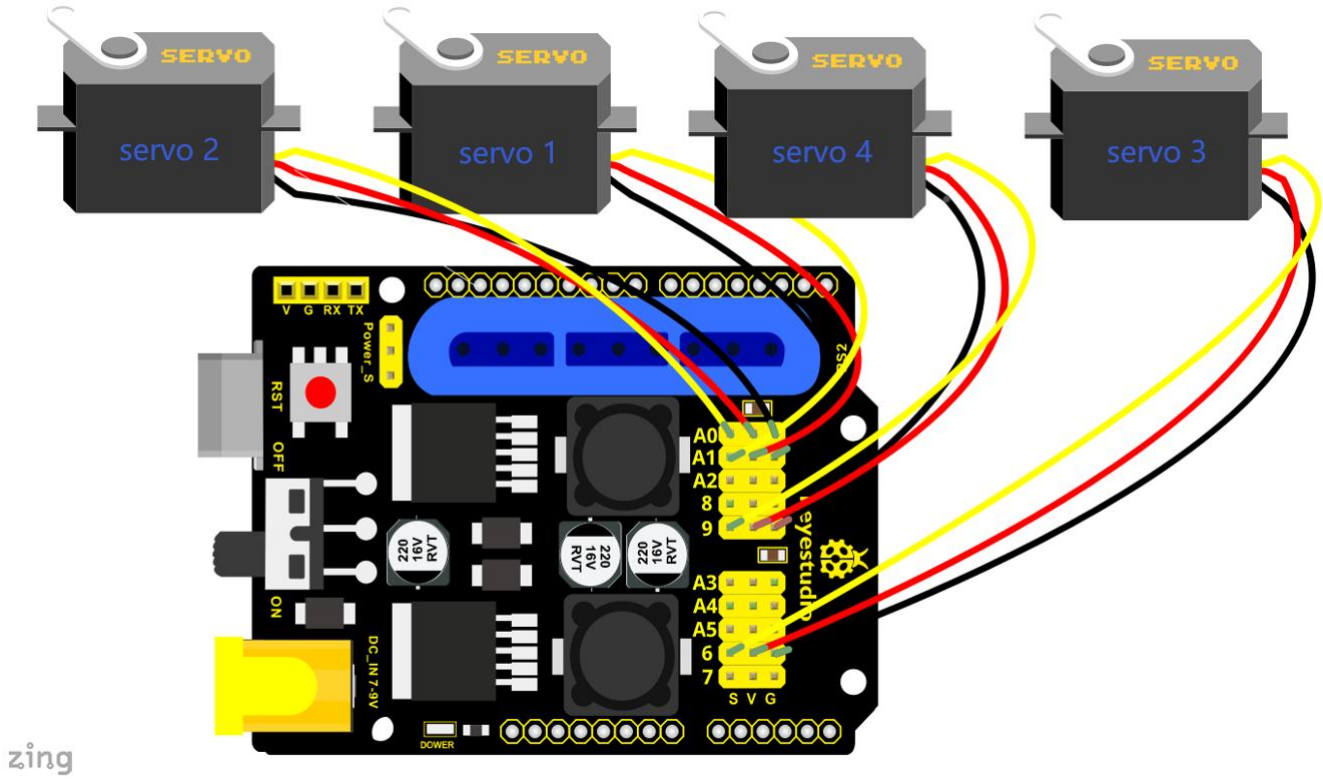
Description:

In the previous section, we have introduced how to make 4DOF robot arm to memorize and perform a group of posture. Furthermore, let' s extend one more loop function. When the robot arm performs all the memorized actions, it will not stop, and continue to repeat those actions.

In the following experiment, press the key Z1, 4DOF robot arm will exit the looping action. Press the key Z1 again, start to memorize the posture, after that, press the key Z2 to loop the memorized actions.

Hookup Guide:


left
right
Joystick
Keyestudio
B X Y
V G RX TX
Power_S
PS2
A0
A1
A2
A3
8
6
7
220
16V
RVT



Test Code 7:

****

```
#include <Servo.h>   //   add the servo libraries
Servo myservo1;   // create servo object to control a servo
Servo myservo2;
Servo myservo3;
Servo myservo4;
int pos1=80, pos2=60, pos3=130, pos4=0;   // define the variable of 4 servo angle and assign the initial value( that is the boot posture angle value)
const int right_X = A2; //   define the right X pin to A2
const int right_Y = A5; //   define the right Y pin to A5
const int right_key = 7; // define the right key pin to 7  (that is Z value)

const int left_X = A3; //define the left X pin to A3
```

```
const int left_Y = A4;   // define the left Y pin to A4
const int left_key = 8; // define the left key pin to 8（that is Z value）

int x1,y1,z1;   // define the variable, used to save the joystick value.
int x2,y2,z2;
int s1,s2,s3,s4;
int jiyi1[20];   //define 4 array, separately used to save the angle of four servo.
int jiyi2[20];   //   （array length is 20，namely can save angle data of 0~20 servo）
int jiyi3[20];   //if need to save more data, just change the number 20 to be more larger number.
int jiyi4[20];
int i=0;   // for loop
int j=0;   //   save the last value of i

void setup()
{
  // boot posture
  myservo1.write(pos1);   //turn servo 1 to 90 degrees
  delay(1000);
  myservo2.write(pos2);   // turn servo 2 to 90 degrees
  myservo3.write(pos3);   // turn servo 3 to 120 degrees
  myservo4.write(pos4);   // turn servo 4 to 35 degrees
  delay(1500);


  pinMode(right_key, INPUT);     // set the right/left key to INOUT
  pinMode(left_key, INPUT);
  Serial.begin(9600);     // set the baud rate to 9600
}
```

```
void loop()
{
  myservo1.attach(A1);   // set the control pin of servo 1 to A1
  myservo2.attach(A0);   // set the control pin of servo 2 to A0
  myservo3.attach(6);    //set the control pin of servo 3 to D6
  myservo4.attach(9);    // set the control pin of servo 4 to D9

  x1 = analogRead(right_X); // read the right X value
  y1 = analogRead(right_Y);   //read the right Y value
  z1 = digitalRead(right_key);   //read the right Z value

  x2 = analogRead(left_X);   //   read the left X value
  y2 = analogRead(left_Y);   // read the left Y value
  z2 = digitalRead(left_key);   // read the left Z value
  //delay(5);   // delay, used to reduce the joystick value read, that is reduce the whole speed.
  if(z1==1)    // if the joystick right key is pressed
  {
    delay(10);   // delay for eliminating shake
    if(z1==1)    // judge again if the right key is pressed
    {
      s1=myservo1.read();   // read the angle value of servo 1 and assign it to s1
      delay(100);
      Serial.println(s1); // print out the angle value of servo 1 on the serial monitor
      s2=myservo2.read();   //   read the angle value of servo 2 and assign it to s2
      delay(100);
      Serial.println(s2);
      s3=myservo3.read();    //   read the angle value of servo 3 and assign it to s3
      delay(100);
      Serial.println(s3);
```

```
      s4=myservo4.read();     // read the angle value of servo 4 and assign it to s4
      delay(100);
      Serial.println(s4);

      jiyi1[i]=s1;   // Save the read servo value to the array sequentially
      jiyi2[i]=s2;
      jiyi3[i]=s3;
      jiyi4[i]=s4;
      i++;     //i plus 1
      j=i;     // assign the last value of i to j
      delay(100);   // delay 100ms
      Serial.println(i);   // print out the value i
    }
}
if(z2==1) //   if the left joystick key is pressed
{
   delay(10);   // delay for eliminating shake
   if(z2==1)     //judge again if the left key is pressed
   {
      pos1 = myservo1.read();   // memorize the angle value of 4 servo posture
      pos2 = myservo2.read();
      pos3 = myservo3.read();
      pos4 = myservo4.read();

      while(z2==1)   // loop, make the arm repeat the action.
      {
         for(int k=1;k<j;k++)   //for loop, perform all the stored actions.
         {
            if(pos1<jiyi1[k])     // if the current servo 1 angle is less than the value stored in array 1.
```

```
        {
          while(pos1<jiyi1[k])    //while loop, make servo turn to the position of value stored in the array.
          {
            myservo1.write(pos1);   //servo 1 performs the action
            delay(5);     //delay 5ms，controlling the servo rotating speed.
            pos1++;     //pos1 plus 1
            //Serial.println(pos1);
          }
        }
        else     //if the current servo 1 angle is greater than the value stored in array 1.
        {
         while(pos1>jiyi1[k])       //while loop, make servo turn to the position of value stored in the array.
          {
            myservo1.write(pos1);   //servo 1 performs the action
            delay(5);     //delay 5ms，controlling the servo rotating speed.
            pos1--;     //pos1 subtracts 1
            //Serial.println(pos1);
          }
        }
  //************************************************************
  //the explanation is the same as the previous servo.
        if(pos2<jiyi2[k])
        {
          while(pos2<jiyi2[k])
          {
            myservo2.write(pos2);
            delay(5);
```

```
            pos2++;
            //Serial.println(pos1);
          }
        }
        else
        {
         while(pos2>jiyi2[k])
          {
            myservo2.write(pos2);
            delay(5);
            pos2--;
            //Serial.println(pos1);
          }
        }
//*****************************************
//the explanation is the same as the previous servo.
        if(pos3<jiyi3[k])
        {
          while(pos3<jiyi3[k])
          {
            myservo3.write(pos3);
            delay(5);
            pos3++;
            //Serial.println(pos1);
          }
        }
        else
        {
         while(pos3>jiyi3[k])
```

```
        {
          myservo3.write(pos3);
          delay(5);
          pos3--;
          //Serial.println(pos1);
        }
      }
//*****************************************
//the explanation is the same as the previous servo.
      if(pos4<jiyi4[k])
      {
        while(pos4<jiyi4[k])
        {
          myservo4.write(pos4);
          delay(5);
          pos4++;
          //Serial.println(pos1);
        }
      }
      else
      {
       while(pos4>jiyi4[k])
        {
          myservo4.write(pos4);
          delay(5);
          pos4--;
          //Serial.println(pos1);
        }
      }
```

```
          }
//*************************************************************
// for exiting the loop
                z1 = digitalRead(right_key);   // read the right Z value
                if(z1==1)   // if the right key is pressed
                {
                  delay(10);   //eliminate the shake
                  if(z1==1)   // if the key z1 is pressed
                  {
                    pos1=jiyi1[(j-1)];   // assign the last angle value saved in array to pos
                    pos2=jiyi2[(j-1)];   // for exiting the loop, still access to joystick control.
                    pos3=jiyi3[(j-1)];
                    pos4=jiyi4[(j-1)];
                    i=0;   // assign i as 0，prepare for saving the angle value using array
                    z2=0; // assign z2 as 0，for exiting the while loop
                    break;   //exit the current loop
                  }
                }
//*************************************************************
        }
      }
    }

    //claw
    zhuazi();
    //turn
    zhuandong();
    //upper arm
    xiaobi();
```

```
  //lower arm
  dabi();
}



//claw
void zhuazi()
{
     //claw
  if(x2<50) // if push the left joystick to the right
  {
       pos4=pos4-2;   // angle of servo 4, subtract 2 (change the value you subtract, thus change the closed speed of claw)
       //Serial.println(pos4);
       myservo4.write(pos4);   //   servo 4 operates the motion and claw is gradually closed.
       delay(5);
       if(pos4<2)   // if pos4 value subtracts to 2, the claw in 37 degrees we have tested is closed.)
       {                  //  (should change the value based on the fact)
          pos4=2;     //stop subtraction when reduce to 2
       }
   }
  if(x2>1000) ////if push the left joystick to the left
  {
       pos4=pos4+8; //current angle of servo 4 plus 8  (change the value you plus, thus change the open speed of claw)
       //Serial.println(pos4);
       myservo4.write(pos4); // servo 4 operates the action, claw gradually opens.
       delay(5);
       if(pos4>90)   //limit the largest angle opened
```

```
        {
          pos4=90;
        }
    }
}
//*****************************************************
 //turn
void zhuandong()
{
   if(x1<50)   //if push the right joystick to the right
   {
      pos1=pos1-1;   //pos1 subtracts 1
      myservo1.write(pos1);   // servo 1 performs the action, the robot arm turns right.
      delay(5);
      if(pos1<1)     // limit the right turning angle
      {
         pos1=1;
      }
   }
   if(x1>1000)   // if push the right joystick to the left
   {
      pos1=pos1+1;   //pos1 plus 1
      myservo1.write(pos1);   //the robot arm turns left.
      delay(5);
      if(pos1>180)   //limit the left turning angle
      {
         pos1=180;
      }
   }
```

```
}

//*********************************************************/
// upper arm
void xiaobi()
{
    if(y1>1000) // if push the right joystick upward
  {
    pos2=pos2-1;
    myservo2.write(pos2); // the robot arm will lift
    delay(5);
    if(pos2<0)   // limit the lifting angle
    {
      pos2=0;
    }
  }
  if(y1<50)   // if push the right joystick downward
  {
    pos2=pos2+1;
    myservo2.write(pos2);   // the robot arm will go down
    delay(5);
    if(pos2>180)   // limit the declining angle
    {
      pos2=180;
    }
  }
}

//*********************************************************/
```

```
// lower arm
void dabi()
{
  if(y2>1000)   // if push the left joystick upward
  {
    pos3=pos3-1;
    myservo3.write(pos3);   // the lower arm will stretch out
    delay(5);
    if(pos3<35)   // limit the stretched angle
    {
      pos3=35;
    }
  }

  if(y2<50)   // if push the right joystick downward
  {
    pos3=pos3+1;
    myservo3.write(pos3);   // the lower arm will draw back
    delay(5);
    if(pos3>180)    // limit the retraction angle
    {
      pos3=180;
    }
  }
}
```

****

Test Result:

Wire it up, stack the shield onto V4.0, upload the code. Powered on, press the key Z1 of right Joystick to save the angle value of 4 servos. Press down the key Z1 to memorize different postures, at most 10 postures in the code. If need to memorize more postures, can set it in the code.

When memorizing successfully, press down the key Z2 of left Joystick to make the robot arm carry out several postures stored successively, looping.

Long press the key Z1, 4DOF robot arm will exit the looping action. Press the key Z1 again, start to memorize the posture, after that, press the key Z2 to loop the memorized actions.

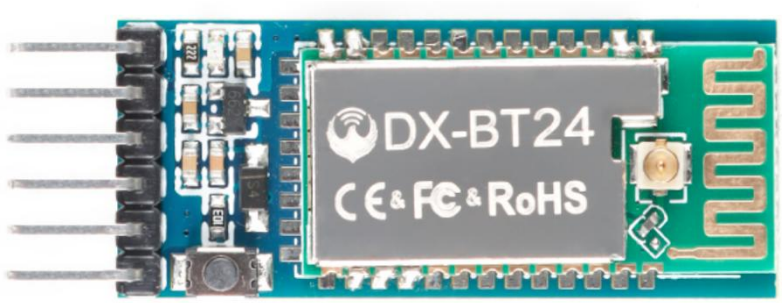
Move the thumbsticks and press the button of right thumbstick, then move them and press the right button again. That indicates that actions of the arm are memorized. Next, you can press the left button to perform actions saved.

Project 4: BT-controlled Robot Arm

✧ Principle of BT Control

Bluetooth technology is a wireless standard technology that can realize short-distance data exchange between fixed equipment, mobile equipment and personal area network (UHF radio waves in the ISM band of 2.4-2.485 GHz). In the kit, we equip with the BT-24 Bluetooth module. BT-24 Bluetooth m odule supports Android and IOS system.

In the experiment, we default the BT-24 Bluetooth module as the slave and the mobile phone as the master.We especially design APP to control robotic arm(Android /IOS system)



Specification

Bluetooth protocol: Bluetooth Specification V5.1 BLE

Working distance: In an open environment, achieve 40m ultra-long distance communication

Operating frequency: 2.4GHz ISM band

Communication interface: UART

Bluetooth certification: in line with FCC CE ROHS REACH certification standards

Serial port parameters: 9600, 8 data bits, 1 stop bit, invalid bit, no flow

control

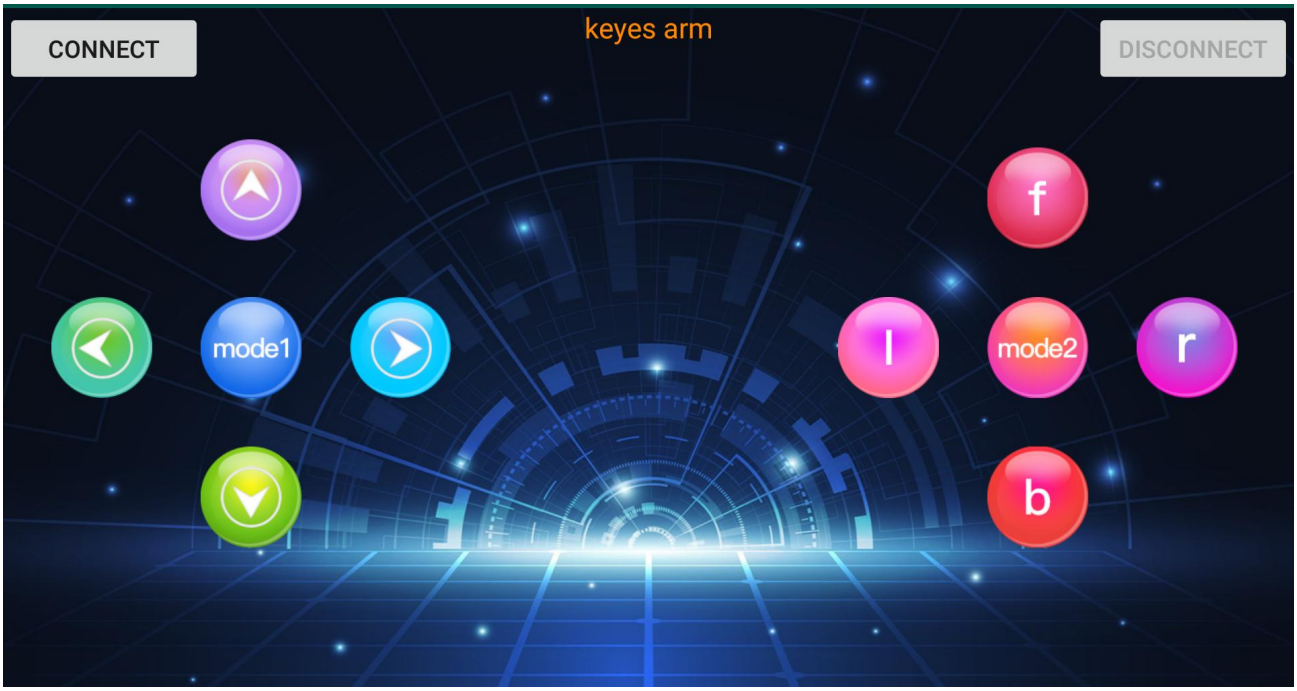
Power: 5V DC

Operating temperature: –10 to +65 degrees Celsius

✧ Bluetooth Control Key Test

Description

Next, we are going to introduce the use method for BT-24 Bluetooth module. To easily use the BT-24 Bluetooth module to control the robot arm, we particularly design the APP control. Shown below.



There are 10 control keys on the App. When connect well the HC-06 Bluetooth module to Android phone using our APP, press the control key, Android phone will receive a corresponding value.
When programming, you can set the function for the corresponding value. So in the experiment, we will test each key to get the corresponding value.

Installation Steps for Android system:

APP for Android mobile:

Enter google play, search "keyes arm".

https://play.google.com/store/apps/details?id=com.keyestudio.keyes_arm_123

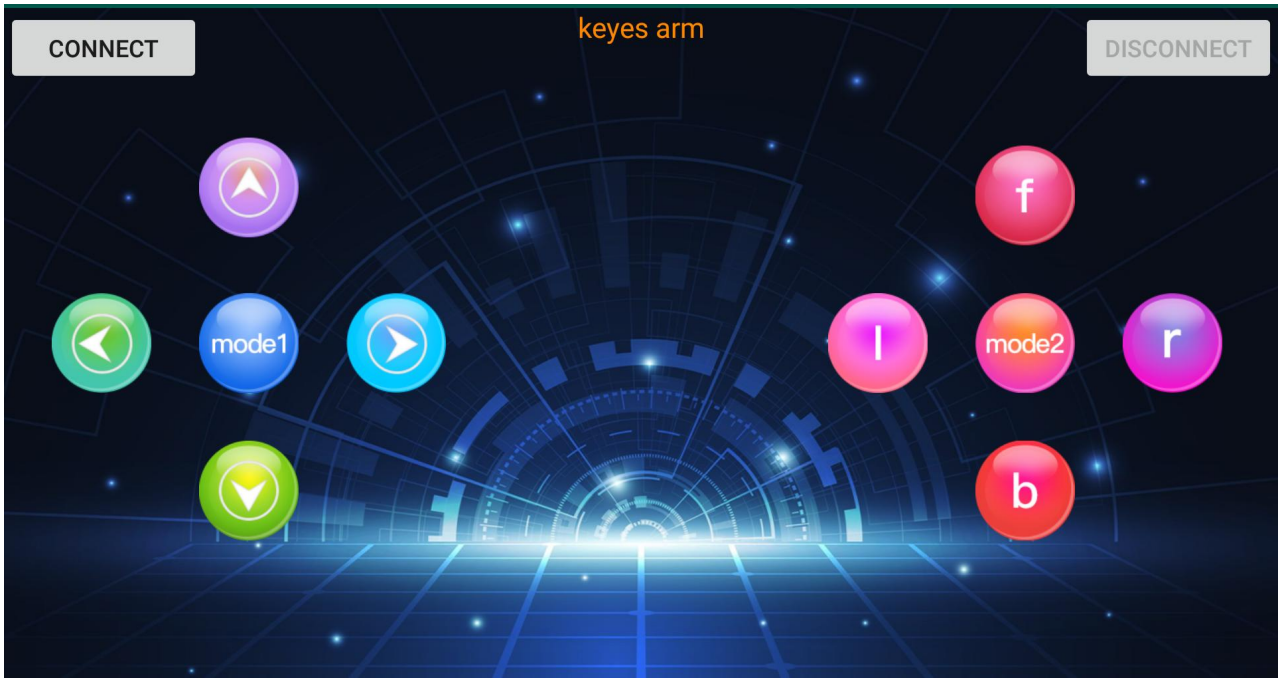
Note: Allow APP to access "location" in settings of your cellphone when connecting to Bluetooth module, otherwise, Bluetooth may not be connected.

This are operating steps as below, the interface for Android and ios system is same.

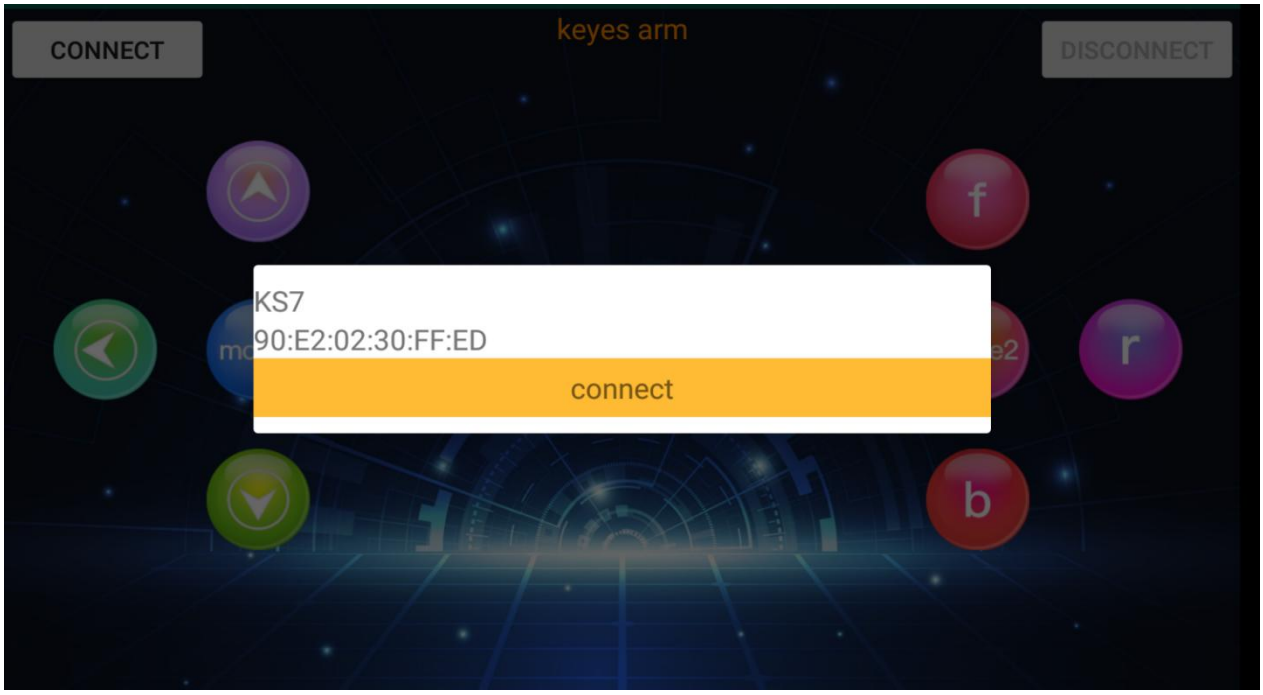
Android System:

1. Download and install 

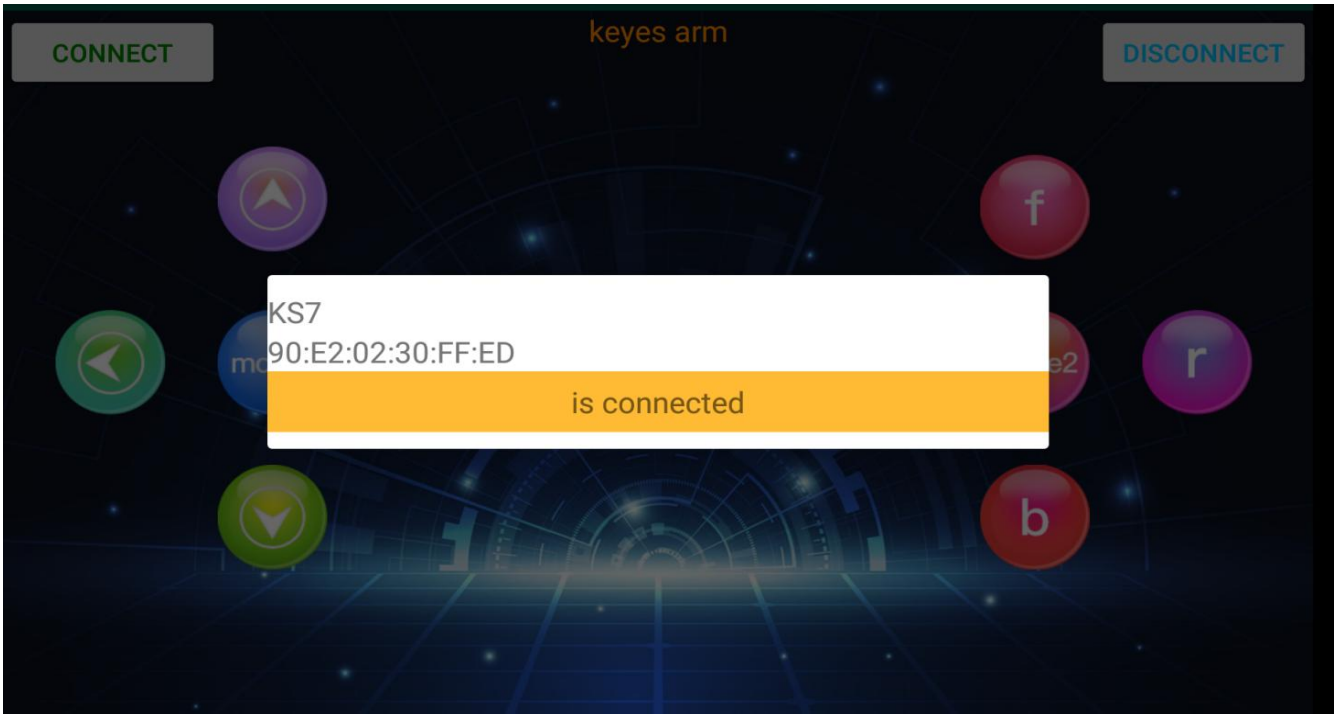
, the interface shown below:



2. Upload code and power on, Led of Bluetooth module blinks. Start Bluetooth and open App to click "CONNECT" to connect.

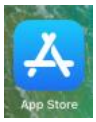


3. Upload code on control board, after power-on, LED blinks on Bluetooth module. Start Bluetooth and open App to click "connect", Bluetooth is connected.

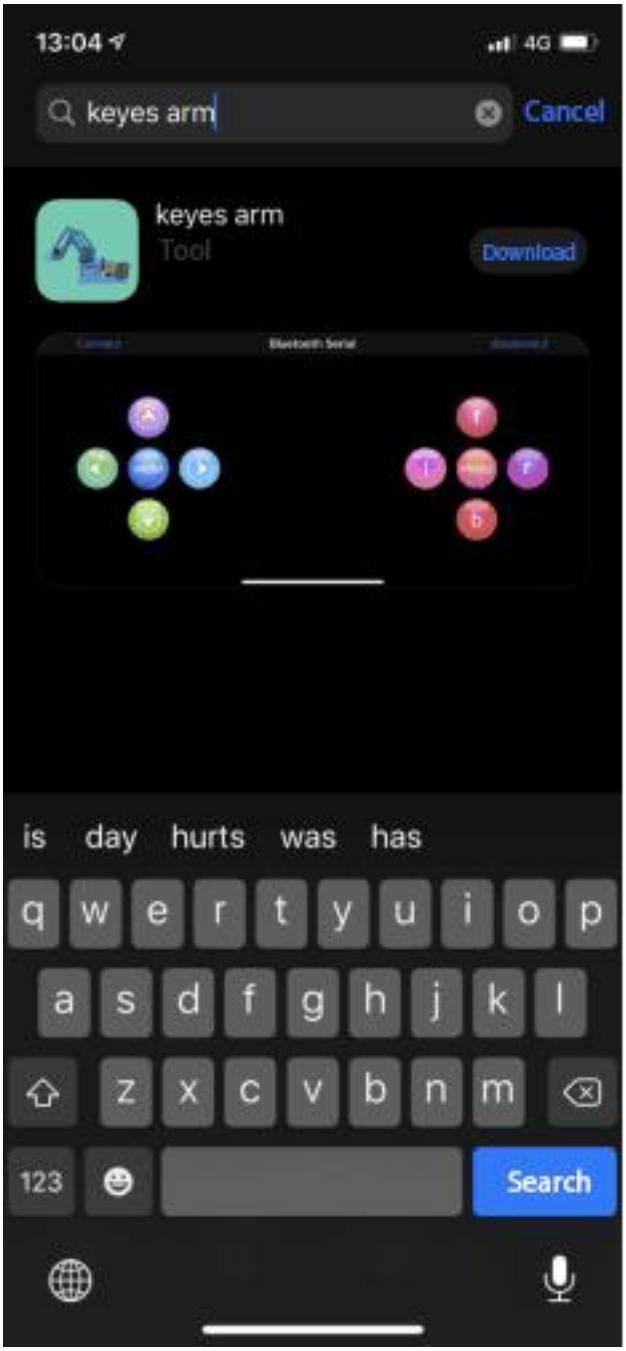


For IOS system:

2. Open App Store

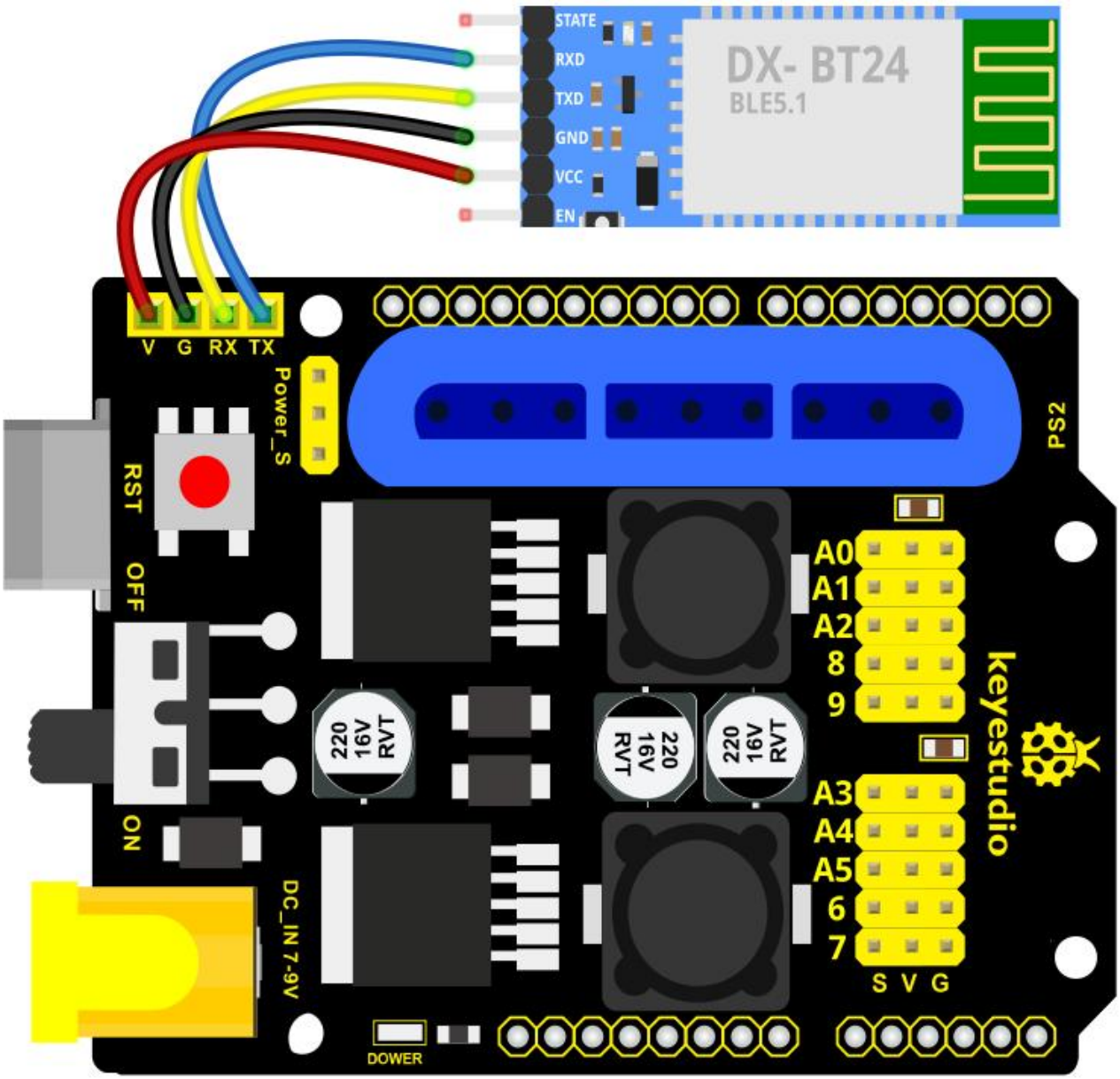


3. Search "keyes arm"on APP Store，then click "downlaod".



Special Note: Remove the Bluetooth module please, when uploading the Test Code. Otherwise, the program will fail to upload. After uploading the Test Code, then connect the Bluetooth and Bluetooth module to pair.

Connection Diagram



Test Code

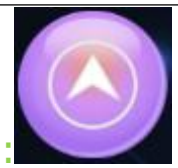
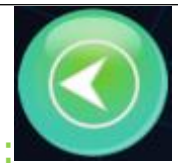
```
void setup()
{
  Serial.begin(9600);        // set the serial baud rate to 9600
```

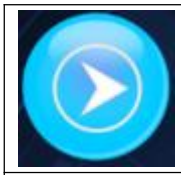
```
}


void loop()
{
  char val;      // define a variable, used to receive the value read from Bluetooth.
  if(Serial.available())       // if receive the value
  {
    val = Serial.read();          // assign the value read to val
    Serial.println(val);
  }
}
```

After connecting Bluetooth module, open serial port monitor to set baud rate to 9600. Press control keys on App, the serial port prints out the corresponding control character. As shown below:

Test Result:

The functions of control keys:

CONNECT	Connect APP to bt-24 Bluetooth module	
DISCONNECT	Turn off Bluetooth	
	Press to send “F” Release to send “S”	Left servo goes front Left servo stops motion
	Press to send “L” Release to send “S”	Clamp claw opens Clamp claw stops
	Mode 1	

	Press to send “R” Release to send “S”	Clamp claw closes Clamp claw stops
	Press to send “B” Release to send “S”	Left Servo draws back Left Servo stops motion
	Press to send “f” Release to send “S”	Right servo stretches out Right servo stops motion
	Press to send “l” Release to send “S”	The base servo turns left Base servo stops
	Mode 2	----------
	Press to send “r” Release to send “S”	Base Servo turns right Base Servo stops
	Press to send “b” Release to send “S”	Right Servo draws back Right Servo stops

✧ Bluetooth Controls the Robotic Arm

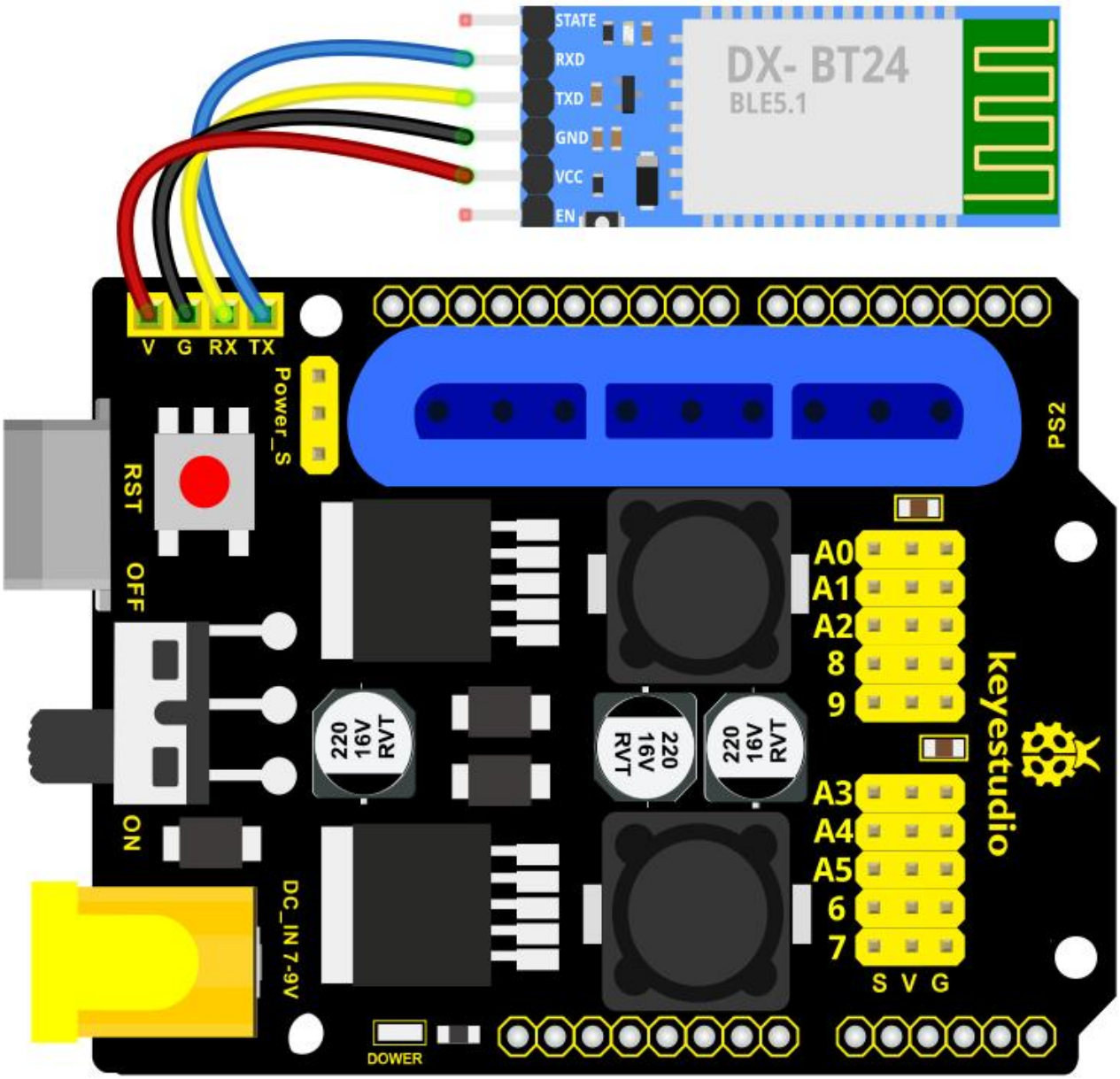
Description

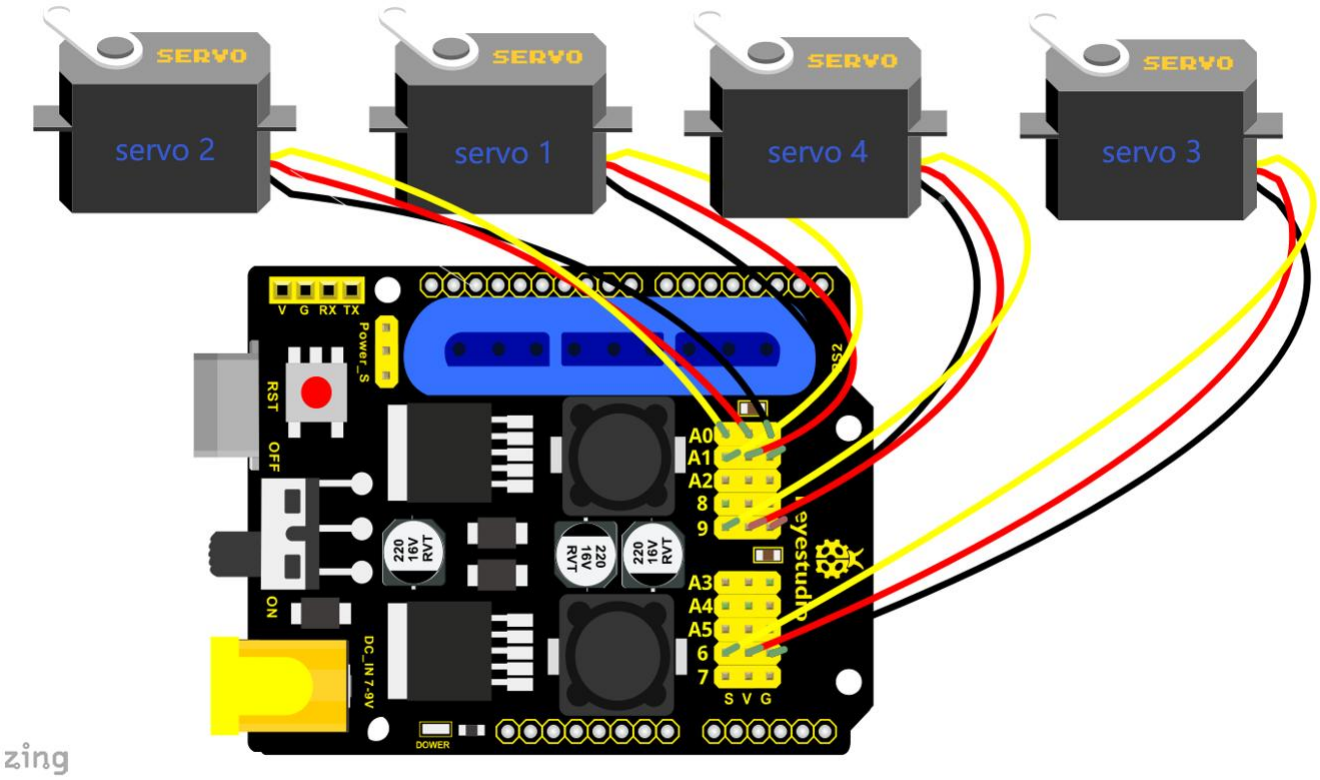
We introduced the control method of the 4-DOF robot arm and bt-24 Bluetooth

module. In this experiment, we'll control 4DOF robotic arm movement via APP.

Note: After uploading test code successfully, unplug the USB data cable and power up via external power supply and control 4 DOF robot arm movement via APP.

Connection Diagram


STATE
RXD
TXD
GND
VCC
EN
DX- BT24
BLE5.1
V G RX TX
Power_S
RST
OFF
ON
DC_IN 7-9V
DOWER
220 16V RVT
220 16V RVT
220 16V RVT
PS2
A0
A1
A2
8
9
A3
A4
A5
6
7
S V G
keyestudio



Test Code

```
#include <Servo.h>    // add the servo libraries
Servo myservo1;    // create servo object to control a servo
Servo myservo2;
Servo myservo3;
Servo myservo4;
int pos1=80, pos2=60, pos3=130, pos4=0;    // define the variable of 4 servo
angle and assign the initial value( that is the boot posture angle value)
char val;
char val2;
```

```
void setup()
{
    // boot posture
   myservo1.write(pos1);
   delay(1000);
   myservo2.write(pos2);
   myservo3.write(pos3);
   myservo4.write(pos4);
   delay(1500);

   Serial.begin(9600); //   set the baud rate to 9600
}

void loop()
{
   myservo1.attach(A1);   // set the control pin of servo 1 to A1
   myservo2.attach(A0);   // set the control pin of servo 2 to A0
   myservo3.attach(6);    // set the control pin of servo 3 to D6
   myservo4.attach(9);    // set the control pin of servo 4 to D9

   if(Serial.available())    // if receive the data
   {
```

```
    val=Serial.read();       // read the received data
    val2=val;                  //Give the value of val to val2
    Serial.println(val);


    switch(val)
    {
      case 'L':   T_left();   break;     // execute the corresponding function when
receive the value
      case 'R':   T_right();   break;
      case 'f':   RF();   break;
      case 'b':   rb();   break;
      case 'F':   ZK();   break;
      case 'B':   ZB();   break;
      case 'l':   LF();   break;
      case 'r':   lb();   break;
      case 'S':   servo_stop();   break;          //stop instruction
    }


  }
  else
  {
    switch(val2)                    //When the button is pressed and not
```

```
released,
      {     //"else" is executed because Bluetooth does not send characters,
            // and the value of val2 is the value of the previously pressed button,
            //so the command of pressing the button will be repeated
        case 'L':   T_left();   break;    // execute the corresponding function when
receive the value
        case 'R':   T_right();   break;
        case 'f':   RF();   break;
        case 'b':   rb();   break;
        case 'F':   ZK();   break;
        case 'B':   ZB();   break;
        case 'l':   LF();   break;
        case 'r':   lb();   break;
        case 'S':   servo_stop();   break;       //stop instruction
     }
   }
}
//*************************************************
// turn left
void T_left()
{
    pos1=pos1+1;
```

```
    myservo1.write(pos1);
    delay(5);
    if(pos1>180)
    {
      pos1=180;
    }
}
//turn right
void T_right()
{
    pos1=pos1-1;
    myservo1.write(pos1);
    delay(5);
    if(pos1<1)
    {
      pos1=1;
    }
}
//*********************************************
//open the claw
void ZK()
{
```

```
        pos4=pos4-2;
        Serial.println(pos4);
        myservo4.write(pos4);
        delay(5);
        if(pos4<2)
        {
          pos4=0;
        }
}
// close the claw
void ZB()
{
     pos4=pos4+8;
        Serial.println(pos4);
        myservo4.write(pos4);
        delay(5);
        if(pos4>108)
        {
          pos4=108;
        }
}
```

```
//*****************************************
// the upper arm will lift up
void RF()
{
    pos2=pos2-1;
    myservo2.write(pos2);
    delay(5);
    if(pos2<0)
    {
      pos2=0;
    }
}
// the upper arm will go down
void rb()
{
    pos2=pos2+1;
    myservo2.write(pos2);
    delay(5);
    if(pos2>180)
    {
      pos2=180;
    }
```

```
}


//*****************************************
// the lower arm will stretch out
void lb()
{
   pos3=pos3+1;
      myservo3.write(pos3);
      delay(5);
      if(pos3>180)
      {
         pos3=180;
      }
}
// the lower arm will draw back
void LF()
{
   pos3=pos3-1;
      myservo3.write(pos3);
      delay(5);
      if(pos3<35)
      {
```

```
        pos3=35;
    }
}

void servo_stop()
{

    myservo1.write(pos1);
    myservo2.write(pos2);
    myservo3.write(pos3);
    myservo4.write(pos4);

}
```

Test Result:

Upload the code, connect it up and power on, after connecting the Bluetooth APP, press the key to control the robot arm do commanded motions.

Project 5: PS2-controlled Robot Arm (Extension)

5.1 PS2 Joypad Key Test

Description:

On the drive shield there is a PS2 Joystick connector, which is easy for you to control the 4DOF robot arm using the PS2 Joypad. But you need to purchase it by yourself because the PS2 Joypad is not included in the kit.
When use the PS2 Joypad to control the robot arm, first need to get the corresponding character of each key on the PS2 Joypad.
So this experiment will help you test the character of each key on the PS2 Joypad.

After connecting the Joypad, should upload the test program on Arduino IDE. But before testing, should place the **PS2X_lib** folder inside the libraries folder of Arduino IDE directory.
Uploading the code, open the serial monitor, connect the PS2 Joypad. When press down the key, you should see the corresponding character on the monitor.

Test Code 10:

```
#include <PS2X_lib.h>  //for v1.6


PS2X ps2x; // create PS2 Controller Class


//right now, the library does NOT support hot pluggable controllers, meaning

//you must always either restart your Arduino after you conect the controller,

//or call config_gamepad(pins) again after connecting the controller.
```

```
int error = 0;

byte type = 0;

byte vibrate = 0;


void setup(){

 Serial.begin(57600);


 //CHANGES for v1.6 HERE!!! **************PAY ATTENTION*************


 error = ps2x.config_gamepad(13,11,10,12, true, true);     //setup pins and settings:

GamePad(clock, command, attention, data, Pressures?, Rumble?) check for error


 if(error == 0){

    Serial.println("Found Controller, configured successful");

    Serial.println("Try out all the buttons, X will vibrate the controller, faster as you press

harder;");

   Serial.println("holding L1 or R1 will print out the analog stick values.");

   Serial.println("Go to www.billporter.info for updates and to report bugs.");

 }


   else if(error == 1)

    Serial.println("No controller found, check wiring, see readme.txt to enable debug. visit
```

```
www.billporter.info for troubleshooting tips");


  else if(error == 2)
   Serial.println("Controller found but not accepting commands. see readme.txt to enable
debug. Visit www.billporter.info for troubleshooting tips");


  else if(error == 3)
   Serial.println("Controller refusing to enter Pressures mode, may not support it. ");


   //Serial.print(ps2x.Analog(1), HEX);


   type = ps2x.readType();
     switch(type) {
       case 0:
        Serial.println("Unknown Controller type");
       break;
       case 1:
        Serial.println("DualShock Controller Found");
       break;
       case 2:
         Serial.println("GuitarHero Controller Found");
       break;
```

```
        }


}

void loop(){
    /* You must Read Gamepad to get new values
    Read GamePad and set vibration values
    ps2x.read_gamepad(small motor on/off, larger motor strenght from 0-255)
    if you don't enable the rumble, use ps2x.read_gamepad(); with no values

    you should call this at least once a second
    */



 if(error == 1) //skip loop if no controller found
  return;

 if(type == 2){ //Guitar Hero Controller

    ps2x.read_gamepad();              //read controller
```

```
if(ps2x.ButtonPressed(GREEN_FRET))
  Serial.println("Green Fret Pressed");
if(ps2x.ButtonPressed(RED_FRET))
  Serial.println("Red Fret Pressed");
if(ps2x.ButtonPressed(YELLOW_FRET))
  Serial.println("Yellow Fret Pressed");
if(ps2x.ButtonPressed(BLUE_FRET))
  Serial.println("Blue Fret Pressed");
if(ps2x.ButtonPressed(ORANGE_FRET))
  Serial.println("Orange Fret Pressed");


 if(ps2x.ButtonPressed(STAR_POWER))
  Serial.println("Star Power Command");

 if(ps2x.Button(UP_STRUM))          //will be TRUE as long as button is pressed
  Serial.println("Up Strum");
 if(ps2x.Button(DOWN_STRUM))
  Serial.println("DOWN Strum");


 if(ps2x.Button(PSB_START))                   //will be TRUE as long as button is pressed
```

```
            Serial.println("Start is being held");
      if(ps2x.Button(PSB_SELECT))
            Serial.println("Select is being held");



      if(ps2x.Button(ORANGE_FRET)) // print stick value IF TRUE
      {
            Serial.print("Wammy Bar Position:");
            Serial.println(ps2x.Analog(WHAMMY_BAR), DEC);
      }
 }

  else { //DualShock Controller

      ps2x.read_gamepad(false, vibrate);          //read controller and set large motor to spin
at 'vibrate' speed

      if(ps2x.Button(PSB_START))                   //will be TRUE as long as button is pressed
            Serial.println("Start is being held");
      if(ps2x.Button(PSB_SELECT))
            Serial.println("Select is being held");
```

```
      if(ps2x.Button(PSB_PAD_UP)) {              //will be TRUE as long as button is pressed
        Serial.print("Up held this hard: ");
        Serial.println(ps2x.Analog(PSAB_PAD_UP), DEC);
       }
       if(ps2x.Button(PSB_PAD_RIGHT)){
        Serial.print("Right held this hard: ");
          Serial.println(ps2x.Analog(PSAB_PAD_RIGHT), DEC);
       }
       if(ps2x.Button(PSB_PAD_LEFT)){
        Serial.print("LEFT held this hard: ");
          Serial.println(ps2x.Analog(PSAB_PAD_LEFT), DEC);
       }
       if(ps2x.Button(PSB_PAD_DOWN)){
        Serial.print("DOWN held this hard: ");
      Serial.println(ps2x.Analog(PSAB_PAD_DOWN), DEC);
       }


       vibrate = ps2x.Analog(PSAB_BLUE);          //this will set the large motor vibrate speed
based on
                                                  //how hard you press the blue (X) button
```

```
    if (ps2x.NewButtonState())               //will be TRUE if any button changes state (on to
off, or off to on)
    {




      if(ps2x.Button(PSB_L3))
       Serial.println("L3 pressed");
      if(ps2x.Button(PSB_R3))
       Serial.println("R3 pressed");
      if(ps2x.Button(PSB_L2))
       Serial.println("L2 pressed");
      if(ps2x.Button(PSB_R2))
       Serial.println("R2 pressed");
      if(ps2x.Button(PSB_GREEN))
       Serial.println("Triangle pressed");


    }



    if(ps2x.ButtonPressed(PSB_RED))             //will be TRUE if button was JUST pressed
```

```
        Serial.println("Circle just pressed");


    if(ps2x.ButtonReleased(PSB_PINK))                  //will be TRUE if button was JUST released
        Serial.println("Square just released");


    if(ps2x.NewButtonState(PSB_BLUE))                  //will be TRUE if button was JUST pressed
OR released
        Serial.println("X just changed");



    if(ps2x.Button(PSB_L1) || ps2x.Button(PSB_R1)) // print stick values if either is TRUE
    {
        Serial.print("Stick Values:");
        Serial.print(ps2x.Analog(PSS_LY), DEC); //Left stick, Y axis. Other options: LX, RY, RX
        Serial.print(",");
        Serial.print(ps2x.Analog(PSS_LX), DEC);
        Serial.print(",");
        Serial.print(ps2x.Analog(PSS_RY), DEC);
        Serial.print(",");
        Serial.println(ps2x.Analog(PSS_RX), DEC);
    }
```

```
 }


 delay(50);

}
```

****

Test Result:

Stack the drive shield onto V4.0 and upload the code. Connecting the PS2 Joypad, open the serial monitor and set the baud rate to 57600. When press down the key or push the rocker, you should see the corresponding character showed on the monitor.

5.2 PS2 Joypad Control

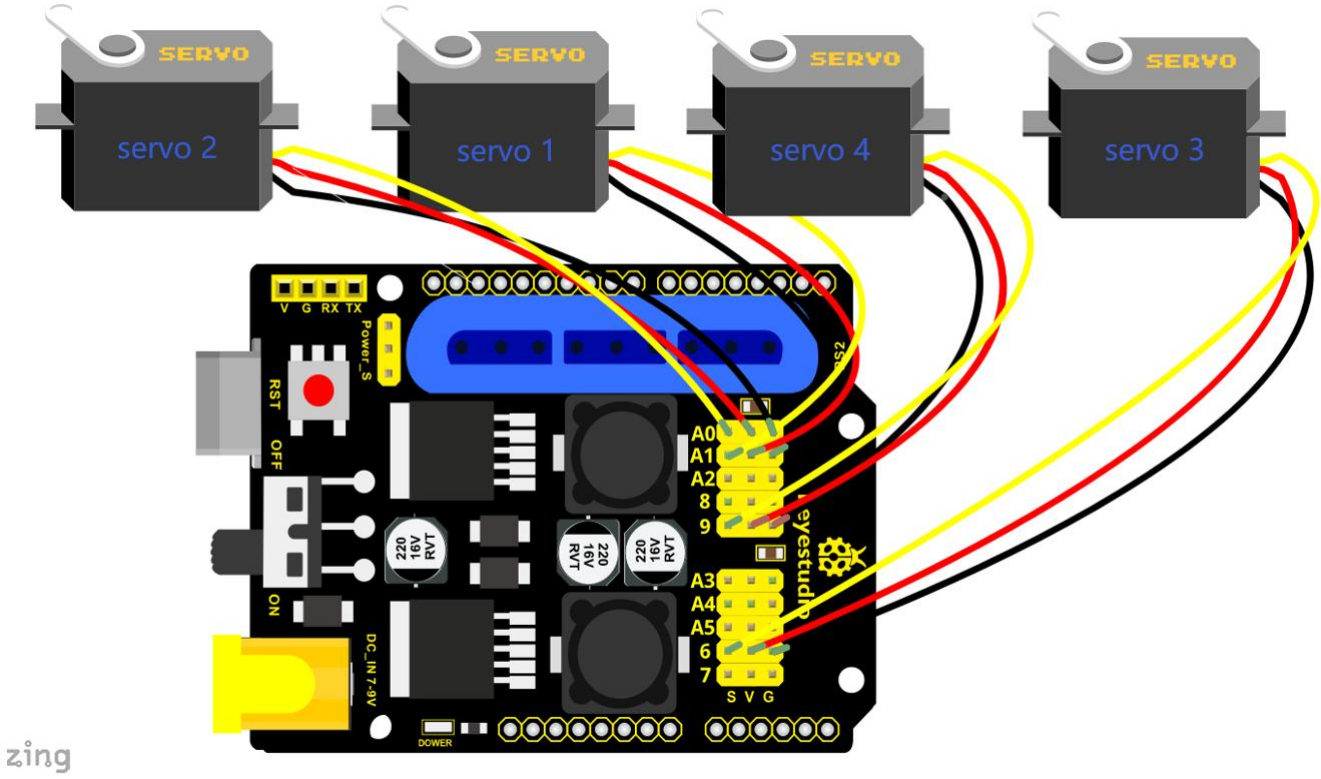
Description:

In the previous section, we have showed how to use Joystick module to control the robot arm. It is almost the same for you to control the 4DOF robot arm using the PS2 Joypad.

PS2 Joystick Control

Right Joystick	Robot Arm	Left Joystick	Robotic Claw
Push to the right side	Rotate to right	Push to the right side	close
Push to the left side	Rotate to left	Push to the left side	open
Push forward	The small arm will lift	Push forward	The large arm will move forward
Push back	The small arm will lower	Push back	The large arm will move back

Connection Diagram



Test Code

```
**********************************************************************************************************
#include <PS2X_lib.h>

PS2X ps2x; // create PS2 Controller Class
```

```
//right now, the library does NOT support hot pluggable controllers,
meaning
//you must always either restart your Arduino after you connect the
controller,
//or call config_gamepad(pins) again after connecting the controller.
int error = 0;
byte vibrate = 0;

#include <Servo.h>    // add the servo libraries
Servo myservo1;    // create servo object to control a servo
Servo myservo2;
Servo myservo3;
Servo myservo4;

int pos1=80, pos2=60, pos3=130, pos4=0;    // define the variable of 4
servo angle and assign the initial value( that is the boot posture angle
value)

void setup(){
  Serial.begin(57600);

// boot posture
```

```
  myservo1.write(pos1);
  delay(1000);
  myservo2.write(pos2);
  myservo3.write(pos3);
  myservo4.write(pos4);
  delay(1500);

 error = ps2x.config_gamepad(13,11,10,12);     //setup GamePad(clock, command, attention, data) pins, check for error

 if(error == 0){
    Serial.println("Found Controller, configured successful");
    Serial.println("Try out all the buttons, X will vibrate the controller, faster as you press harder;");
  Serial.println("holding L1 or R1 will print out the analog stick values.");
  Serial.println("Go to www.billporter.info for updates and to report bugs.");
 }

  else if(error == 1)
    Serial.println("No controller found, check wiring, see readme.txt to enable debug. visit www.billporter.info for troubleshooting tips");
```

```
  else if(error == 2)
    Serial.println("Controller found but not accepting commands. see readme.txt to enable debug. Visit www.billporter.info for troubleshooting tips");

    //Serial.print(ps2x.Analog(1), HEX);


 ps2x.enableRumble();                  //enable rumble vibration motors
 ps2x.enablePressures();               //enable reading the pressure values from the buttons.



}

void loop(){
    /* You must Read Gamepad to get new values
    Read GamePad and set vibration values
    ps2x.read_gamepad(small motor on/off, larger motor strenght from 0-255)
```

```
    if you don't enable the rumble, use ps2x.read_gamepad(); with no
values

    you should call this at least once a second
    */

  myservo1.attach(A1);   // set the control pin of servo 1 to A1
  myservo2.attach(A0);   // set the control pin of servo 2 to A0
  myservo3.attach(6);    // set the control pin of servo 3 to D6
  myservo4.attach(9);    // set the control pin of servo 4 to D9

 if(error != 0)
  return;

  ps2x.read_gamepad(false, vibrate);          //read controller and set
large motor to spin at 'vibrate' speed

  if(ps2x.Button(PSB_START))                  //will be TRUE as long as
button is pressed
        Serial.println("Start is being held");
  if(ps2x.Button(PSB_SELECT))
        Serial.println("Select is being held");
```

```
    if(ps2x.Button(PSB_PAD_UP)) {              //will be TRUE as long as button
is pressed
      Serial.print("Up held this hard: ");
      Serial.println(ps2x.Analog(PSAB_PAD_UP), DEC);
     }
     if(ps2x.Button(PSB_PAD_RIGHT)){
      Serial.print("Right held this hard: ");
       Serial.println(ps2x.Analog(PSAB_PAD_RIGHT), DEC);
     }
     if(ps2x.Button(PSB_PAD_LEFT)){
      Serial.print("LEFT held this hard: ");
       Serial.println(ps2x.Analog(PSAB_PAD_LEFT), DEC);
     }
     if(ps2x.Button(PSB_PAD_DOWN)){
      Serial.print("DOWN held this hard: ");
    Serial.println(ps2x.Analog(PSAB_PAD_DOWN), DEC);
     }


     vibrate = ps2x.Analog(PSAB_BLUE);            //this will set the large
```

```
motor vibrate speed based on
                                                    //how hard you press the
blue (X) button

  if (ps2x.NewButtonState())                    //will be TRUE if any button
changes state (on to off, or off to on)
  {
      if(ps2x.Button(PSB_R3))

        Serial.println("R3 pressed");



      if(ps2x.Button(PSB_L3))
        Serial.println("L3 pressed");

      if(ps2x.Button(PSB_L2))
        Serial.println("L2 pressed");
      if(ps2x.Button(PSB_R2))
        Serial.println("R2 pressed");
      if(ps2x.Button(PSB_GREEN))
        Serial.println("Triangle pressed");
```

```
  }


  if(ps2x.ButtonPressed(PSB_RED))                  //will be TRUE if button
was JUST pressed
        Serial.println("Circle just pressed");

  if(ps2x.ButtonReleased(PSB_PINK))                  //will be TRUE if button
was JUST released
        Serial.println("Square just released");

  if(ps2x.NewButtonState(PSB_BLUE))                  //will be TRUE if button
was JUST pressed OR released
        Serial.println("X just changed");

    //转动
    zhuandong();
    //爪子
    zhuazi();
    //大臂
    dabi();
    //小臂
```

```
      xiaobi();


   if(ps2x.Button(PSB_L1) || ps2x.Button(PSB_R1)) // print stick values if
either is TRUE
   {
        Serial.print("Stick Values:");
        Serial.print(ps2x.Analog(PSS_LY), DEC); //Left stick, Y axis. Other
options: LX, RY, RX
        Serial.print(",");
        Serial.print(ps2x.Analog(PSS_LX), DEC);
        Serial.print(",");
        Serial.print(ps2x.Analog(PSS_RY), DEC);
        Serial.print(",");
        Serial.println(ps2x.Analog(PSS_RX), DEC);
   }
   delay(5);
}
//*********************************************************************
// turn
void zhuandong()
{
//turn right
```

```
    if(ps2x.Analog (PSS_RX) > 200)   // if push the right joystick to the right
     {
       //Serial.println(ps2x.Analog(PSS_RX), DEC);
       pos1=pos1-1;       //pos1 subtracts 1
       myservo1.write(pos1);     // servo 1 executes the action, the arm will
turn right.
       // delay(5);
       if(pos1<1)     // limit the right turning angle
       {
          pos1=1;
       }
      }
       // turn left
      if(ps2x.Analog (PSS_RX) < 50)       // if push the right joystick to the
left
      {
        //Serial.println(ps2x.Analog(PSS_RX), DEC);
        pos1=pos1+1;     //pos1 plus 1
        myservo1.write(pos1);        // the arm turns left
        // delay(5);
        if(pos1>180)        // limit the left turning angle
        {
```

```
            pos1=180;
          }
        }
  }
  //*****************************************************************
  // upper arm
void xiaobi()
{
   //upper arm front
    if(ps2x.Analog(PSS_RY)<50)   // if push the right joystick upward
    {
        pos2=pos2-1;
        myservo2.write(pos2);       // the upper arm will lift
        delay(5);
        if(pos2<0)       // limit the lifting angle
        {
           pos2=0;
        }
     }
     //upper arm back
     if(ps2x.Analog(PSS_RY)>200)       // if push the right joystick downward
     {
```

```
        pos2=pos2+1;
        myservo2.write(pos2);     // the upper arm will go down
        delay(5);
        if(pos2>180)    // limit the declining angle
        {
           pos2=180;
        }
     }
}
//*************************************************************
void zhuazi()
{
// close the claw
    if(ps2x.Analog(PSS_LX)>220)     // if push the left joystick to the right
    {
        pos4=pos4-1;
        Serial.println(pos4);
        myservo4.write(pos4);    // servo 4 carries out the action and the claw
is gradually closed.
        delay(5);
        if(pos4<0)     // if pos4 value subtracts to 37, the claw in 37 degrees
we have tested is closed.)
```

```
        {
          pos4=0;
        }
      }
      // open the claw
      if(ps2x.Analog(PSS_LX)<10)     // if push the left joystick to the left
      {
        pos4=pos4+8;
        Serial.println(pos4);
        myservo4.write(pos4);     // servo 4 carries out the action and the
claw is gradually opened
        delay(5);
        if(pos4>108)       // limit the maximum opening angle
        {
          pos4=108;
        }
      }
}
//*************************************************************
void dabi()
{
  // lower arm front
```

```
  if(ps2x.Analog(PSS_LY)>200)    // if push the left joystick upward
  {
     pos3=pos3+1;
     myservo3.write(pos3);    // the lower arm will stretch out
     delay(5);
     if(pos3>180)     // limit the stretched angle
     {
        pos3=180;
     }
   }
  if(ps2x.Analog(PSS_LY)<10)       //if push the left joystick downward
  {
     pos3=pos3-1;
     myservo3.write(pos3);     // the lower arm will draw back
     delay(5);
     if(pos3<35)       // limit the retracted angle
     {
        pos3=35;
     }
   }
}
```

****

Test Result

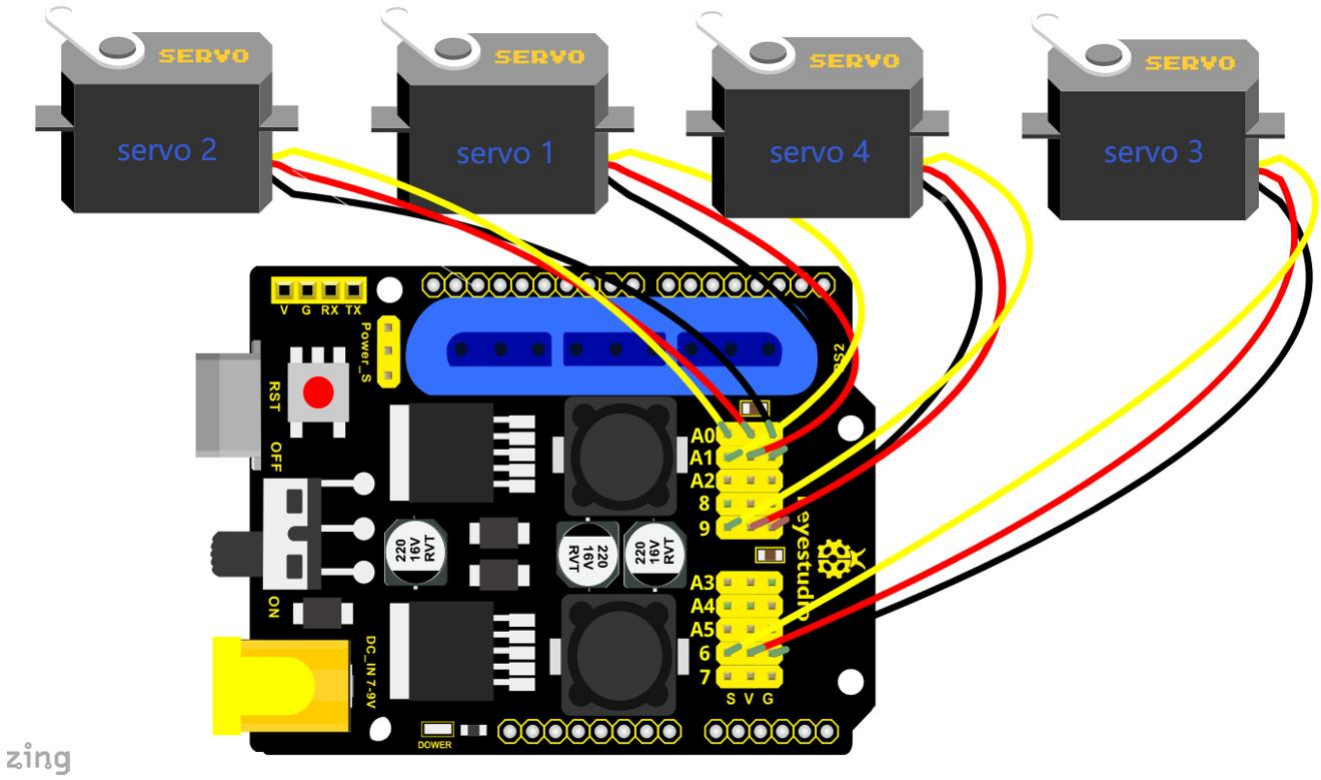
Control the robotic arm with PS2 joypad.

5.3 PS2 Controlling Posture Memory

Description

In the previous experiment, we have showed how to use Joystick module to memorize several postures. Now we replace the joystick module with PS2 Joypad. Press the Z1 button to memorize the postures of the arm. If you want to memorize more, you can set in the code. After that, press the Z2 button to perform the saved actions of the arm

Connection Diagram



Test Code12

```
#include <PS2X_lib.h>

#include <Servo.h>  // add the servo libraries

Servo myservo1;  // create servo object to control a servo

Servo myservo2;

Servo myservo3;

Servo myservo4;


int pos1=80, pos2=60, pos3=130, pos4=0;  // define the variable of 4 servo angle and assign the initial value( that is the boot posture angle value)


PS2X ps2x; // create PS2 Controller Class
```

```
//right now, the library does NOT support hot pluggable controllers, meaning
//you must always either restart your Arduino after you conect the controller,
//or call config_gamepad(pins) again after connecting the controller.
int error = 0;
byte vibrate = 0;


int s1,s2,s3,s4;
int jiyi1[20];    // define four array, separately used to save the angle of 4 servos.
int jiyi2[20];
int jiyi3[20];
int jiyi4[20];
int i=0;
int j=0;


void setup()
{
  Serial.begin(57600);


  // boot posture
    myservo1.write(pos1);
    delay(1000);
```

```
    myservo2.write(pos2);
    myservo3.write(pos3);
    myservo4.write(pos4);
    delay(1500);


  error = ps2x.config_gamepad(13,11,10,12);      //setup GamePad(clock, command, attention, data) pins, check for error

  if(error == 0){
     Serial.println("Found Controller, configured successful");
     Serial.println("Try out all the buttons, X will vibrate the controller, faster as you press harder;");
    Serial.println("holding L1 or R1 will print out the analog stick values.");
    Serial.println("Go to www.billporter.info for updates and to report bugs.");
  }

    else if(error == 1)
     Serial.println("No controller found, check wiring, see readme.txt to enable debug. visit www.billporter.info for troubleshooting tips");

    else if(error == 2)
```

```
    Serial.println("Controller found but not accepting commands. see readme.txt to enable debug. Visit www.billporter.info for troubleshooting tips");

    //Serial.print(ps2x.Analog(1), HEX);


  ps2x.enableRumble();                  //enable rumble vibration motors
  ps2x.enablePressures();                //enable reading the pressure values from the buttons.



}

void loop()
{
   myservo1.attach(A1);   // set the control pin of servo 1 to A1
   myservo2.attach(A0);   // set the control pin of servo 2 to A0
   myservo3.attach(6);    // set the control pin of servo 3 to D6
   myservo4.attach(9);    // set the control pin of servo 4 to D9

  if(error != 0)
```

```
    return;

    ps2x.read_gamepad(false, vibrate);          //read controller and set large motor
to spin at 'vibrate' speed

    if(ps2x.Button(PSB_START))                  //will be TRUE as long as button is
pressed
            Serial.println("Start is being held");
    if(ps2x.Button(PSB_SELECT))
            Serial.println("Select is being held");


     if(ps2x.Button(PSB_PAD_UP)) {          //will be TRUE as long as button is pressed
       Serial.print("Up held this hard: ");
       Serial.println(ps2x.Analog(PSAB_PAD_UP), DEC);
      }
      if(ps2x.Button(PSB_PAD_RIGHT)){
       Serial.print("Right held this hard: ");
        Serial.println(ps2x.Analog(PSAB_PAD_RIGHT), DEC);
      }
      if(ps2x.Button(PSB_PAD_LEFT)){
       Serial.print("LEFT held this hard: ");
```

```
        Serial.println(ps2x.Analog(PSAB_PAD_LEFT), DEC);
      }
      if(ps2x.Button(PSB_PAD_DOWN)){
       Serial.print("DOWN held this hard: ");
     Serial.println(ps2x.Analog(PSAB_PAD_DOWN), DEC);
      }


      vibrate = ps2x.Analog(PSAB_BLUE);          //this will set the large motor vibrate
speed based on
                                                 //how hard you press the blue (X)
button


   if (ps2x.NewButtonState())                    //will be TRUE if any button changes
state (on to off, or off to on)
   {
        if(ps2x.Button(PSB_R3))
        {
          //Serial.println("R3 pressed");
          // record
          s1=myservo1.read();
          delay(100);
```

```
    Serial.println(s1);
    s2=myservo2.read();
    delay(100);
    Serial.println(s2);
    s3=myservo3.read();
    delay(100);
    Serial.println(s3);
    s4=myservo4.read();
    delay(100);
    Serial.println(s4);

    jiyi1[i]=s1;    // save the servo value read in the array sequentially
    jiyi2[i]=s2;
    jiyi3[i]=s3;
    jiyi4[i]=s4;
    i++;
    j=i;
  // delay(100);
  Serial.println(i);
}

if(ps2x.Button(PSB_L3))
```

```
        {
          //Serial.println("L3 pressed");
          i=0;
    //执行
          pos1 = myservo1.read();
          pos2 = myservo2.read();
          pos3 = myservo3.read();
          pos4 = myservo4.read();

        for(int k=0;k<j;k++)   //for loop, to execute all the stored actions
        {
          if(pos1<jiyi1[k])   //if the current servo 1 angle is less than the value stored in array 1.
          {
            while(pos1<jiyi1[k])    //while loop, make servo turn to the position of value stored in the array.
            {
              myservo1.write(pos1);     // servo 1 executes the action
              delay(5);     // delay 5ms，controlling the rotating speed of servo
              pos1++;
              //Serial.println(pos1);
            }
```

```
        }
        else     //if the current servo 1 angle is greater than the value stored in array
1.
        {
          while(pos1>jiyi1[k])    //while loop, make servo turn to the position of value
stored in the array.
            {
              myservo1.write(pos1);     // servo 1 executes the action
              delay(5);       //delay 5ms，controlling the rotating speed of servo
              pos1--;
              //Serial.println(pos1);
            }

//*********************************************
// the same analysis as the previous servo
        if(pos2<jiyi2[k])
        {
          while(pos2<jiyi2[k])
          {
            myservo2.write(pos2);
            delay(5);
            pos2++;
```

```
            //Serial.println(pos1);
          }
        }
        else
        {
         while(pos2>jiyi2[k])
          {
            myservo2.write(pos2);
            delay(5);
            pos2--;
            //Serial.println(pos1);
          }
        }
//*****************************************************
//the same analysis
        if(pos3<jiyi3[k])
        {
          while(pos3<jiyi3[k])
          {
            myservo3.write(pos3);
            delay(5);
            pos3++;
```

```
            //Serial.println(pos1);
          }
        }
        else
        {
         while(pos3>jiyi3[k])
          {
            myservo3.write(pos3);
            delay(5);
            pos3--;
            //Serial.println(pos1);
          }
        }
//*****************************************************
//the same analysis
        if(pos4<jiyi4[k])
        {
          while(pos4<jiyi4[k])
          {
            myservo4.write(pos4);
            delay(5);
            pos4++;
```

```
            //Serial.println(pos1);
          }
        }
        else
        {
          while(pos4>jiyi4[k])
          {
            myservo4.write(pos4);
            delay(5);
            pos4--;
            //Serial.println(pos1);
          }
        }
      }
    }
    }


    if(ps2x.Button(PSB_L2))
     Serial.println("L2 pressed");
    if(ps2x.Button(PSB_R2))
     Serial.println("R2 pressed");
```

```
        if(ps2x.Button(PSB_GREEN))
          Serial.println("Triangle pressed");

    }


    if(ps2x.ButtonPressed(PSB_RED))                  //will be TRUE if button was JUST
pressed
          Serial.println("Circle just pressed");

    if(ps2x.ButtonReleased(PSB_PINK))                 //will be TRUE if button was JUST
released
          Serial.println("Square just released");

    if(ps2x.NewButtonState(PSB_BLUE))                 //will be TRUE if button was JUST
pressed OR released
          Serial.println("X just changed");

      // turn
      zhuandong();
      // claw
      zhuazi();
```

```
        // lower arm
        dabi();
        // upper arm
        xiaobi();

    if(ps2x.Button(PSB_L1) || ps2x.Button(PSB_R1)) // print stick values if either is TRUE
    {
        Serial.print("Stick Values:");
        Serial.print(ps2x.Analog(PSS_LY), DEC); //Left stick, Y axis. Other options: LX, RY,
RX
        Serial.print(",");
        Serial.print(ps2x.Analog(PSS_LX), DEC);
        Serial.print(",");
        Serial.print(ps2x.Analog(PSS_RY), DEC);
        Serial.print(",");
        Serial.println(ps2x.Analog(PSS_RX), DEC);
    }

  delay(5);
}

//**********************************************************************
```

```
// turn
void zhuandong()
{
//turn right
    if(ps2x.Analog (PSS_RX) > 200)    // if push the right joystick to the right
     {
        //Serial.println(ps2x.Analog(PSS_RX), DEC);
        pos1=pos1-1;       //pos1 subtracts 1
        myservo1.write(pos1);     // servo 1 carries out the action and the arm will turn
right
        // delay(5);
        if(pos1<1)     // limit the right turning angle
        {
           pos1=1;
        }
       }
        //左转
       if(ps2x.Analog (PSS_RX) < 50)       //if push the right joystick to the left
       {
          //Serial.println(ps2x.Analog(PSS_RX), DEC);
          pos1=pos1+1;     //pos1 plus 1
          myservo1.write(pos1);        // the arm will turn left
```

```
            // delay(5);
            if(pos1>180)        // limit the left turning angle
            {
               pos1=180;
            }
         }
  }
  //*********************************************************************
  // upper arm
void xiaobi()
{
    //upper arm front
     if(ps2x.Analog(PSS_RY)<50)    // if push the right joystick upward
     {
         pos2=pos2-1;
         myservo2.write(pos2);       // the upper arm will lift up
         delay(5);
         if(pos2<0)       // limit the lifting angle
         {
            pos2=0;
         }
      }
```

```
      // upper arm back
      if(ps2x.Analog(PSS_RY)>200)       //if push the right joystick downward
      {
         pos2=pos2+1;
         myservo2.write(pos2);     // the upper arm will go down
         delay(5);
         if(pos2>180)    // limit the declining angle
         {
            pos2=180;
         }
      }
}
//****************************************************************
void zhuazi()
{
// close the claw
    if(ps2x.Analog(PSS_LX)>220)     // if push the left joystick to the right
    {
        pos4=pos4-1;
        Serial.println(pos4);
        myservo4.write(pos4);     // servo 4 carries out the action and the claw is
gradually closed.
```

```
        delay(5);
        if(pos4<0)     // if pos4 value reduces to 37（the claw we test in 37degrees is closed）
        {
          pos4=0;
        }
      }
      // open the claw
      if(ps2x.Analog(PSS_LX)<10)     // if push the left joystick to the left
      {
        pos4=pos4+8;
        Serial.println(pos4);
        myservo4.write(pos4);       // servo 4 carries out the action and the claw is gradually opened
        delay(5);
        if(pos4>108)       // limit the maximum angle opened
        {
          pos4=108;
        }
      }
}
//*************************************************************
```

```
void dabi()
{
  // lower arm front
  if(ps2x.Analog(PSS_LY)>200)   //   if push the left joystick upward
  {
    pos3=pos3+1;
    myservo3.write(pos3);   // the lower arm will stretch out
    delay(5);
    if(pos3>180)     // limit the stretched angle
    {
      pos3=180;
    }
   }
  if(ps2x.Analog(PSS_LY)<10)      // if push the left joystick downward
  {
    pos3=pos3-1;
    myservo3.write(pos3);     //the lower arm will retract
    delay(5);
    if(pos3<35)      // limit the retracted angle
    {
      pos3=35;
    }
```

```
        }
    }
```

****

Test Result

Move the PS2 rocker to control robot arm, press the button of the PS2 rocker to record its posture, and move the joystick again and press the button of the PS2 rocker to memorize the posture. Next, press the left button of the PS2 joypad to perform postures.

5.4 PS2 Controls Posture Memory and Loop

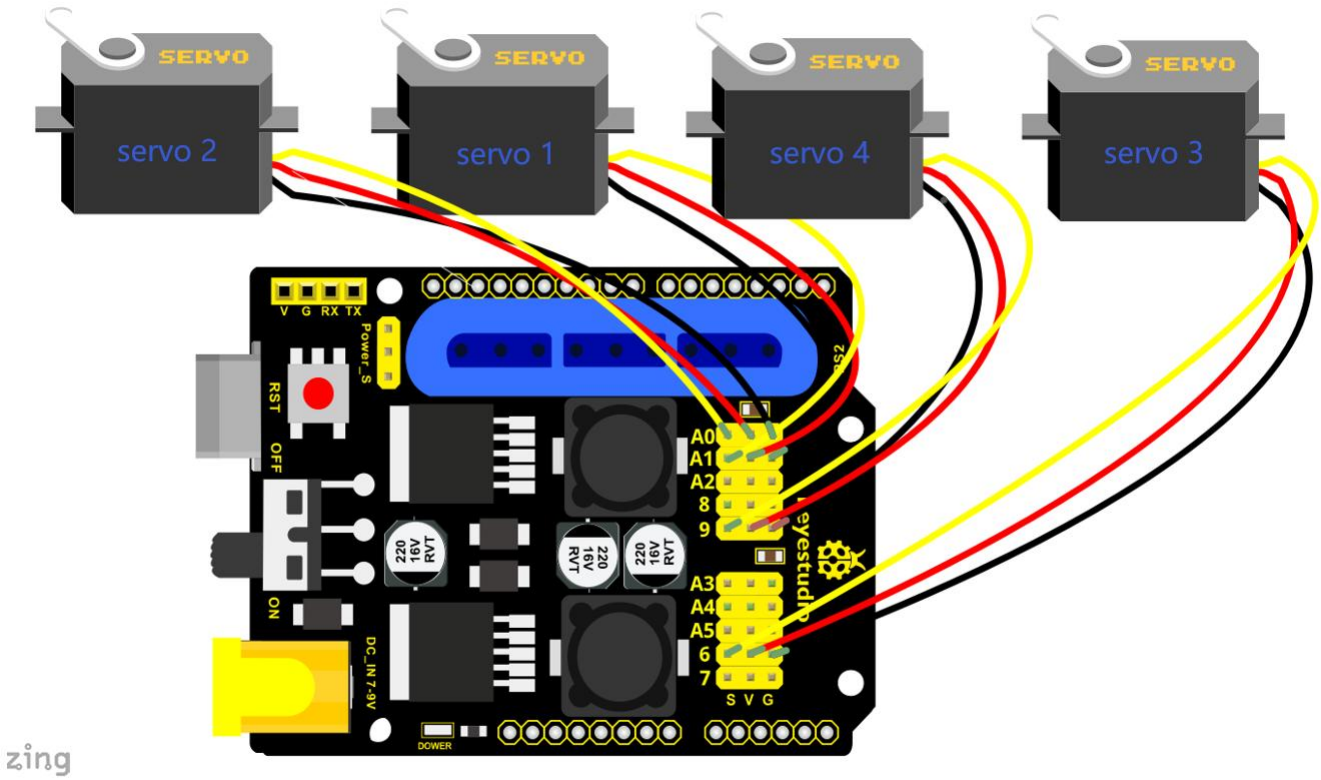
Description:

In the previous experiment, we have showed how to use Joystick module to control the robot arm memorize several postures and loop. Now we replace the Joystick module with the PS2 Joypad. The program is almost the same.

Move the thumbsticks and press the button of the right thumbstick, then

move them and press the right button again. That indicates that actions of the arm are memorized. Next, you can press the left button to perform actions saved.

Connection Diagram:



Test Code13

```
#include <PS2X_lib.h>
```

```
#include <Servo.h>    // add the servo libraries
Servo myservo1;    // create servo object to control a servo
Servo myservo2;
Servo myservo3;
Servo myservo4;

int pos1=80, pos2=60, pos3=130, pos4=0;    // define the variable of 4 servo angle and assign the initial value( that is the boot posture angle value)

PS2X ps2x; // create PS2 Controller Class

//right now, the library does NOT support hot pluggable controllers, meaning
//you must always either restart your Arduino after you conect the controller,
//or call config_gamepad(pins) again after connecting the controller.
int error = 0;
byte vibrate = 0;

int s1,s2,s3,s4;
int jiyi1[30];     //define four array, separately used to save the angle of 4 servos.
int jiyi2[30];
int jiyi3[30];
```

```
int jiyi4[30];
int i=0;
int j=0,tt=0;
void setup()
{
 Serial.begin(57600);


 // boot posture
   myservo1.write(pos1);
   delay(1000);
   myservo2.write(pos2);
   myservo3.write(pos3);
   myservo4.write(pos4);
   delay(1500);



 error = ps2x.config_gamepad(13,11,10,12);     //setup GamePad(clock, command, attention, data)
pins, check for error


 if(error == 0){
   Serial.println("Found Controller, configured successful");
   Serial.println("Try out all the buttons, X will vibrate the controller, faster as you press harder;");
```

```
      Serial.println("holding L1 or R1 will print out the analog stick values.");
      Serial.println("Go to www.billporter.info for updates and to report bugs.");
    }

      else if(error == 1)
       Serial.println("No controller found, check wiring, see readme.txt to enable debug. visit
www.billporter.info for troubleshooting tips");

      else if(error == 2)
       Serial.println("Controller found but not accepting commands. see readme.txt to enable debug.
Visit www.billporter.info for troubleshooting tips");

       //Serial.print(ps2x.Analog(1), HEX);

    ps2x.enableRumble();                    //enable rumble vibration motors
    ps2x.enablePressures();                 //enable reading the pressure values from the buttons.
  }

  void loop()
  {
     myservo1.attach(A1);   // set the control pin of servo 1 to A1
```

```
    myservo2.attach(A0);   //set the control pin of servo 2 to A0
    myservo3.attach(6);    //set the control pin of servo 3 to D6
    myservo4.attach(9);    //set the control pin of servo 4 to D9

  if(error != 0)
    return;

    ps2x.read_gamepad(false, vibrate);          //read controller and set large motor to spin at
'vibrate' speed

    if(ps2x.Button(PSB_START))                  //will be TRUE as long as button is pressed
        Serial.println("Start is being held");
    if(ps2x.Button(PSB_SELECT))
        Serial.println("Select is being held");

     if(ps2x.Button(PSB_PAD_UP)) {          //will be TRUE as long as button is pressed
       Serial.print("Up held this hard: ");
       Serial.println(ps2x.Analog(PSAB_PAD_UP), DEC);
      }
      if(ps2x.Button(PSB_PAD_RIGHT)){
       Serial.print("Right held this hard: ");
```

```
        Serial.println(ps2x.Analog(PSAB_PAD_RIGHT), DEC);
      }
      if(ps2x.Button(PSB_PAD_LEFT)){
        Serial.print("LEFT held this hard: ");
        Serial.println(ps2x.Analog(PSAB_PAD_LEFT), DEC);
      }
      if(ps2x.Button(PSB_PAD_DOWN)){
        Serial.print("DOWN held this hard: ");
      Serial.println(ps2x.Analog(PSAB_PAD_DOWN), DEC);
      }


      vibrate = ps2x.Analog(PSAB_BLUE);        //this will set the large motor vibrate speed based
on
                                               //how hard you press the blue (X) button


    if (ps2x.NewButtonState())                 //will be TRUE if any button changes state (on to off,
or off to on)
    {
        if(ps2x.Button(PSB_R3))
        {
          //Serial.println("R3 pressed");
```

```
//record
s1=myservo1.read();
delay(100);
Serial.println(s1);
s2=myservo2.read();
delay(100);
Serial.println(s2);
s3=myservo3.read();
delay(100);
Serial.println(s3);
s4=myservo4.read();
delay(100);
Serial.println(s4);

jiyi1[i]=s1;    //save the servo value read in the array sequentially
jiyi2[i]=s2;
jiyi3[i]=s3;
jiyi4[i]=s4;
i++;
j=i;
// delay(100);
Serial.println(i);
```

```
  }


   // carry out
  if(ps2x.Button(PSB_L3))
  {
     //Serial.println("L3 pressed");
     i=0;
     tt=1;


    pos1 = myservo1.read();   // record the angle value of 4 servo posture
    pos2 = myservo2.read();
    pos3 = myservo3.read();
    pos4 = myservo4.read();


 while(tt==1)   // repeat the actions
 {
    for(int k=0;k<j;k++)     //for loop, to execute all the stored actions.
  {
     if(pos1<jiyi1[k])     // if the current servo 1 angle is less than the value stored in array 1.
     {
        while(pos1<jiyi1[k])      //while loop, make servo turn to the position of value stored in
the array.
```

```
    {
      myservo1.write(pos1);     //servo 1 executes the action
      delay(5);        //delay 5ms，controlling the rotating speed of servo.
      pos1++;
      //Serial.println(pos1);
    }
  }
  else        //if the current servo 1 angle is greater than the value stored in array 1.
  {
   while(pos1>jiyi1[k])        //while loop, make servo turn to the position of value stored in
the array.
    {
      myservo1.write(pos1);       //servo 1 executes the action
      delay(5);                   //delay 5ms，controlling the rotating speed of servo.
      pos1--;
      //Serial.println(pos1);
    }

//*********************************************
// the same analysis as the previous servo
  if(pos2<jiyi2[k])
  {
```

```
            while(pos2<jiyi2[k])
            {
               myservo2.write(pos2);
               delay(5);
               pos2++;
               //Serial.println(pos1);
            }
          }
          else
          {
           while(pos2>jiyi2[k])
            {
               myservo2.write(pos2);
               delay(5);
               pos2--;
               //Serial.println(pos1);
            }
          }
 //*****************************************************
// the same analysis as the previous servo
          if(pos3<jiyi3[k])
          {
```

```
            while(pos3<jiyi3[k])
            {
               myservo3.write(pos3);
               delay(5);
               pos3++;
               //Serial.println(pos1);
            }
          }
          else
          {
           while(pos3>jiyi3[k])
            {
               myservo3.write(pos3);
               delay(5);
               pos3--;
               //Serial.println(pos1);
            }
          }
 //*****************************************************
// the same analysis as the previous servo
          if(pos4<jiyi4[k])
          {
```

```
        while(pos4<jiyi4[k])
        {
          myservo4.write(pos4);
          delay(5);
          pos4++;
          //Serial.println(pos1);
        }
      }
      else
      {
       while(pos4>jiyi4[k])
        {
          myservo4.write(pos4);
          delay(5);
          pos4--;
          //Serial.println(pos1);
        }
      }
    }
}
//*******************************************************
// exit the looping
```

```
        ps2x.enableRumble();                    //enable rumble vibration motors
        ps2x.enablePressures();
        ps2x.read_gamepad(false, vibrate);
        vibrate = ps2x.Analog(PSAB_BLUE);
         if (ps2x.NewButtonState())                    //will be TRUE if any button changes state (on to
off, or off to on)
          {
            if(ps2x.Button(PSB_R3))
            {
               tt=0;
               i=0;
               break;
            }
          }
      //*******************************************************
       }
     }


          if(ps2x.Button(PSB_L2))
            Serial.println("L2 pressed");
          if(ps2x.Button(PSB_R2))
            Serial.println("R2 pressed");
```

```
        if(ps2x.Button(PSB_GREEN))
          Serial.println("Triangle pressed");


    }


    if(ps2x.ButtonPressed(PSB_RED))                  //will be TRUE if button was JUST pressed
          Serial.println("Circle just pressed");


    if(ps2x.ButtonReleased(PSB_PINK))                  //will be TRUE if button was JUST released
          Serial.println("Square just released");


    if(ps2x.NewButtonState(PSB_BLUE))                  //will be TRUE if button was JUST pressed OR
released
          Serial.println("X just changed");


      //turn
      zhuandong();
      //claw
      zhuazi();
      //lower arm
      dabi();
```

```
      //upper arm
      xiaobi();

   if(ps2x.Button(PSB_L1) || ps2x.Button(PSB_R1)) // print stick values if either is TRUE
   {
        Serial.print("Stick Values:");
        Serial.print(ps2x.Analog(PSS_LY), DEC); //Left stick, Y axis. Other options: LX, RY, RX
        Serial.print(",");
        Serial.print(ps2x.Analog(PSS_LX), DEC);
        Serial.print(",");
        Serial.print(ps2x.Analog(PSS_RY), DEC);
        Serial.print(",");
        Serial.println(ps2x.Analog(PSS_RX), DEC);
   }

  delay(5);
}

//*****************************************************************
// turn
void zhuandong()
{
```

```
// turn right
    if(ps2x.Analog (PSS_RX) > 200)   // if push the right joystick to the right
     {
       //Serial.println(ps2x.Analog(PSS_RX), DEC);
       pos1=pos1-1;       //pos1 subtracts 1
       myservo1.write(pos1);     // servo 1 carries out the action, the robot arm turns right.
       // delay(5);
       if(pos1<1)     // limit the right turning angle
       {
          pos1=1;
       }
     }
       // turn left
     if(ps2x.Analog (PSS_RX) < 50)       // if push the right joystick to the left
     {
        //Serial.println(ps2x.Analog(PSS_RX), DEC);
        pos1=pos1+1;     //pos1 plus 1
        myservo1.write(pos1);        // the robot arm turns left
        // delay(5);
        if(pos1>180)        // limit the left turning angle
        {
           pos1=180;
```

```
          }
        }
  }
  //*********************************************************************
  // the upper arm
void xiaobi()
{
   // upper arm front
    if(ps2x.Analog(PSS_RY)<50)   // if push the right joystick upward
    {
        pos2=pos2-1;
        myservo2.write(pos2);       // the upper arm will lift up
        delay(5);
        if(pos2<0)       // limit the lifting angle
        {
           pos2=0;
        }
     }
     // upper arm back
     if(ps2x.Analog(PSS_RY)>200)       //if push the right joystick to downward
     {
        pos2=pos2+1;
```

```
            myservo2.write(pos2);     // the robot arm will go down
            delay(5);
            if(pos2>180)    // limit the declining angle
            {
               pos2=180;
            }
         }
   }
   //*************************************************************
   void zhuazi()
   {
   // close the claw
       if(ps2x.Analog(PSS_LX)>220)     // if push the left joystick to the right
       {
            pos4=pos4-1;
            Serial.println(pos4);
            myservo4.write(pos4);    // servo 4 carries out the action and claw is gradually closed
            delay(5);
            if(pos4<0)     // if pos4 value subtracts to 37, the claw in 37 degrees we have tested is
closed.）
            {
               pos4=0;
```

```
        }
      }
      // open the claw
      if(ps2x.Analog(PSS_LX)<10)     //    if push the left joystick to the left
      {
        pos4=pos4+8;
        Serial.println(pos4);
        myservo4.write(pos4);     //    servo 4 carries out the action and claw is gradually opened
        delay(5);
        if(pos4>108)       // limit the maximum angle opened
        {
          pos4=108;
        }
      }
}
//*************************************************************
void dabi()
{
   // lower arm front
   if(ps2x.Analog(PSS_LY)>200)    // if push the left joystick upward
   {
     pos3=pos3+1;
```

```
        myservo3.write(pos3);   //   the lower arm will stretch out
        delay(5);
        if(pos3>180)     // limit the stretched angle
        {
           pos3=180;
        }
      }
    if(ps2x.Analog(PSS_LY)<10)       // if push the left joystick downward
    {
        pos3=pos3-1;
        myservo3.write(pos3);     // the lower arm will draw back
        delay(5);
        if(pos3<35)      //   limit the retracted angle
        {
           pos3=35;
        }
      }
  }
```

****

Test Result

Operate the PS2 joypad and press the right thumbstick to remember the posture of the robot arm, then press the left thumbstick to perform postures saved. Hold down the right thumbstick to exit the loop of postures.

Test Result:

Stack the shield onto V4.0 and upload the code. Powered on and connected the PS2 Joypad, you can use the PS2 Joypad to control the robot arm memorize several postures, looping.