ROBO-ARM™

Instruction Manual

Model RBA18

The **Robo-Arm** Kit for Arduino is designed to teach the following:

1. How to build a mechanical arm, piece-by-piece.
2. Basic workings of mechanical arm
3. Coding and control of self-built robot arm

SUNFOUNDER

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Contents

1. Introduction

1.1 Overview

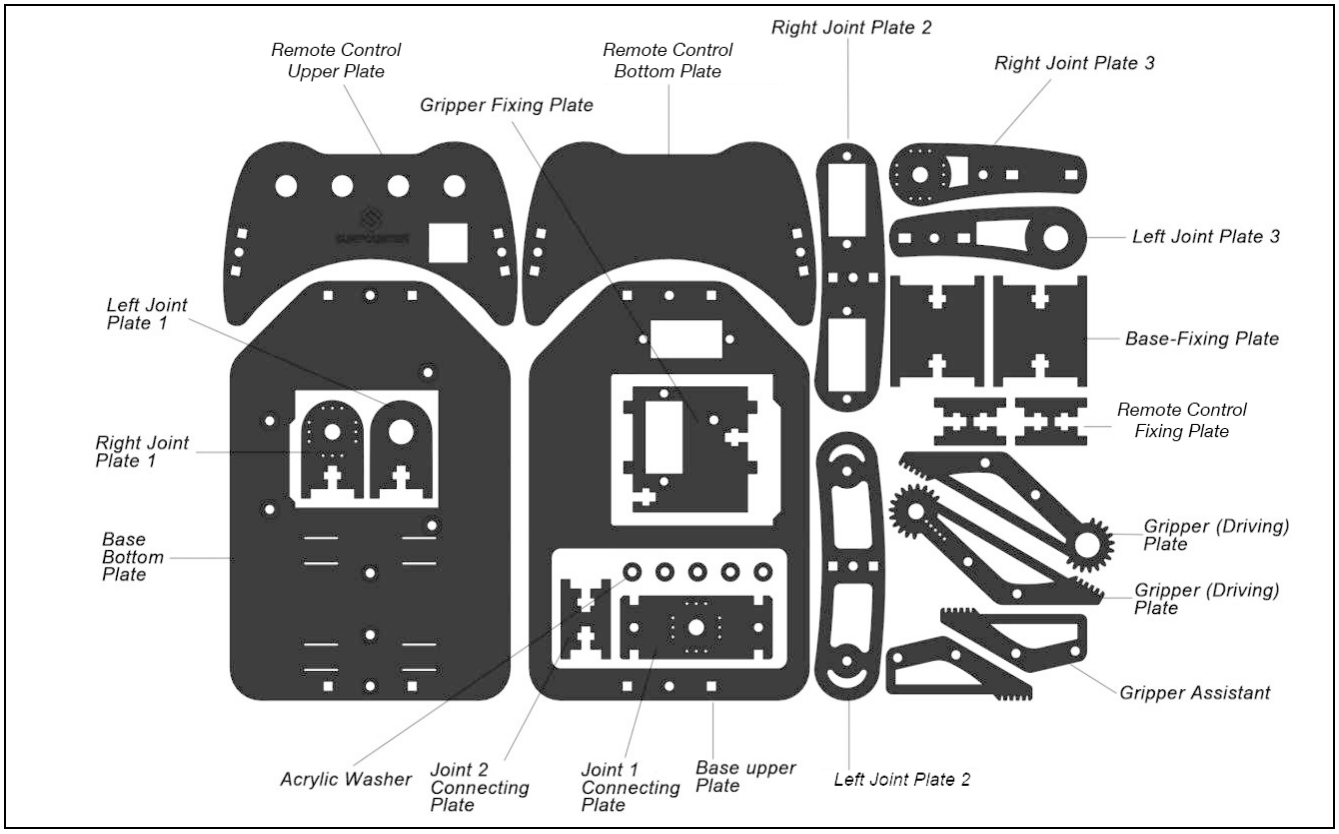
Robo-Arm is a mechanical engineering robot arm based on Arduino, enabling users to learn programming and coding from easy to difficult, and control the mechanical arm in many different ways!

Robo-Arm consists of 4 axes, each controlled by a servo. Powered by two 18650 batteries, the control system consists of an Uno board, servo extension board, and remote control board.

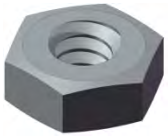
This kit includes all necessary components: acrylic plates, circuit boards, and connector parts. Instruction and installation videos are provided on our website, along with lesson plans and guides.

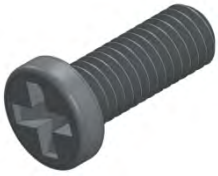
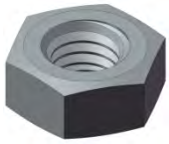
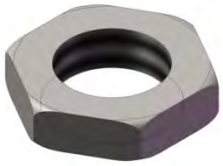
Components List

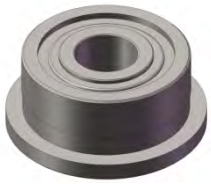
1. Acrylic Plates



2. Connecting Components

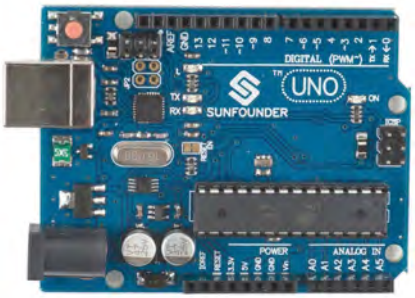
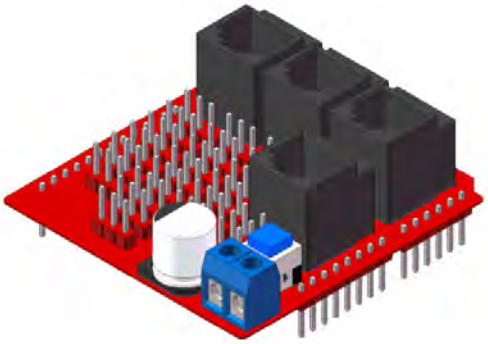
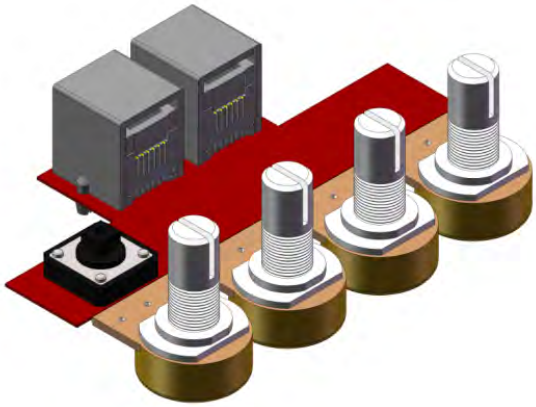
Name	Component	Qty.
M1.2*4 Self-Tapping Screw		14
M2*8 Screw		8
M2 Nut		8

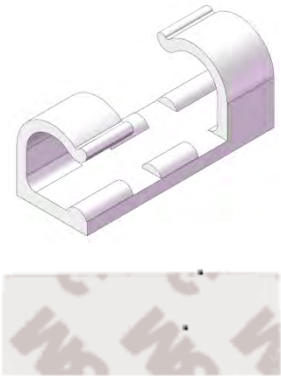
M3*8 Flat-Head Screw		2
M3*8 Screw		10
M3*10 Screw		18
M3 Nut		20
M7 Thin Nut		4
M3*10*1 Washer		1
M3*10 Aluminium Tube		5
M3*6 Corn Rivet		2

φ3*φ8*4 Band Edge Bearing		3

3. Electronic Components

SunFounder Servo (9g)		2
DXW 90 Servo (9g)		2
Potentiometer Button		4
Push Button		1
2*18650 Battery Holder		1

SunFounder UNO		1
Expansion Board		1
Potentiometer Module		1
USB Cable (UNO)		1
RJ11 Cable		2
Ribbon		1
3M Non-skid Pad		4

Heat Sink Tubing		2
Cable Clip		2

4. Tools

Screwdriver		1

5. Batteries

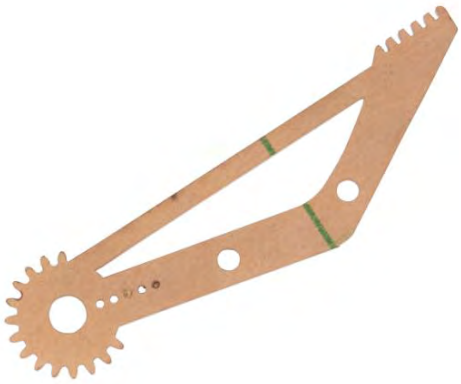
18650 Battery		2

6. Battery Charger

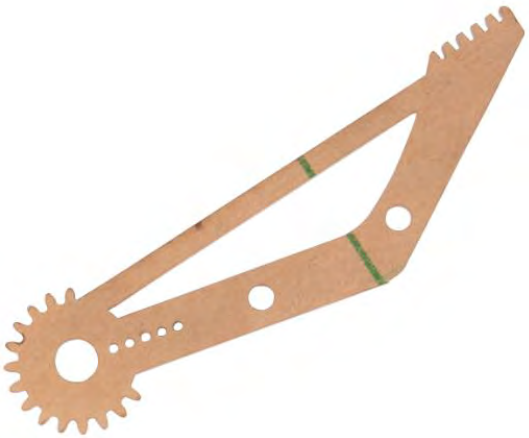
Battery Charger UL Approved		1

Prior to assembling the Robo-Arm, remove any residue in the holes of the plates and the stickers on the plates. See the Joint 1 Plate below, as an example.

1. Use a tool with a pointed tip to remove any excess residue that may still be in plate holes.



2. Use a pointed tip tool to scratch off the sticker on the plate.



3. How to Control

1. Install Arduino IDE
2. Control with Remote: **download** the Robo-Arm Rollarm package and **run** the program (Indispensable step before operating Robo-Arm Rollarm).
3. Control with Labview: **download** the Labview to your PC and install for control (download is a must-do before subsequent operating).

4. Getting Started with Software

4.1 Arduino

4.1.1 Description

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

4.1.2 Install Arduino IDE

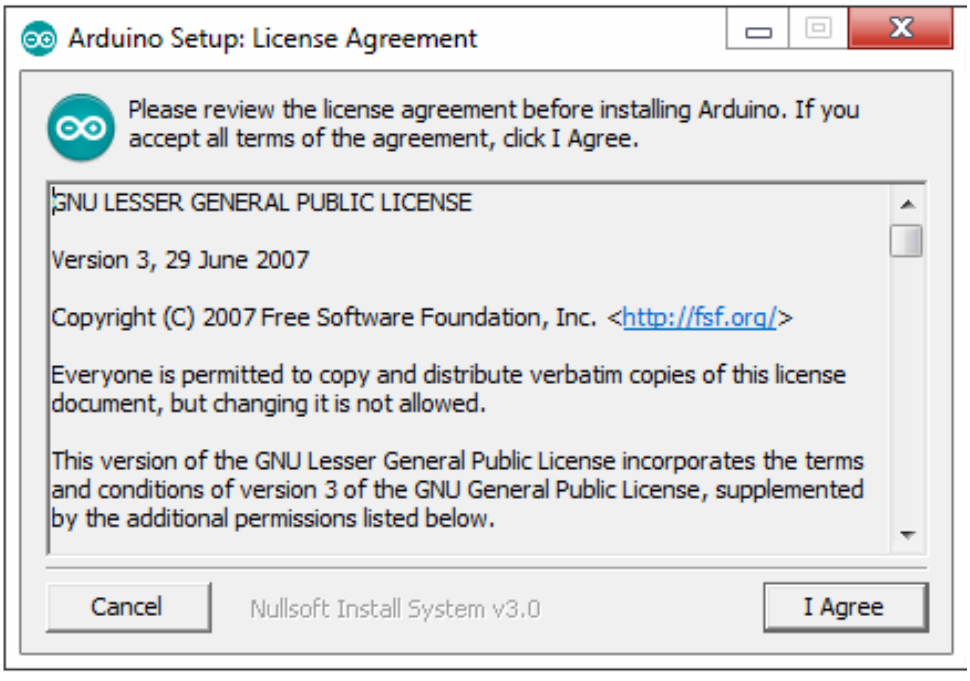
The code in this kit is written based on Arduino, so you need to install the IDE first. Skip it if you have done this.

Step 1: Go to the arduino.cc website and click **Download**. On the page, check the software list on the right side under Download the Arduino Software.

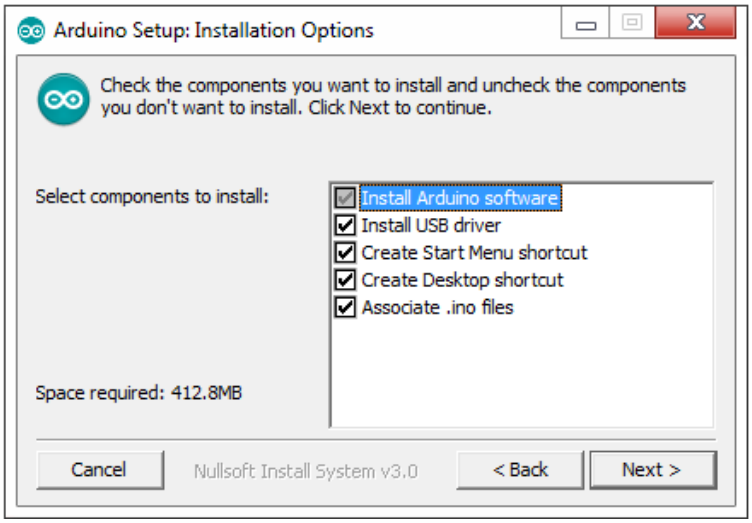
Have the Arduino Software on your computer before you begin, as you will need to configure servos as you build out the robot arm.

Find the one that suits your operation system and click to download. There are two versions of Arduino for Windows: Installer or ZIP file. You're recommended to download the former.

Step 2: Double click the .exe file and the following window will show up. Click **I Agree**. The following interface will show up.

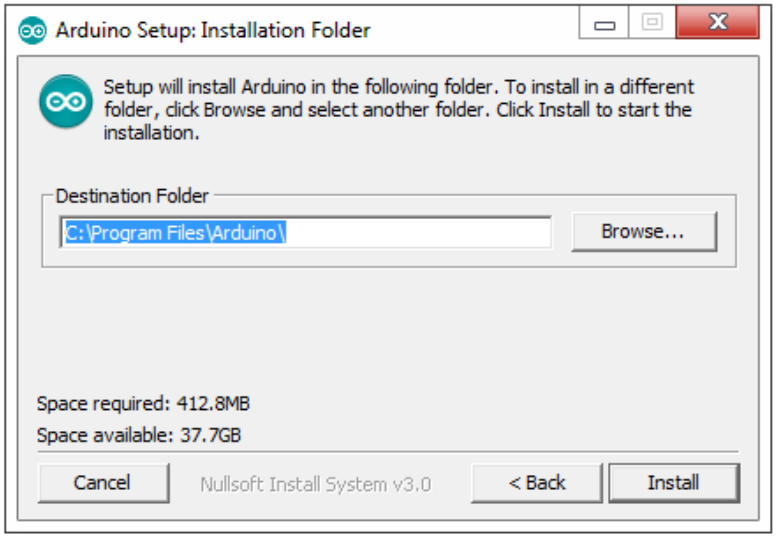


Choose **Next**.

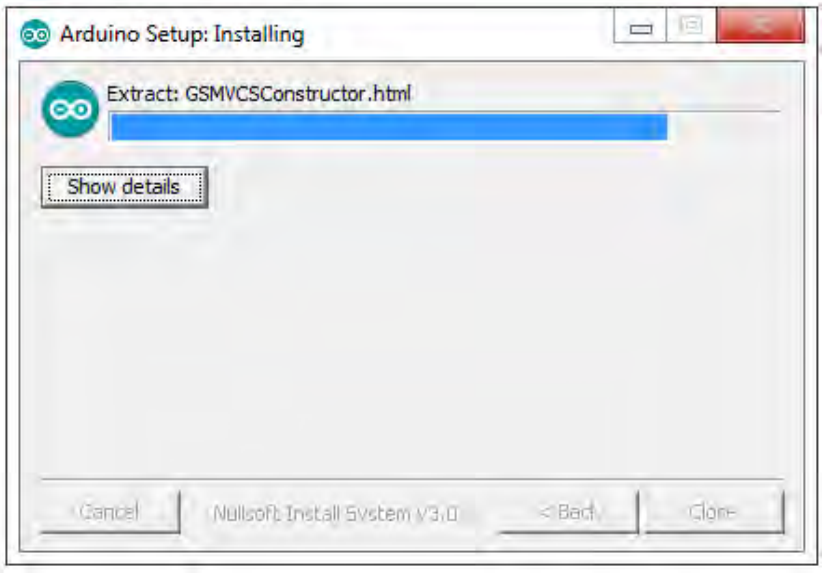


Click **Browse** to choose the installation path or enter a directory at the **Destination Folder**.

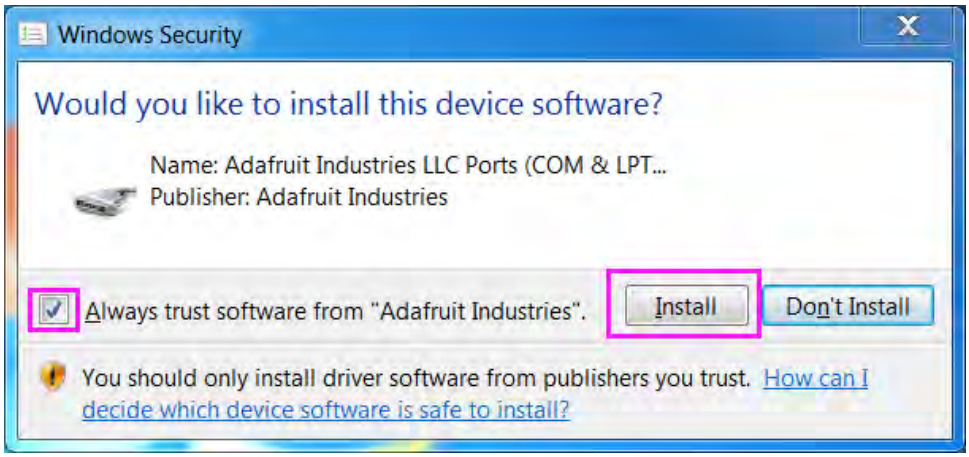
Click **Install.**



The following interface will appear.
Note: After the progress bar reaches the end, simply click on the activated Close button to exit.



The following prompt will appear. Select Always trust software for "Adafruit Industries" and click **Install**.



Select Always trust software for "Arduino srl" and click **Install**.

After the installation is done, click **Close**. Then an Arduino icon will appear on the desktop:

Resources

1. **Download and install the Arduino IDE for your system from here:**
   https://www.arduino.cc/en/Main/Software

2. **To download the programs that run on Arduino for the Robo-Arm, go to**
   http://v3.hamiltonbuhl.com/uploads/roboarm/DIY-RoboArm-Arduino.zip

   - Download the zip file to your local hard drive and open.
   - Reference the detailed instructions when you install these files.
   - For a complete set of instructions, go to the Instructions folder and open the PDF or watch the video (see links below)
   - Each program below should be uploaded separately when your robot is ready to program for each function.

   Inside the folder you will see:

   DIY_Control_Robot_Arm_kit_for_Arduino-Rollarm

   a. **ArduinoCode Folder:**
      - Arduino Code/Servo/Servo.ino is the installer for powering the servos
      - Arduino Code/LIFA_Base /LIFA_Base.ino is the communication between Labview Software and Arduino
      - Rollarm/Rollarm.ino is the control for servos and has three sub-programs that will open automatically when you open the main program: Rollarm.ino.

   b. **Instructions Folder:** Contains the full Instruction Manual for RoboArm
   c. **Schematic Folder:** Contains diagrams for board set up.

3. **Labview software to control the robot from your PC can be found here:**
   http://v3.hamiltonbuhl.com/uploads/roboarm/Labview.zip
   Double-click the setup.exe file to install.

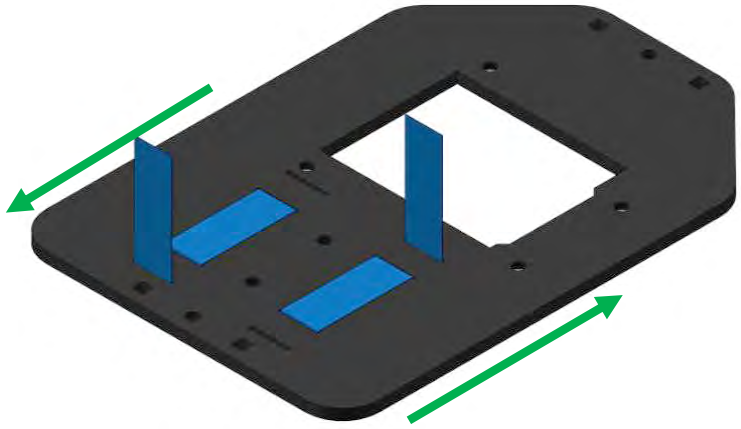
4. **Below are links to helpful instructional and installation videos:**
   http://v3.hamiltonbuhl.com/uploads/roboarm/videos/RoboArm-Part1.mp4

   http://v3.hamiltonbuhl.com/uploads/roboarm/videos/RoboArm-Part2.mp4

5. Assembly

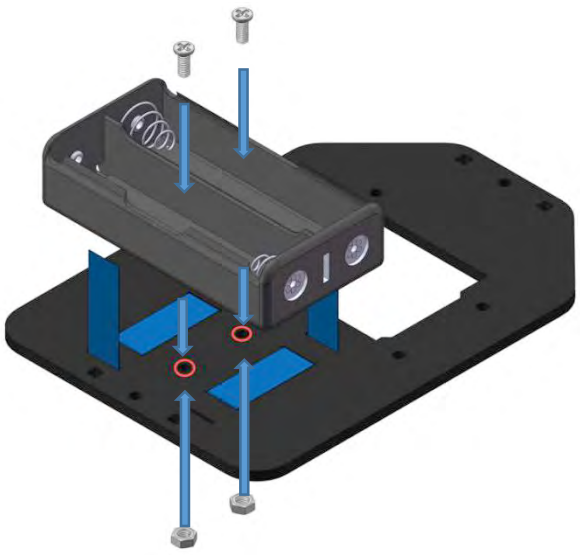
5.1 Base Bottom Plate and Ribbon

1. Cut the ribbon into halves. Thread the ribbon through the acrylic plate. Leave extra ribbon out to easily pull batteries out, as needed. Thread another ribbon through the base bottom plate.



5.2 Base Bottom Plate and Battery Holder

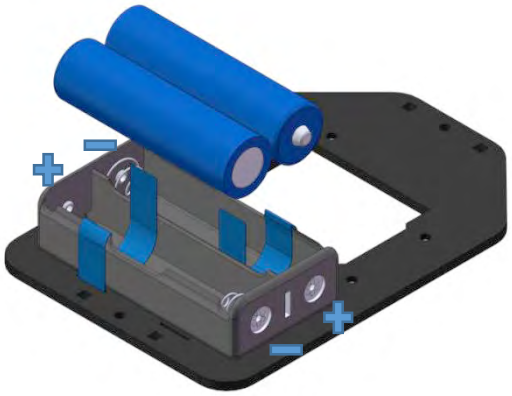
1. Place the battery holder on the base bottom plate. Put two M3 nuts underneath the plate and keep them aligned with the holes on the holder.



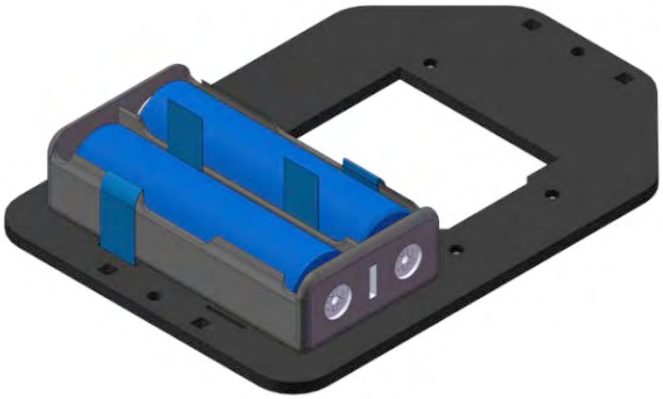
2. Insert two M3*8 flat-head screws into the nuts and fasten with screwdriver.

3. Fold the ribbon in the battery holder.

4. Insert batteries according to the proper polarity (+/-) as indicated.

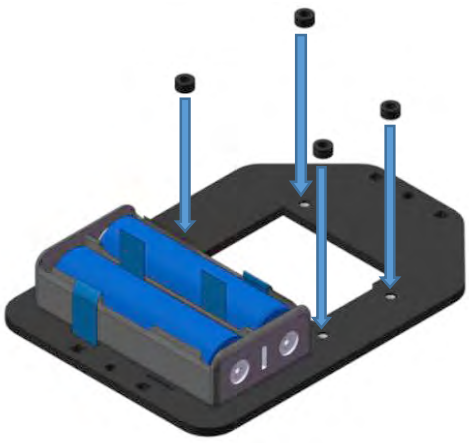


5. Insert the battery into the battery holder.



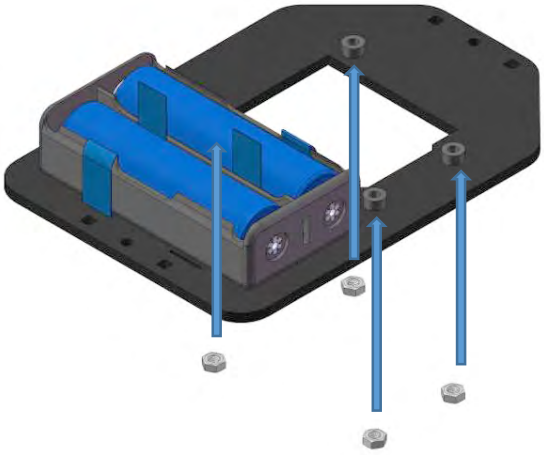
5.3 Base Bottom Plate and Circuit Board

1. Align four acrylic washers with the holes of the base bottom plate (a spare washer is provided).

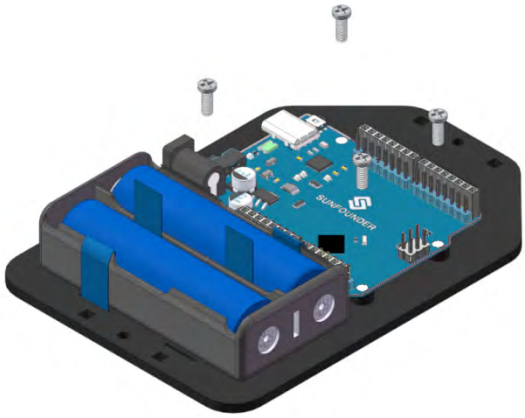


2. Place four acrylic washers on the base bottom plate.

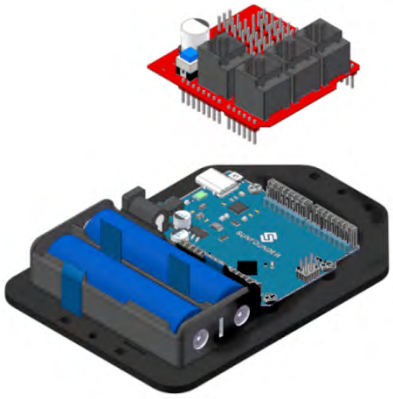
3. Align the acrylic washers and holes on the plate. Put 4 M3 nuts into the holes underneath the plate.



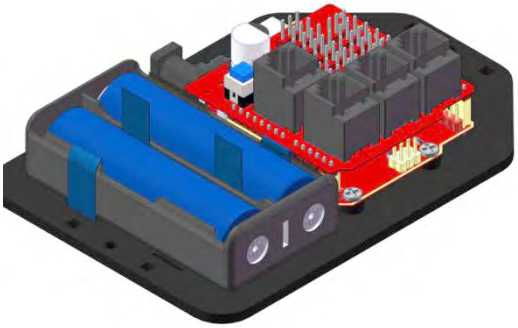
4. Place the Uno board onto the plate with its holes aligned with the washers. Fasten with M3*10 screws.



5. Align the pin headers of the expansion board with the sockets of the Mars board.

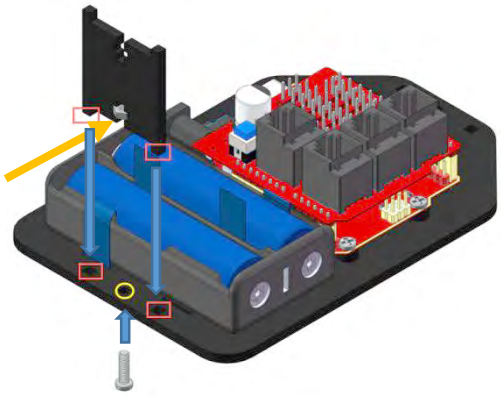


6. Insert the pin headers into the sockets.

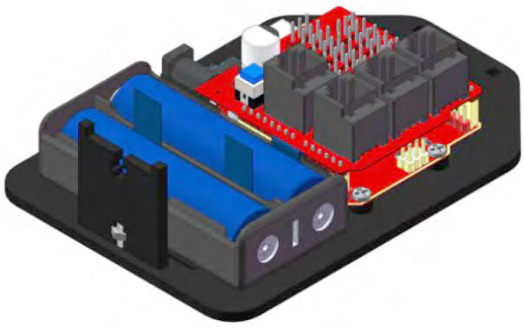


5.4 Base Bottom Plate and Base Fixing Plate

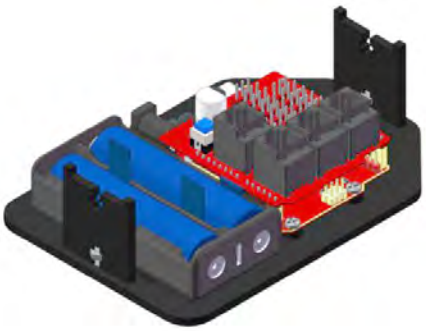
1. Put an M3 nut in the hole of base fixing plate. Align its notches with the slots of the base bottom plate.



2. Insert the notches into the slots. Affix the two plates with M3 nut and M3*10 screw.

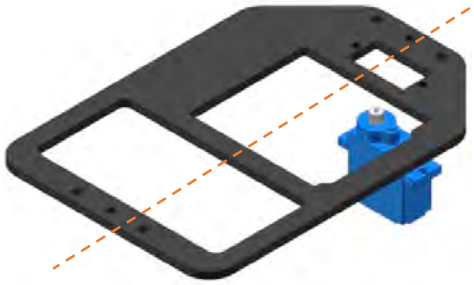


3. Mount the other base fixing plate in the same way.

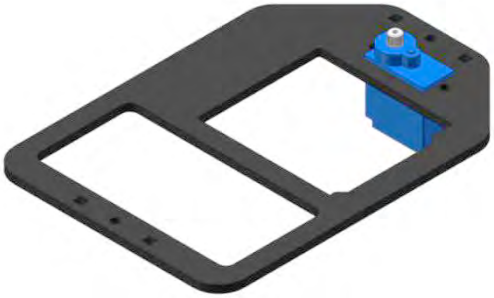


5.5 Base Upper Plate and Servo

1. Align the servo with the slot of the base upper plate, with the rotating axis close to the middle line of the base upper plate.

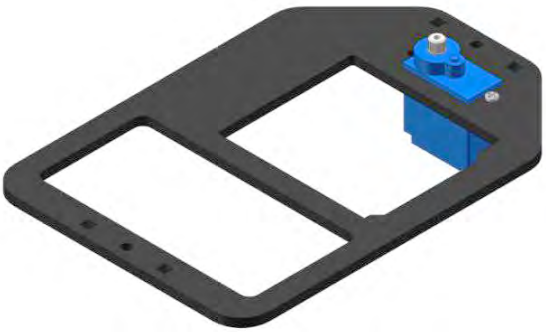


2. Insert the servo into the slot, as shown.



3. Hold an M2 nut under the hole of the servo and the upper plate and insert an M2*8 screw.

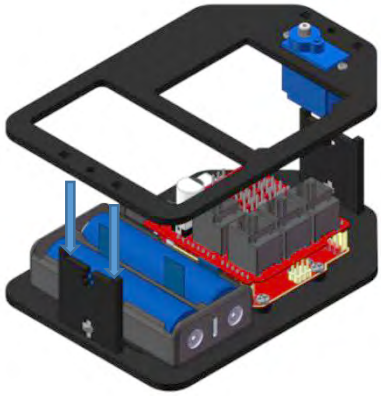
4. Fasten them with screwdriver.



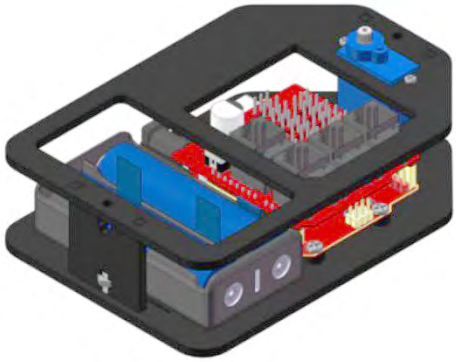
5. Fasten the other screw and nut the same way.

5.6 Base Fixing Plate and Base Upper Plate

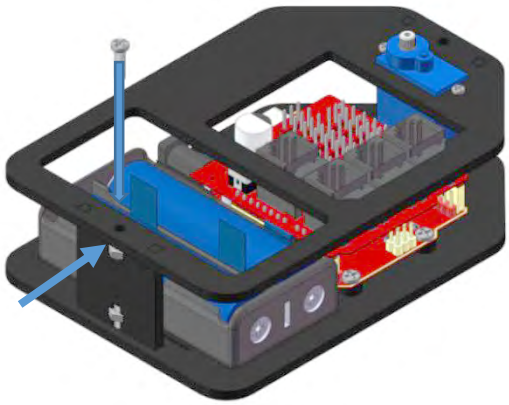
1. Align the holes of the base upper plate with the notches of the base fixing plate.



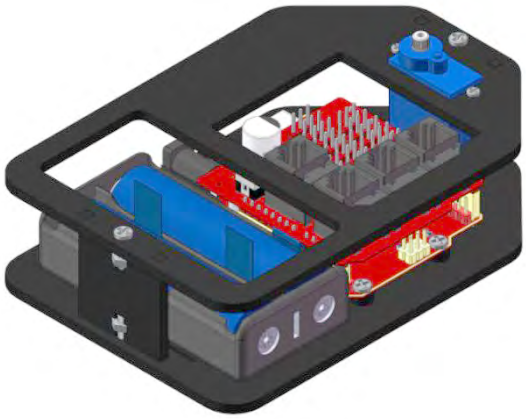
2. Insert the notches into the slots.



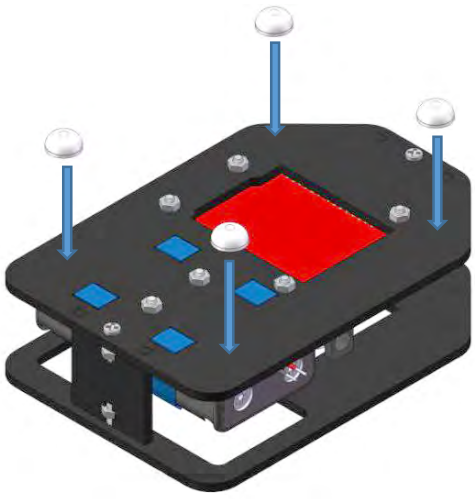
3. Put an M3 nut in the hole of the base fixing plate. Insert an M3*10 screw through the plate into the nut and fasten with screwdriver.



4. Fasten the other screw the same way.



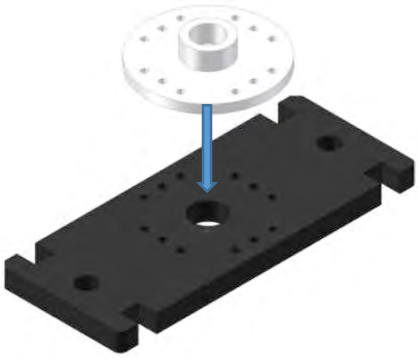
5. Affix four non-skid pads onto the corners of the base bottom plate.



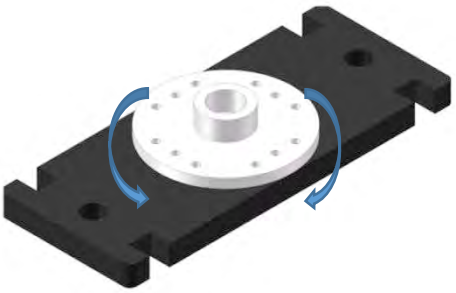
6. It should look like this:

5.7 Joint 1 Connecting Plate and Servo Rocker Arm

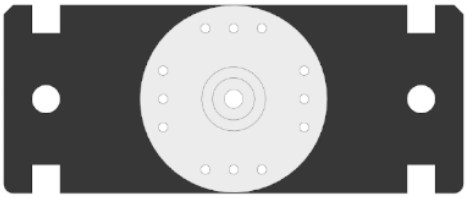
1. Align the servo rocker arm with the hole of the joint 1 connecting plate.



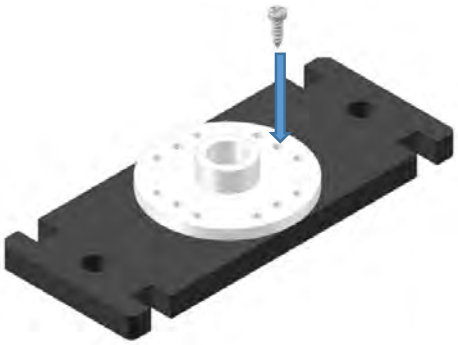
2. Put the rocker arm on the connecting plate and rotate it to align its holes with those of the plate.



3. Align the holes like this:



4. Insert M1.2*4 self-tapping screw into a hole of the plate through the rocker arm.



5. Fasten with the screwdriver.

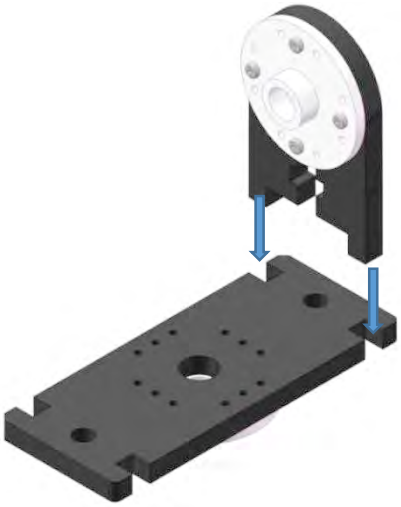
6. Fasten the other self-tapping screws the same way.

7. Affix a servo rocker arm on the right joint plate 1 the same way.

8. Do the same on the right-joint plate 3.

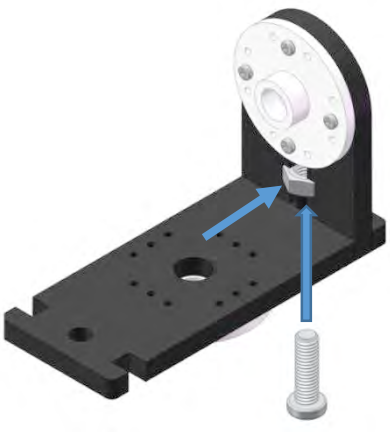
5.8 Joint 1 Connecting Plate

1. Align notches of right-joint plate 1 with the slots on the joint 1 connecting plate.



2. Insert the notches into the slots.

3. Put an M3 nut into the hole of right joint plate 1 and insert an M3*10 screw into the nut through the connecting plate.

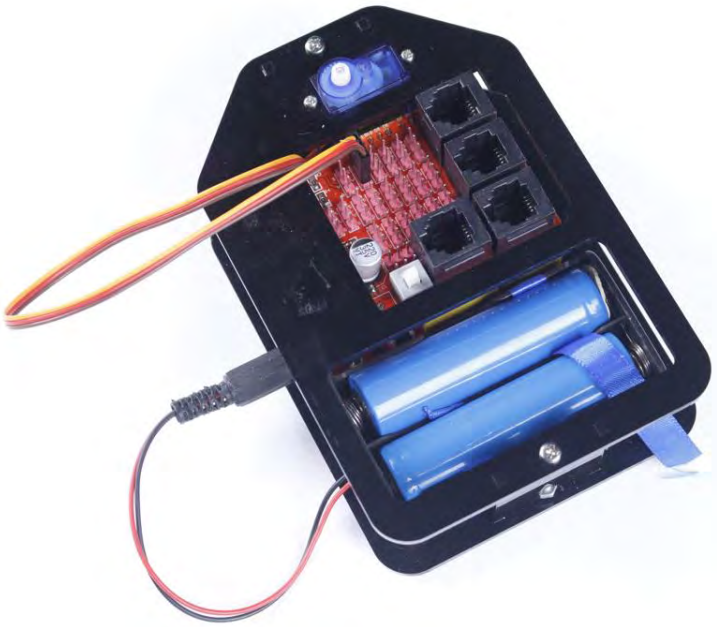


4. Fasten with screwdriver.

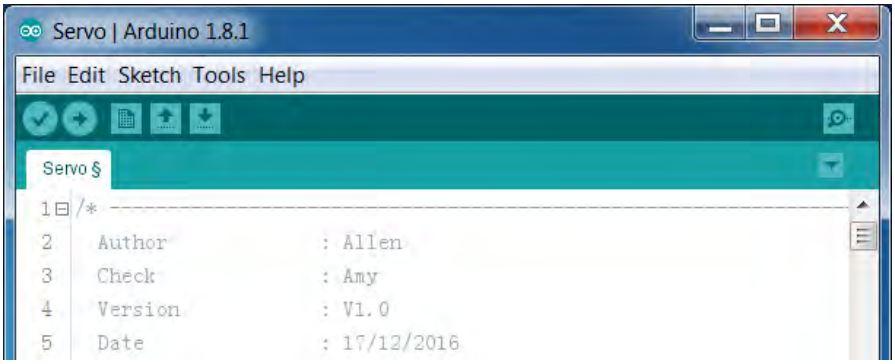
5.9 Base and Joint 1 Connecting Plate

Note: Before installing the rocker arms for each servo, you need to configure the servo.

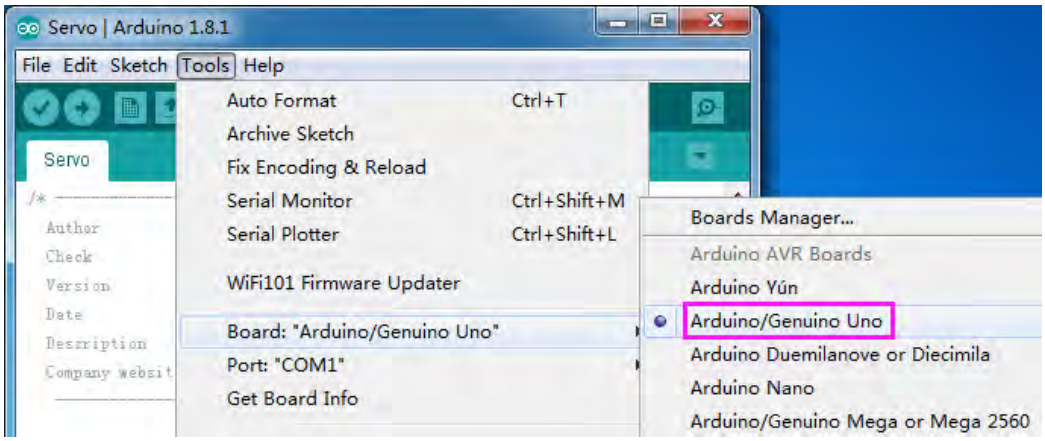
Step 1: Connect the servo wires into D4. Connect the battery power wires to the power point as shown. Connect the servo control board to the PC via USB cable. The driver will automatically be installed. The COM port connected will appear.



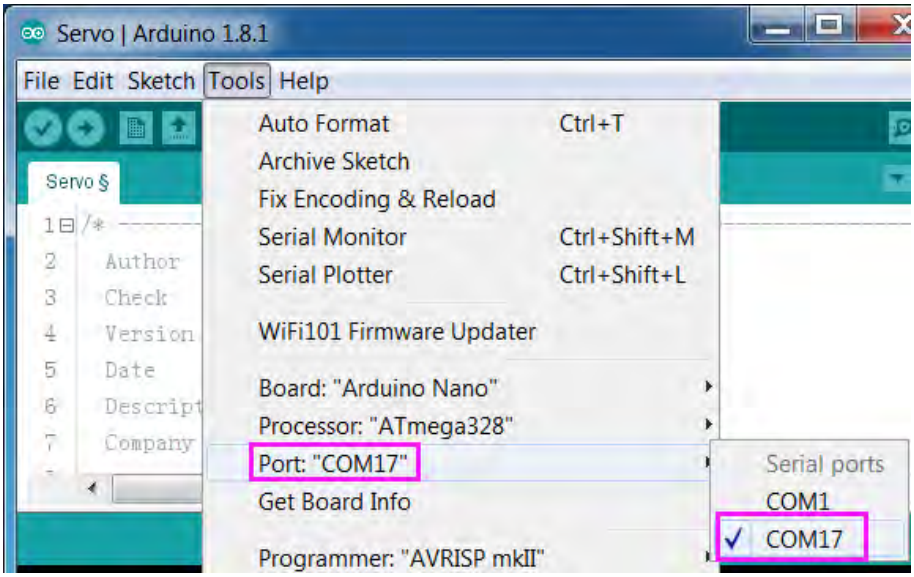
Step 3: Go to the folder **DIY Control Robot Arm kit for *Arduino-Rollarm/Arduino Code /Servo*** and open the file Servo.ino.



Step 4: From the **Tools** dropdown, select the **Board**, then Arduino

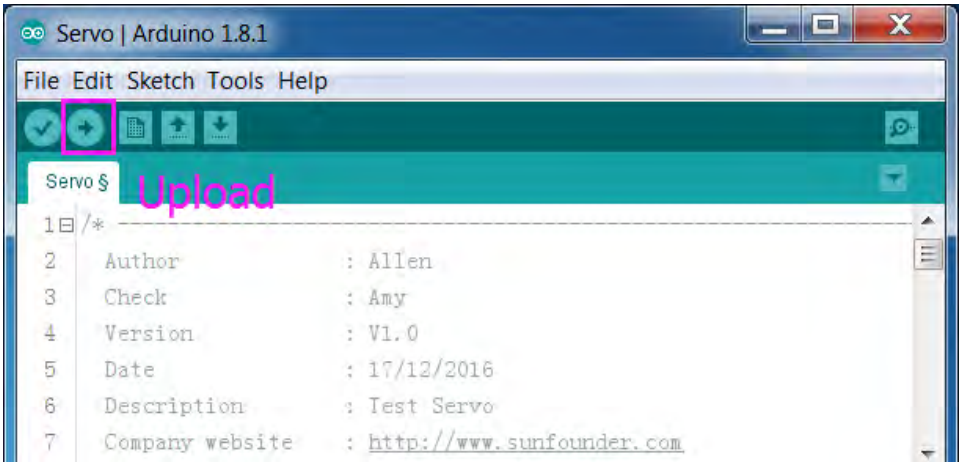


and **Port Detected Automatically: COM17 e.g**.

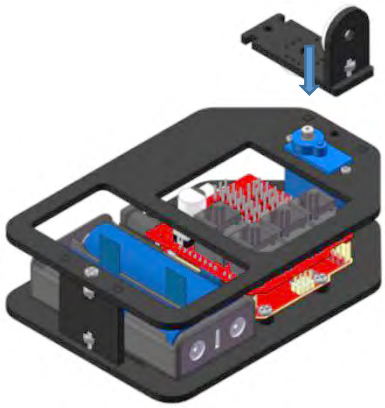
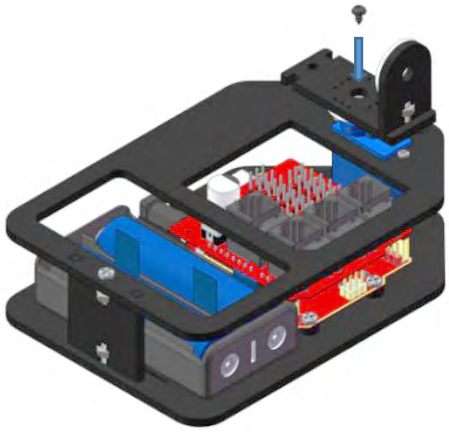
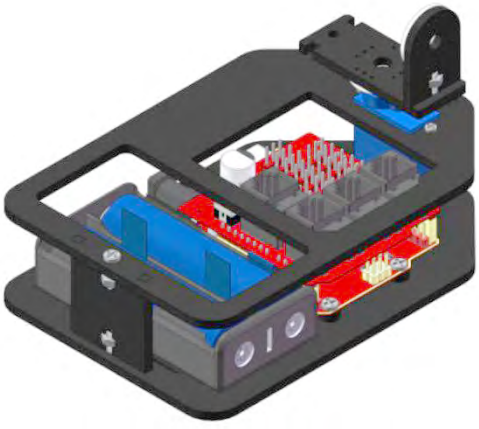


*If there are multiple ports available/showing, make sure to select the correct port.

Step 5: Click **Upload**.



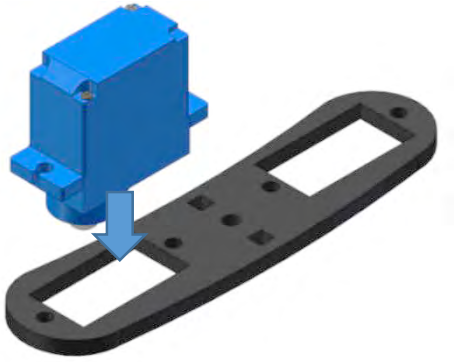
After the upload is complete, unplug the USB cable and press the switch on the board.
If the servo shaft is at 90 degrees, it will not move and you will not hear any gear sound.
If it's not at 90 degrees, you will hear a gear sound as you move it to a 90 degree position.

1. Align the edge of the connecting plate with that of the base plate. 	2. Install the servo rocker arm onto the servo shaft. 
3. Fasten them with M2*4 self-tapping screw. 	4. It should look like this. 

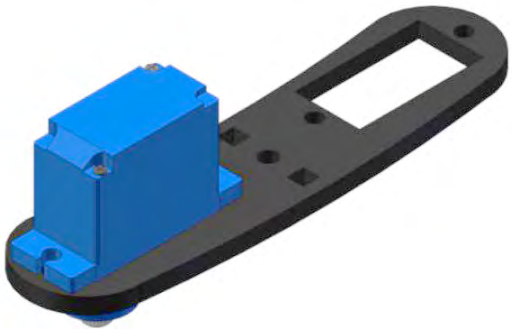
5.10 Joint 2 and Right Joint Plate 2

1. Align the servo with the right joint plate.

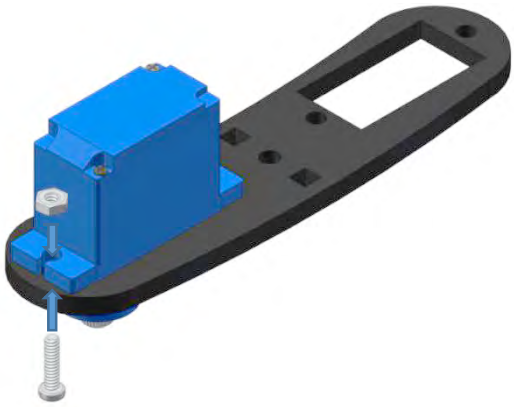
Make sure the servo shaft points to the plate end, near the slot where the servo will be placed.



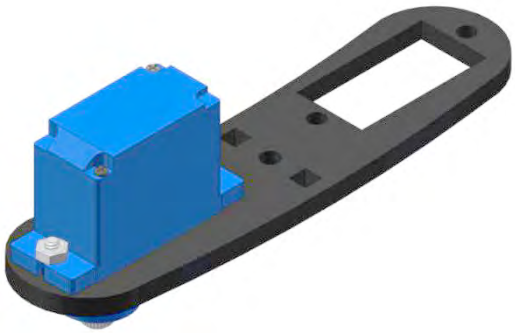
2. Insert the servo into the slot on the plate.



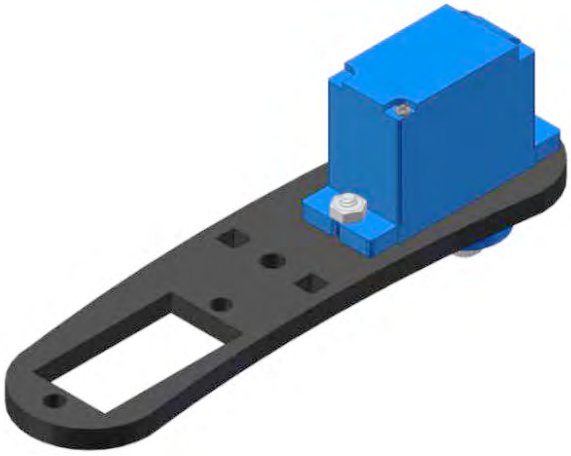
3. Put an M2 nut in the hole on the end of the servo and insert M2*8 screw through the other side of the plate. Screw through to the nut.



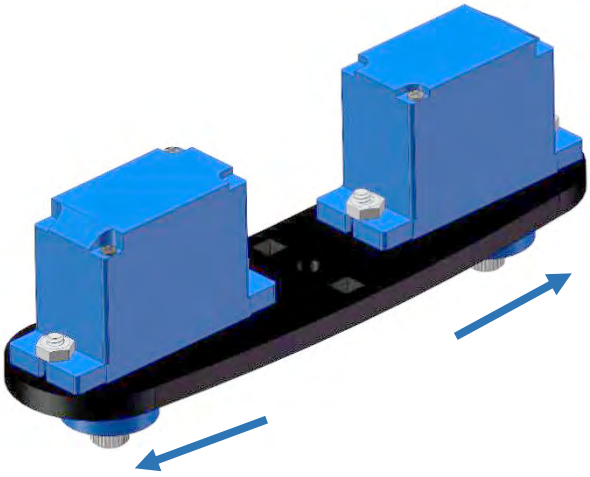
4. It should look like this:



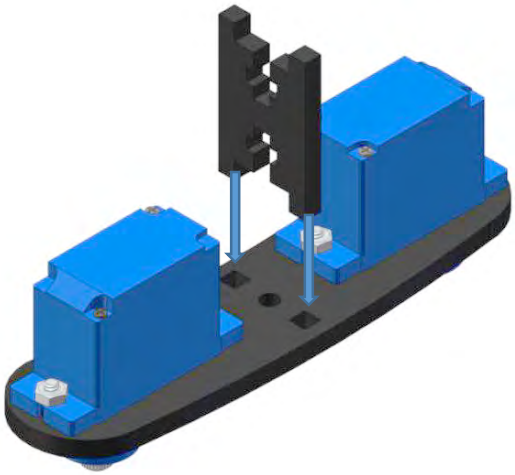
5. Fasten the other screw the same way.



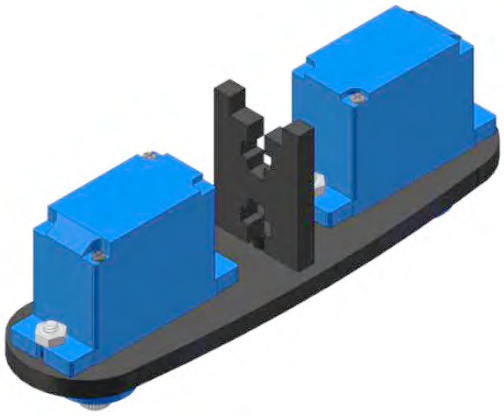
6. Affix the other servo in the same way.



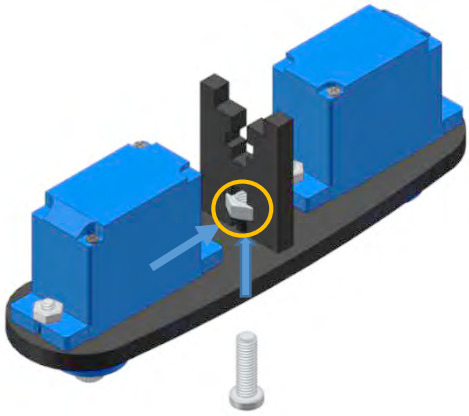
7. Align the notches of the joint 2 connecting| plate with slots of right joint plate 2.



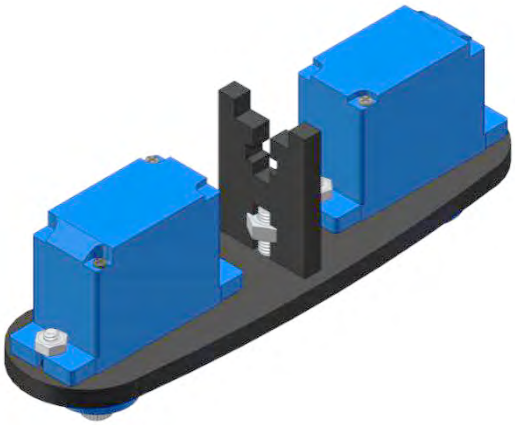
8. Insert the notches into the slots.



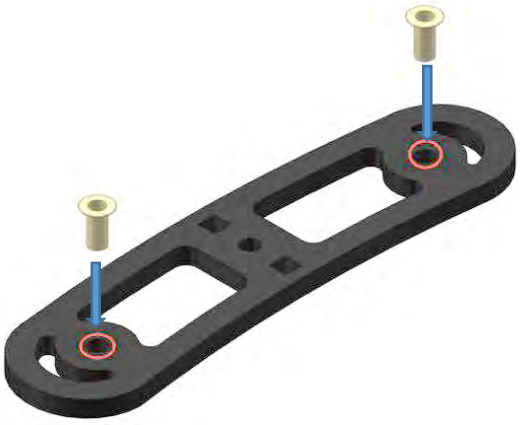
9. Put an M3 nut into the joint 2 connecting plate hole and insert M3*10 screw into the nut.



10. Fasten with screwdriver.

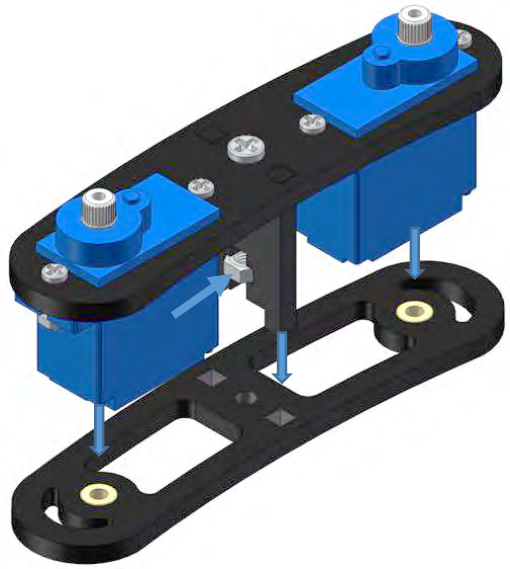


11. Align two M3*6 copper corn rivets with the holes on the left joint plate 2.

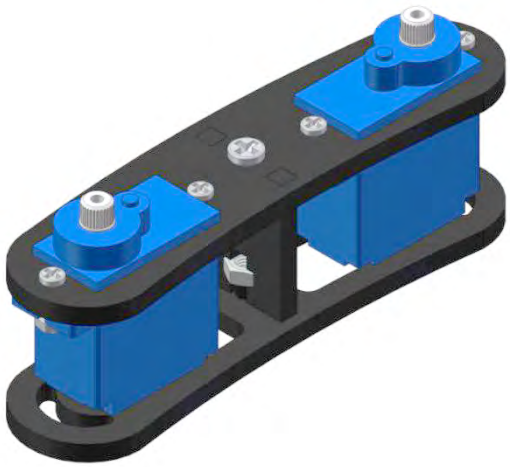


12. Insert rivets into the plate holes.

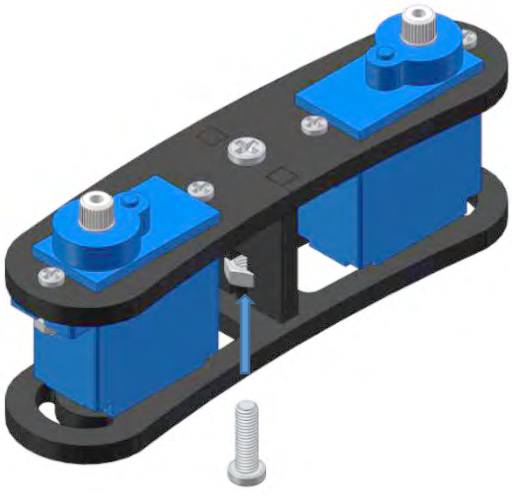
13. Put the M3 nut in the hole of the joint 2 connecting plate. Align the notches on the plate with the slots on left joint plate 2.



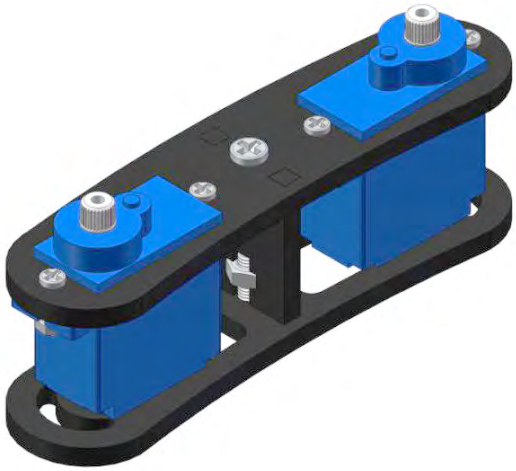
14. Insert the notches into the slots.



15. Insert M3*10 screw into the nut and fasten them with the screwdriver.

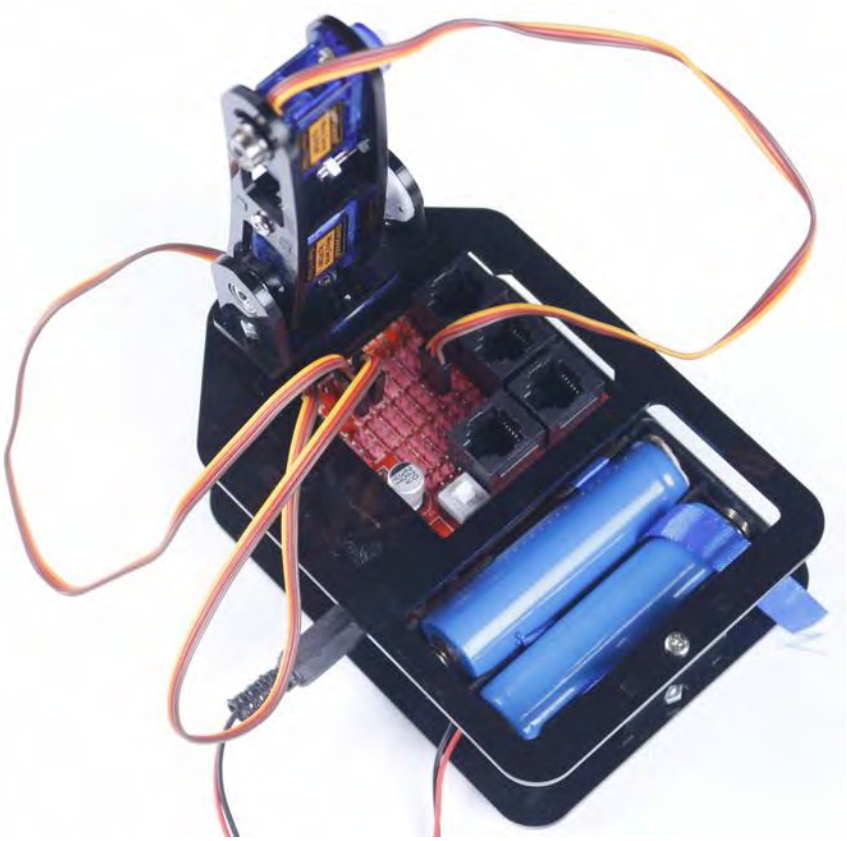


16. It should look like this:



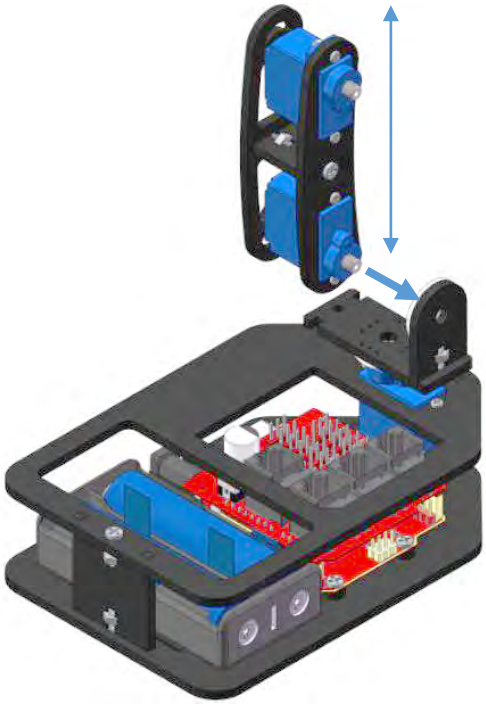
5.11 Joint 1 Connecting Plate and Joint 2 Connecting Plate

Note: Connect the servo of the joint 2 connecting plate to port D5 on the expansion board, and the servo on joint 3 connecting plate to port D6. Power on the servos, then they will be able to rotate 90°.

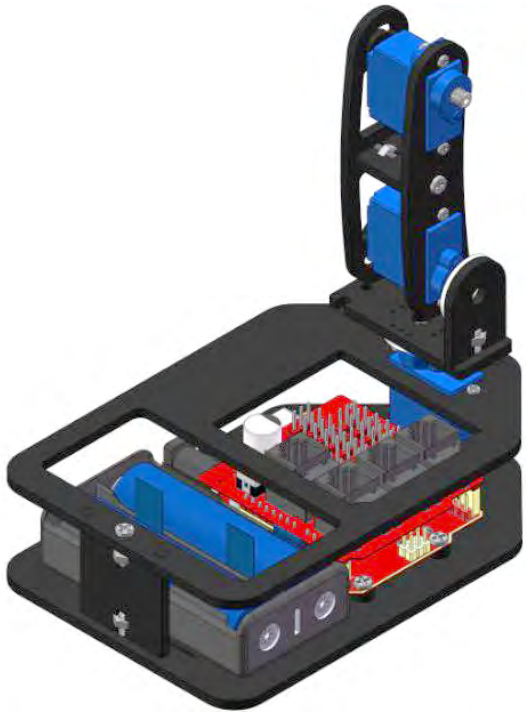


1. Power on the servo. Connect the servo of joint 2 connecting plate to port 5 on the expansion board. Align the servo shaft with the round rocker arm connected to the joint 1 connecting plate.

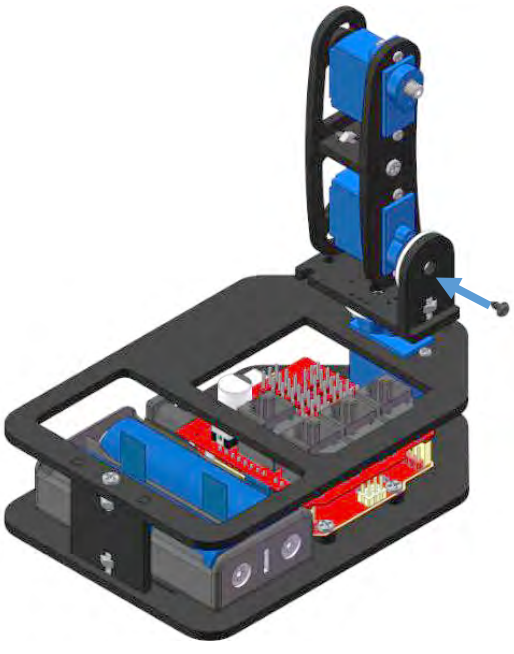
   The servo position should now look like this:



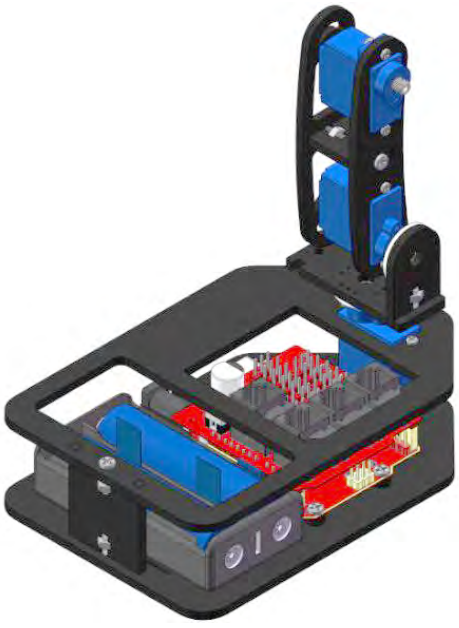
2. Insert the shaft into the rocker arm.



3. Fasten with an M2*4 self-tapping screw.

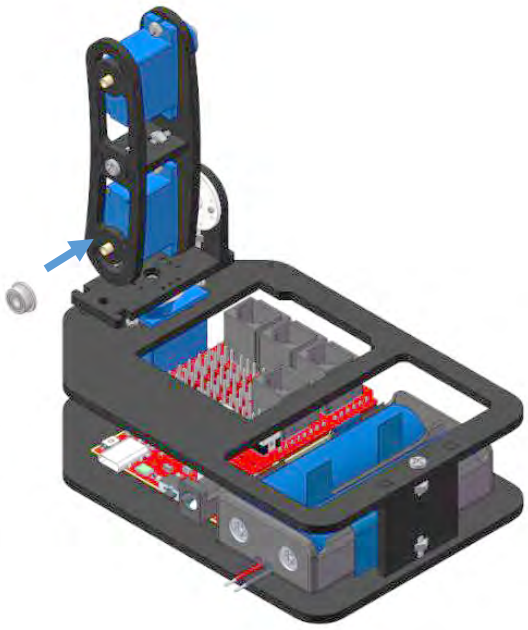


4. It should now look like this:



5.12 Joint 1 Connecting Plate

1. Align band edge bearing with the corn rivet. Put the bearing into the rivet.



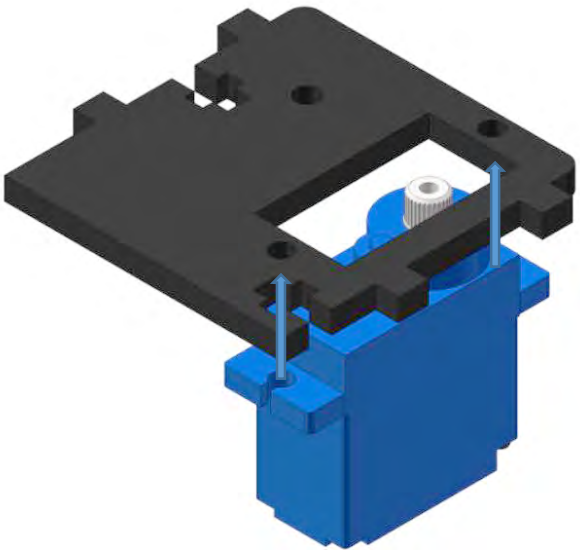
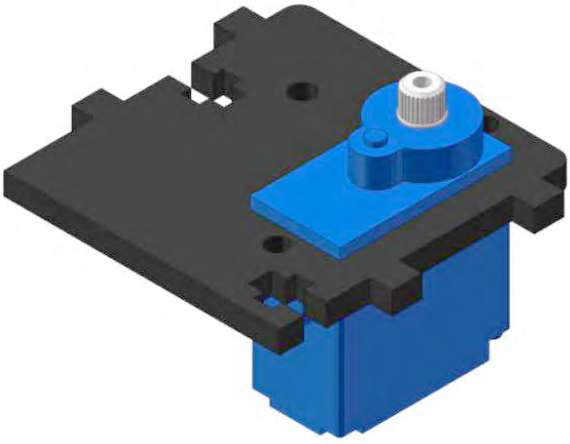
2. Move the bearing against the joint 2 connecting plate and align with the hole on left joint 1 connecting plate.

3. Insert the notches of left joint 1 into the slots of the joint 1 connecting plate and insert the bearing into the hole, as shown.

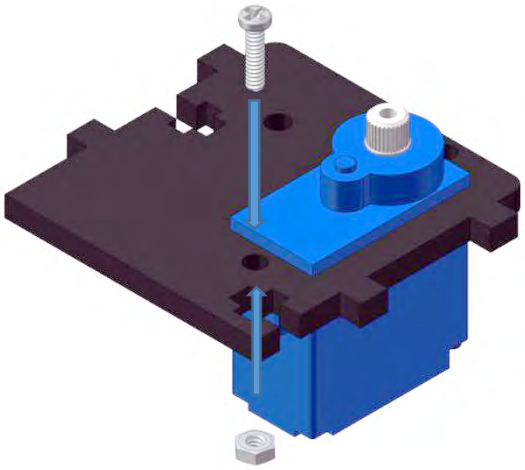
4. **Turn the power switch off.** Rotate the joint 1 connecting plate 90 degrees clockwise.

5. Put an M3 nut in the hole on left joint connecting plate 1. Insert and fasten an M3*10 screw into the nut. 	6. It should look like this: 

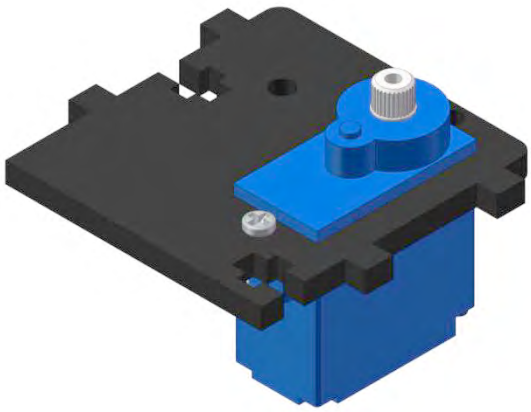
5.13 Gripper Fixing Plate

1. Align the servo with the slot on the gripper fixing plate, paying attention to the direction of the shaft, as shown. 	2. Insert servo into the slot. 

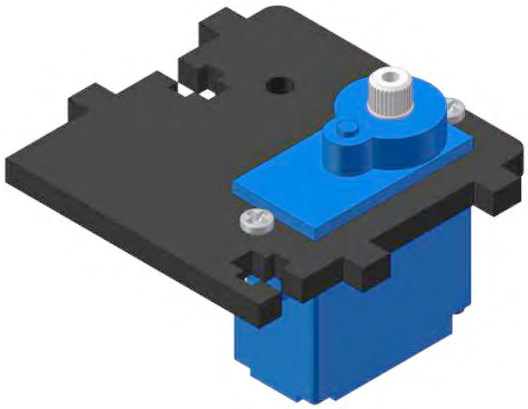
3. Put an M2 nut underneath the hole and and insert and fasten with an M2*8 screw, as shown.



4. It should look like this:



5. Fasten a screw on the other side the same way, as shown:

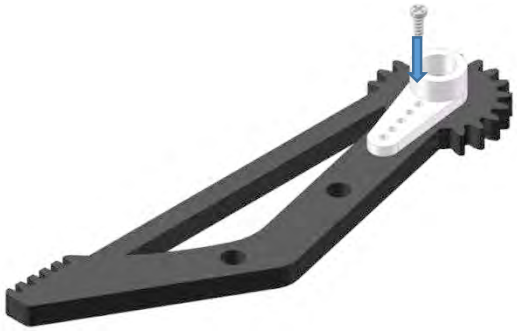


5.14 Gripper Driving Plate

1. Align the servo rocker arm with the hole of the gripper driving plate. Note: Pay close attention to which side the rocker is on.

2. Put the rocker arm on the plate.

3. Insert an M1.2*4 self-tapping screw into the first hole of rocker arm.



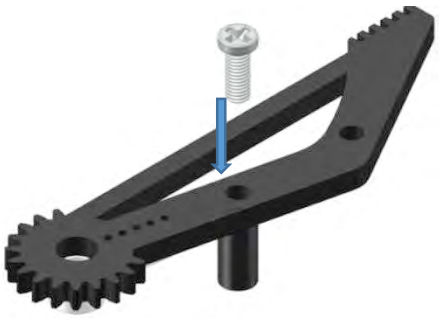
4. Fasten with screwdriver.

5. Insert an M1.2*4 self-tapping screw into the last hole and fasten, as shown.

6. Align an M3*10 aluminum tube with the existing hole on the plate, as shown.

7. It should be positioned like this:

8. Insert an M3*8 screw into the tube from the other side of the plate.



9. Fasten with screwdriver.

10. Add another aluminum tube the same way, as shown.

11. Align the holes of the gripper assistant with the aluminum tubes.

12. It should look like this:

13. Fasten together with an M3*8 screw.

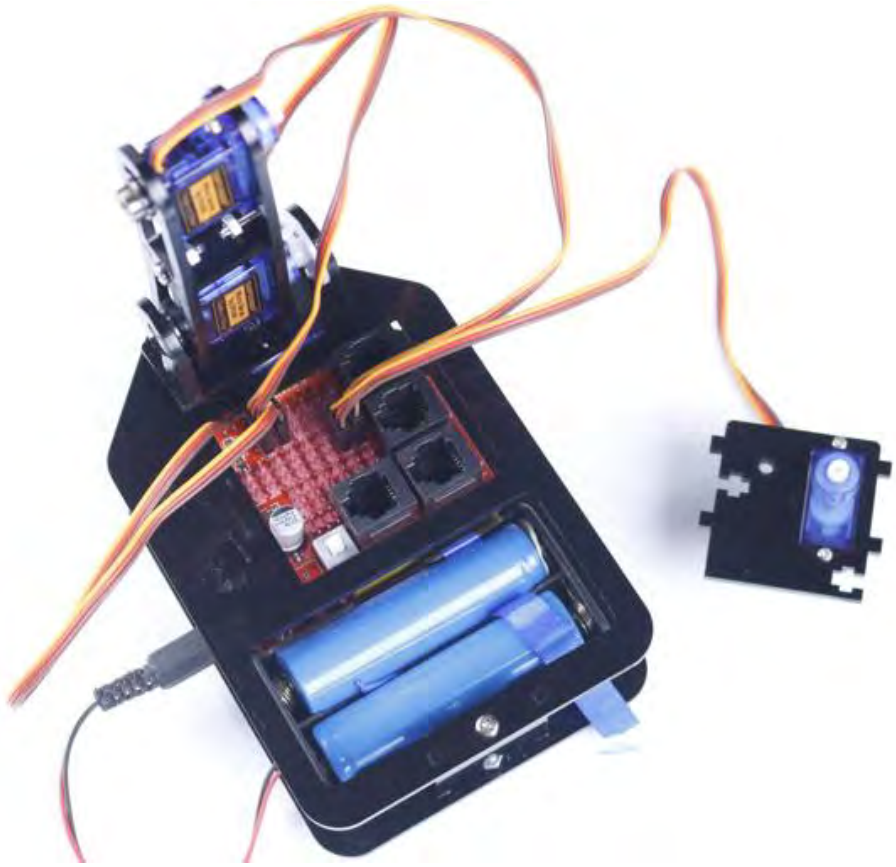
14. It should look like this:

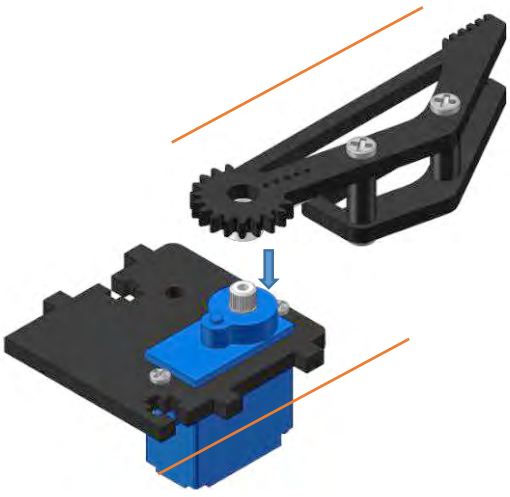
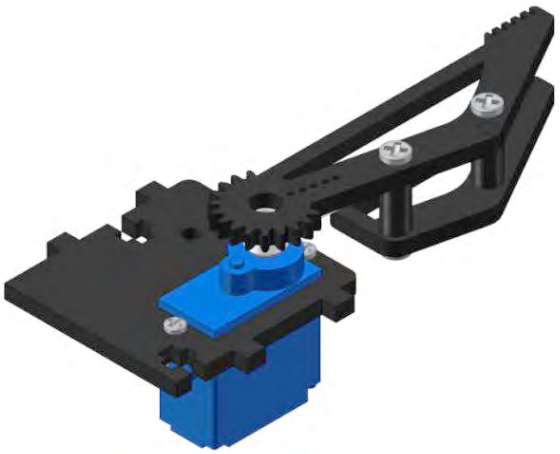
15. Add an M3*8 screw to the other tube.

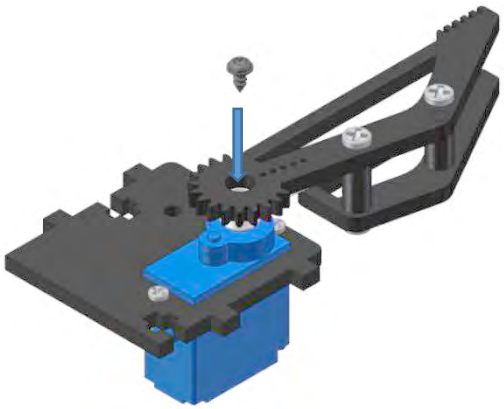
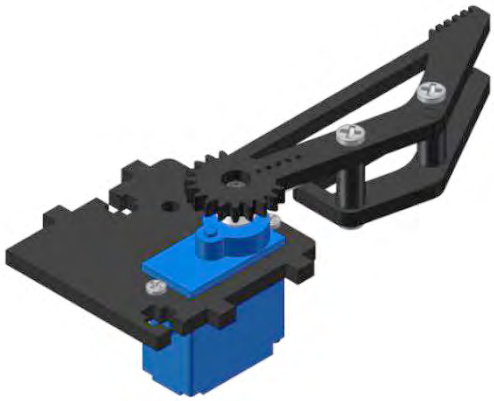
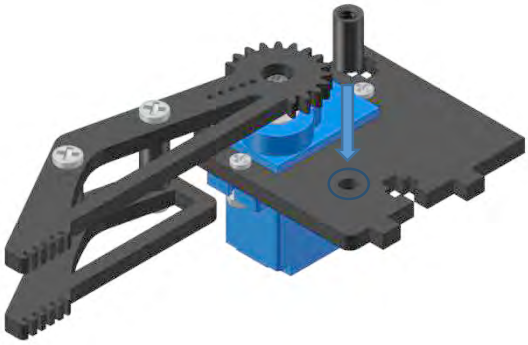
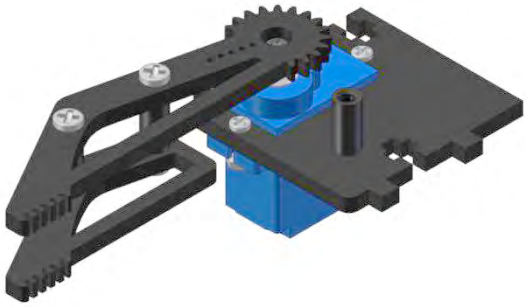
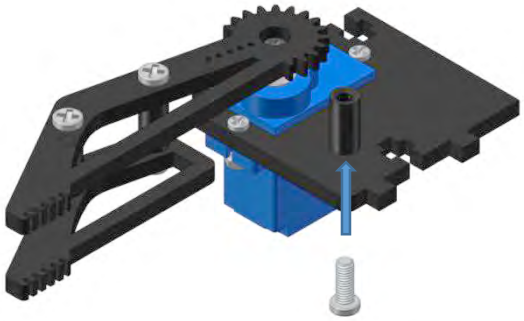
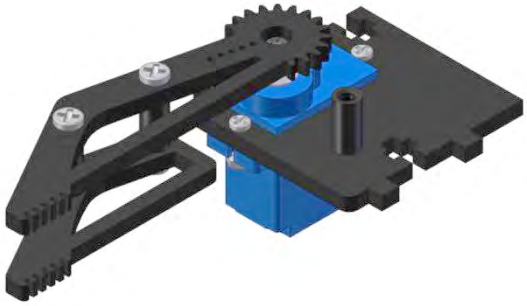
16. Install the gripper driving plate the same way.

5.15 Grippers and Gripper Fixing Plate

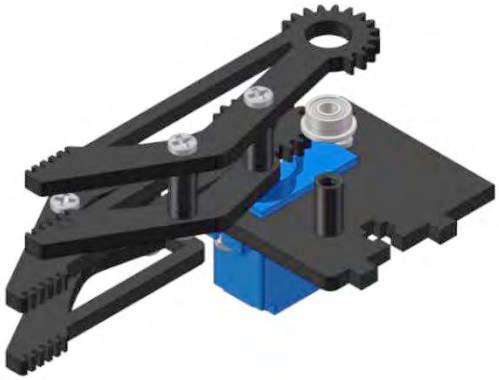
Note: Connect the servo of the gripper fixing plate to port D7 on the expansion board. Then, power on the servo. The servo will rotate 170 degrees.



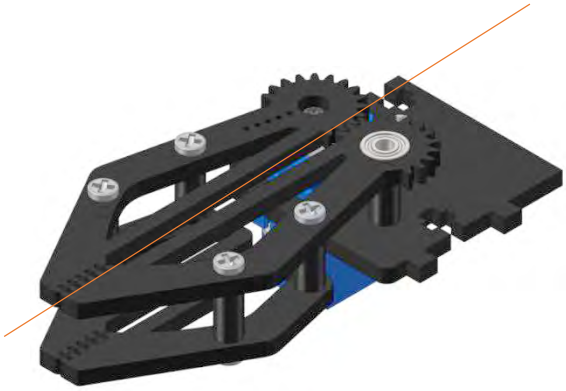
1. Power on and connect the servo of the gripper fixing plate to port 7 on the expansion board. Align the servo rocker arm with the shaft, keeping the gripper edge of the driving plate parallel to the side of the fixing plate. 	2. Insert the servo shaft into the rocker arm. 

3. Fasten with an M2*4 self-tapping screw. 	4. It should look like this: 
5. Align an aluminum tube with the hole on the gripper fixing plate. 	6. Place the tube on the plate. 
7. Insert an M3*8 screw through the hole. 	8. Fasten with screwdriver. 

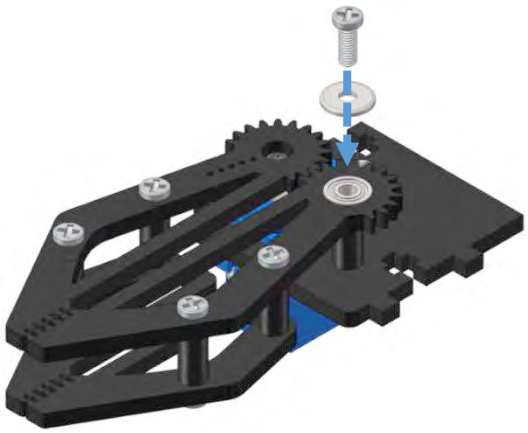
9. Put the other gripper-driving plate onto the bearing.



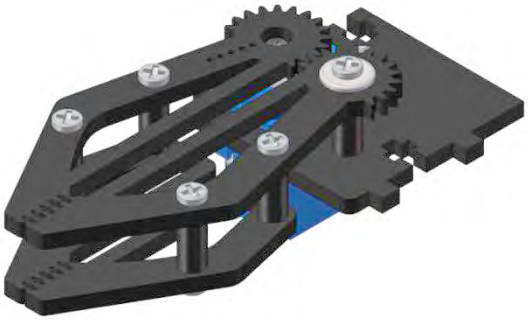
10. Keep the inner edges of the two gripper plates parallel and the gears meshed.



11. Put a 3*10*1 washer on the bearing and fasten with an M3*8 screw, as shown.

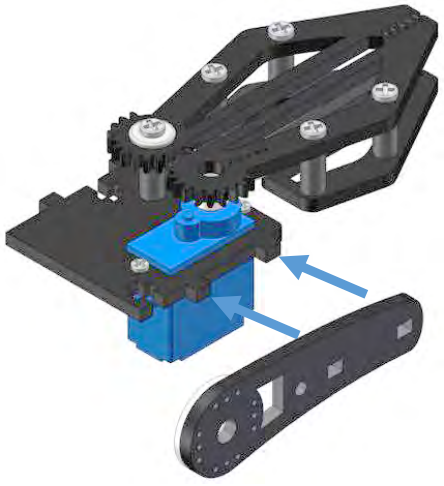


12. It should look like this:

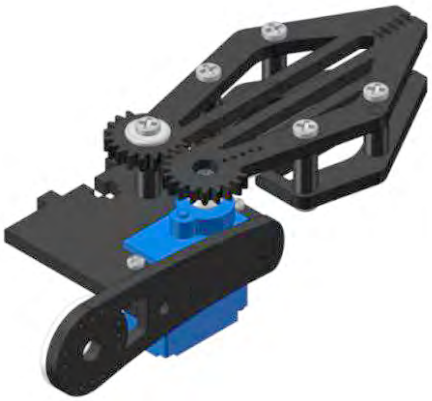


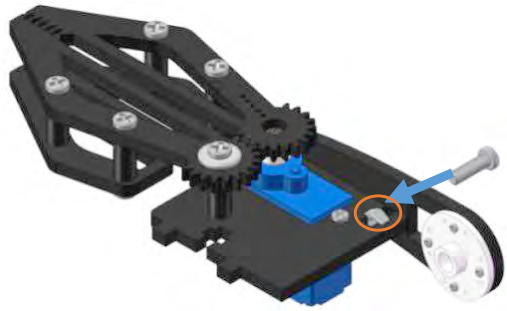
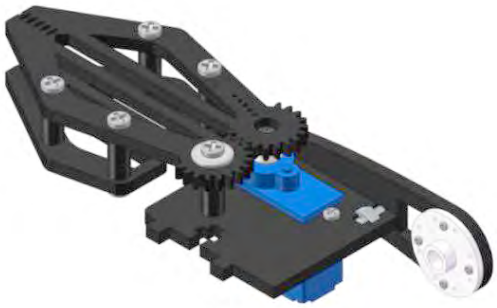
5.16 Gripper Fixing Plate and Right Joint Plate 3

1. Align the notches on the gripper fixing plate to the slots on right joint plate 3.

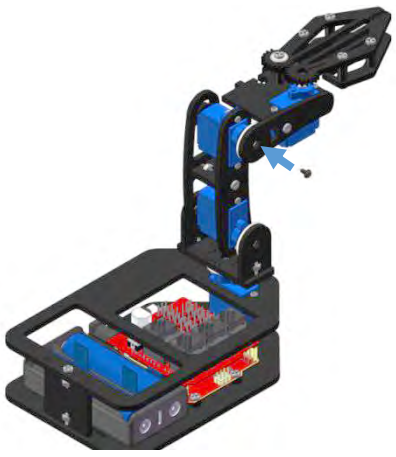
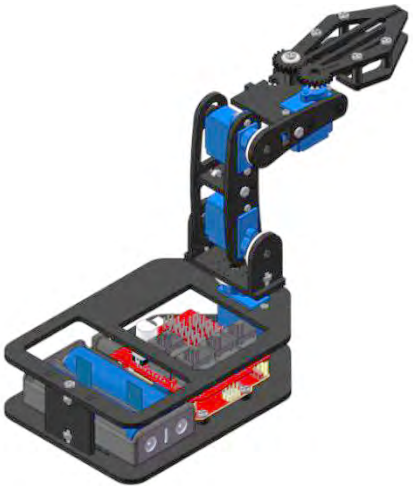


2. Insert into the slots.



3. Put an M3 nut in the hole on the gripper fixing plate and insert an M3*10 screw into the nut. 	4. Fasten with screwdriver. 

5.17 Joint 2 Connecting Plate and Joint 3 Connecting Plate

1. Power on the servo and connect the servo wire on the joint 3 connecting plate to port 6 on the expansion board. Align the servo rocker arm with the shaft, keeping the two joint plates almost perpendicular to each other. 	2. It should be positioned like this: 
3. Fasten them with an M2*4 self-tapping screw. 	4. It should look like this: 

5.18 Left Joint Plate 3

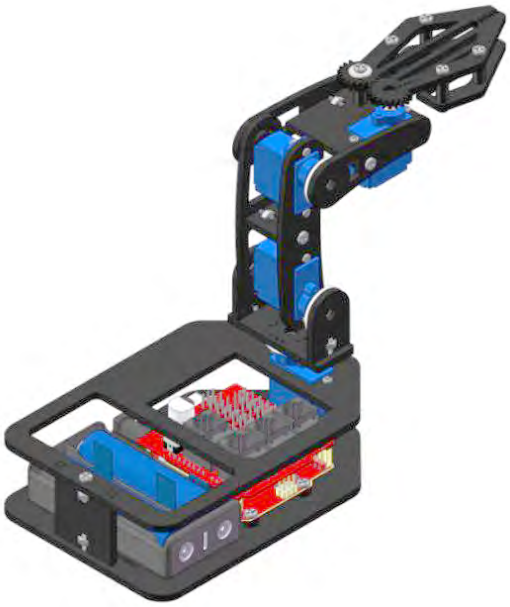
1. Align the band edge bearing with the corn rivet, as shown.

2. Align the left joint plate 3 hole with the bearing.

3. Insert the notches on the gripper fixing plate into the slots on left joint plate 3.

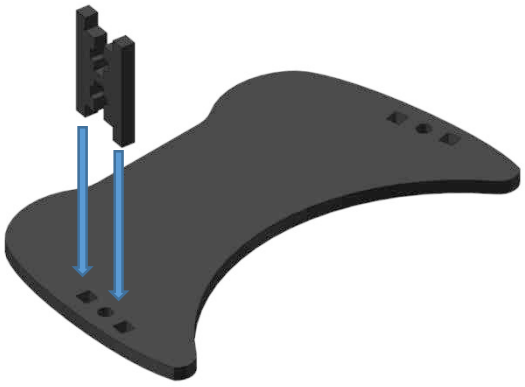
4. Put an M3 nut in the fixing plate hole and insert an M3*10 screw into the nut.

5. Fasten with screwdriver.



5.19 Remote Control (R/C)

1. Align the notches on the R/C fixing plate with the slotted holes of the remote control bottom plate.



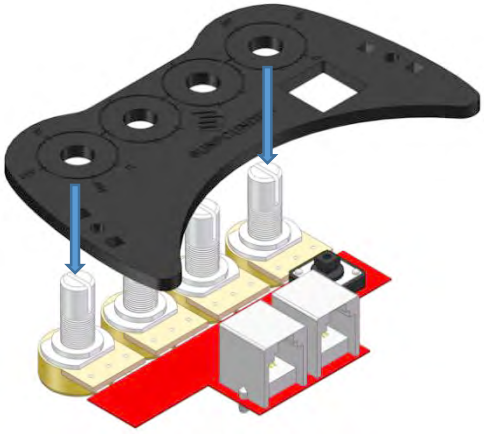
2. Insert the notches into the slots.

3. Put an M3 nut in the hole on the fixing plate and fasten with an M3*10 screw.

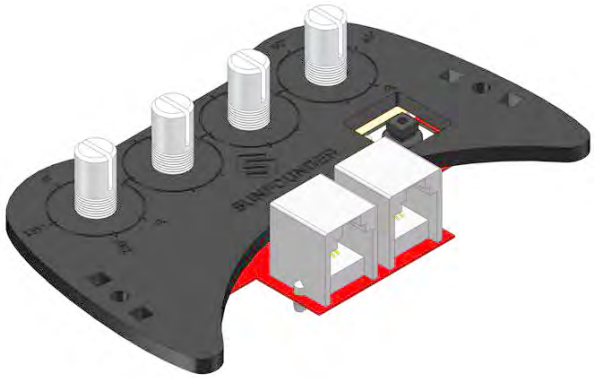
4. It should look like this:

5. Fix the other R/C fixing plates the same way.

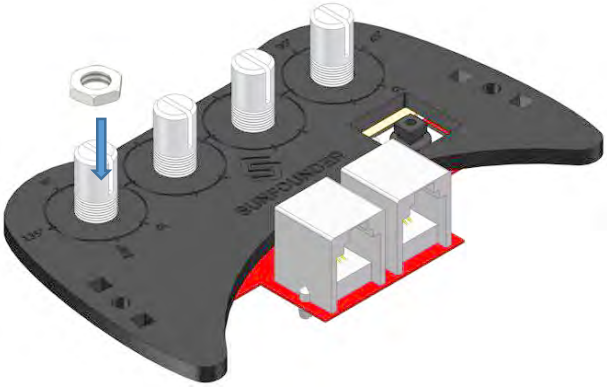
6. Align the four holes on the R/C upper plate with the 4 potentiometers (pots) on the potentiometer module.



7. Insert the pots through the four holes.



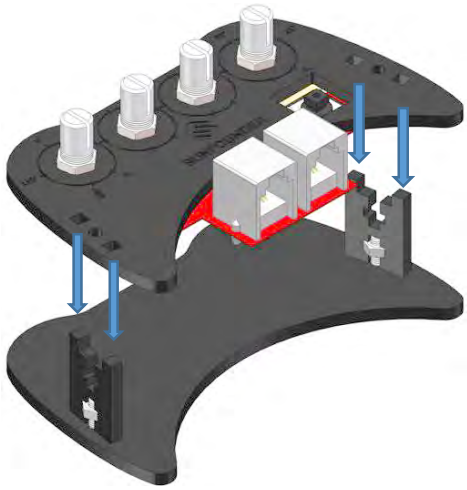
8. Fasten one pot with an M7 thin nut.



9. It should look like this:

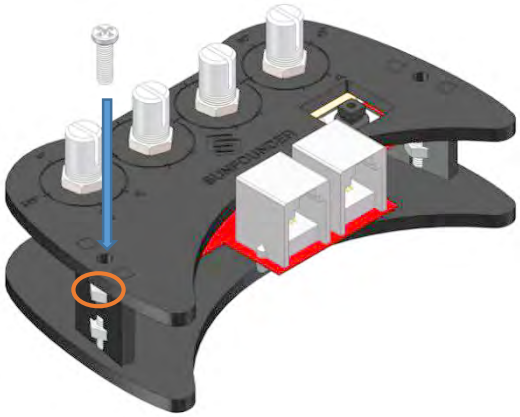
10. Fasten the other three pots the same way.

11. Align the slotted holes of the R/C upper plate with the R/C fixing plate notches.



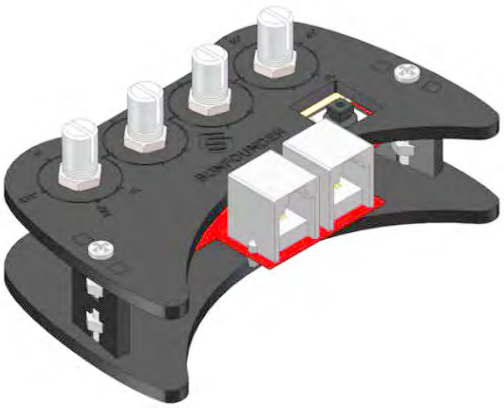
12. Insert the notches into the holes with the module on the bottom plate.

13. Put an M3 nut in the R/C fixing plate hole and insert an M3*10 screw into the nut.

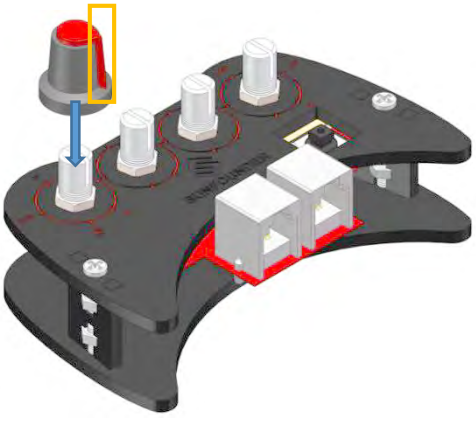


14. Fasten with screwdriver.

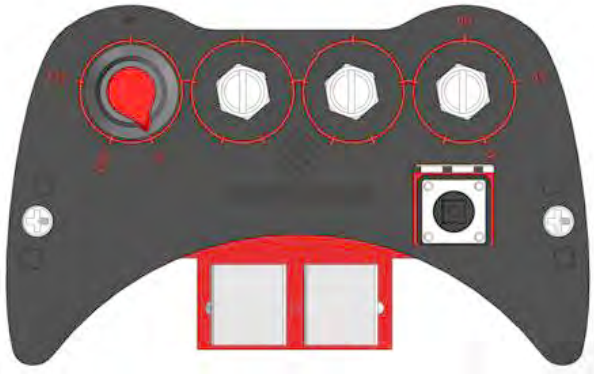
15. Fasten the screw on the other end the same way.



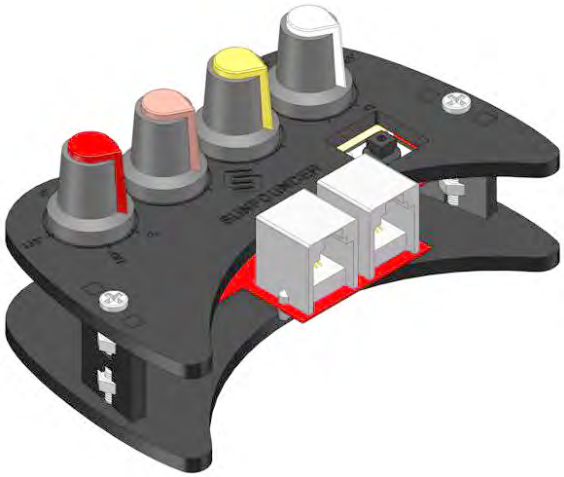
16. Rotate the pot clockwise all the way, with the button notch at the 0° position.



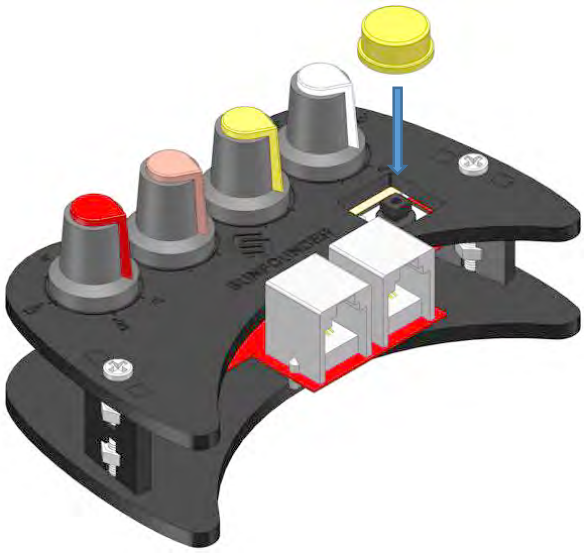
17. Put the button onto the potentiometer and press to firmly affix them.



18. Install the other three pot buttons the same way. Rotate them all to 0° position.



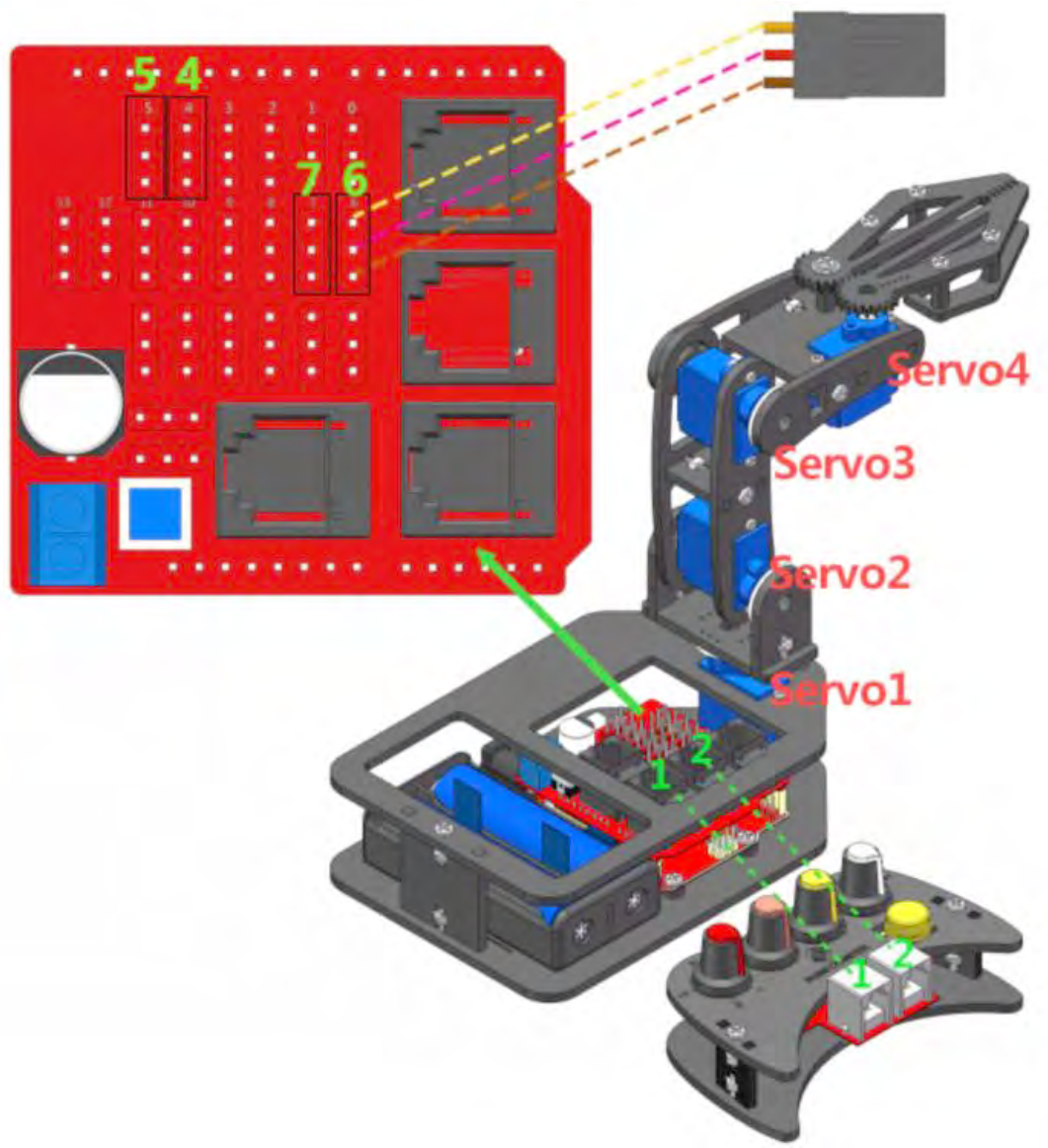
19. Install button, as shown.



20. Press down to ensure it is firmly seated.

5.20 Wiring

In previous servo assemblies, servo 1, 2, 3, and 4 have been connected to ports 4, 5, 6, and 7 on the extension board. So, we only need to connect port 1 and 2 on the remote control to the extension board with RJ11 cables.



Notes:

1. Before connecting the servo wires to the ports, turn the power off. Turn it on again after all the wires are connected.

2. When the servos are on, remember NOT to rotate the servo rocker arms. Turn them off if you want to do so.

3. When you are not running Robo-Arm, keep it powered off.

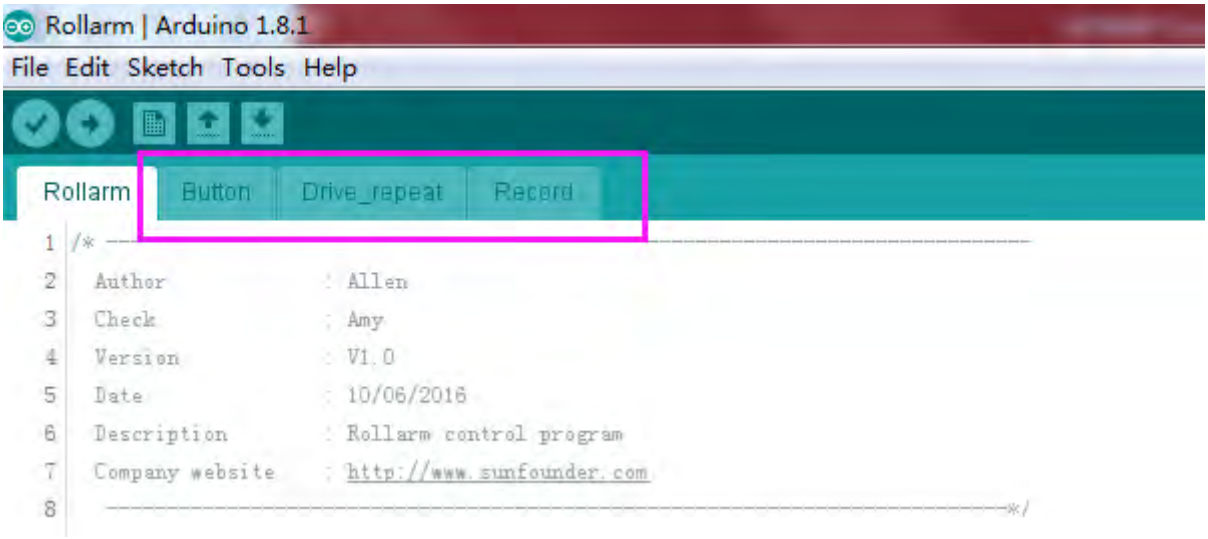
6. Controlling the Robo-Arm

There are two ways to control Robo-Arm: manually (by remote control) or via PC (by Labview). Instructions for both are as follows:

6.1 Manual Control

Step 1: Run the ***Rollarm.ino*** file under the path ***DIY Control Robot Arm kit for Arduino-Rollarm\Arduino Code***. There are four code files. You need to double-click **Rollarm**. **Rollarm.ino** is the main program; the others are subprograms.

When you open the main program, the subprograms will be opened automatically:



Step 2: Select the corresponding board and port, then click **Upload.**

Step 3: After the code uploads, turn on the power switch to control the Rollarm.

Step 4: Rotate the four potentiometer buttons in different colors to test the controlled servo and its direction. The white button controls servo 4, yellow controls servo 3, orange controls servo 2, and red controls servo 1.

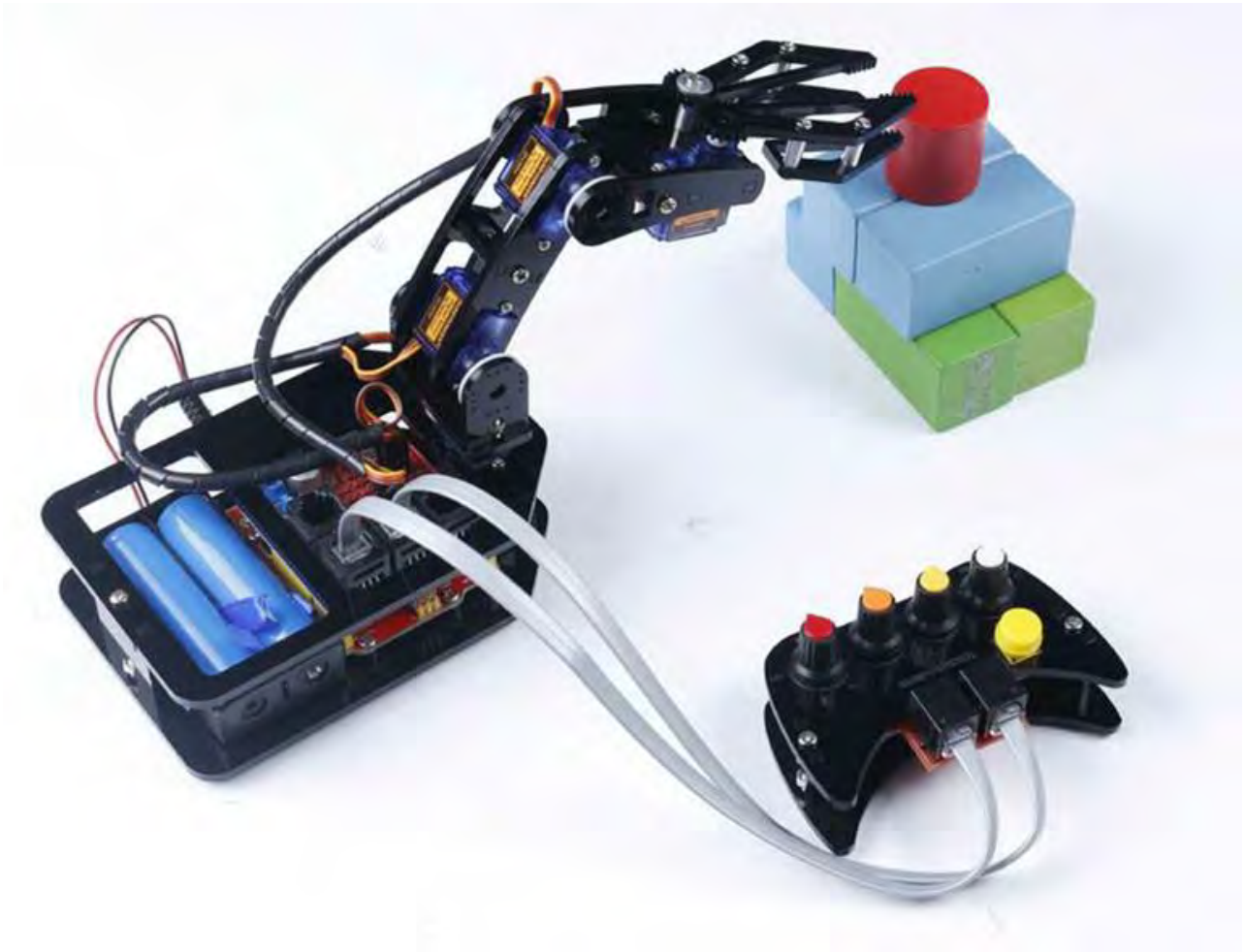
6.2 Automatic Control

With the R/C, Robo-Arm rollarm can record its behaviors:

Rotate one pot button to control one servo to the desired position, and press the yellow button for the control board to record this step. Record the other steps the same way.

When all desired steps are done, press and hold the yellow button for approximately 3 seconds. It will repeat the recorded steps (up to 100 steps).

Robo-Arm can automatically move blocks continuously:



6.3 Code Explanation

The program includes three parts that rotate pots to control Robo-Arm. Press the button for less than a second to record Robo-Arm's behaviors; press and hold the button to repeat the recorded steps.

There are four pots that control the arms. The 4 servos from top to bottom are connected to ports 4-7 on the expansion board, respectively, and the 4 pots control those ports. In other words, turn the white pot to control the uppermost servo, yellow to control the next servo below, orange to control the next servo, and the red to control the bottom servo.

Since the Robo-Arm has four servos acting as moving joints, we need to include a header file for driving the servos and define them.

```
// Create servo object to control a servo.
#include <Servo.h>

Servo Servo_0;
Servo Servo_1;
Servo Servo_2;
Servo Servo_3;
```

After defining the function of driving the servos, we need to read the AD value of the pots and convert it into the rotating angle of the servo, since the servos are controlled by rotating the pots.

```
//Read the values ot the potentiometers.
void ReadPot()
{
  SensVal[0] = 0;
  SensVal[1] = 0;
  SensVal[2] = 0;
  SensVal[3] = 0;

  SensVal[0] = analogRead(A3);
  SensVal[1] = analogRead(A2);
  SensVal[2] = analogRead(A1);
  SensVal[3] = analogRead(A0);
}

//The value of the potentiometer is matched to the angle value.
void Mapping0()
{
  SensVal[0] = map(SensVal[0], 0, 1023, 10, 170);
  SensVal[1] = map(SensVal[1], 0, 1023, 10, 170);
  SensVal[2] = map(SensVal[2], 0, 1023, 10, 170);
  SensVal[3] = map(SensVal[3], 0, 1023, 100, 175);
}
```

After compiling the program, we need to make Robo-Arm remember the steps, which is done by pressing the yellow button.

```
//Calculate the time the button  pressed
void Button()
{
  if (digitalRead(3) == 0)
  {
    delay(10);
    if (digitalRead(3) == 0)
    {
      KeyValue = 0;
      while (!digitalRead(3))
      {
        KeyValue++;
        delay(100);
      }
    }
  }
}
```

We can tell which part of the code Robo-Arm is performing by reading the value when pressing the button. When the value is larger than 10, it means Robo-Arm is repeating the steps. When it is between 0 and 10, it means Robo-Arm is remembering. And when it is 0, it means it is being controlled by the pots. The specific program is as follows:

```
//Check the button.
static int Flag = 1;
Button();

//The time of pressing the button is not long then record the action.
if ((KeyValue < 10) && (KeyValue > 0))
{
  KeyValue = 0;
  Record();
  Mapping1();
}
//Long press the button and open the auto mode ,start repeating the action.
else if (KeyValue > 10)
{
  if (Flag == 1)
  {
    Flag = 0;
    Calculate();
  }
  Drive_init();
  delay(3000);
  for (int i = 1; i < Time; i++)
  {
    Drive_repeat(i);
    delay(500);
  }
}
//Did not press the button , open the manual mode.
else
{
  ReadPot();
  Mapping0();
```

Next, we want to write the value of the servo rotating angle. However, it is not merely about writing the values directly; the difference between two adjacent rotating values will also be written into the servos. Below is an example of a servo program.

```
//The first axis.
 if (Dif0[n] > 0)
 {
   for (int j = Joint0[n - 1]; j <= Joint0[n]; j++)
   {
     Servo_0.write(j);
     delay(10);
   }
 }
 else
 {
   for (int j = Joint0[n - 1]; j >= Joint0[n]; j--)
   {
     Servo_0.write(j);
     delay(10);
   }
 }
```

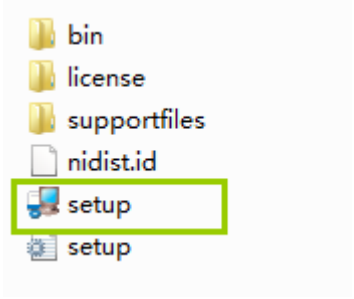
6.4 PC Control (by Labview)

6.4.1 Installing Labview Software

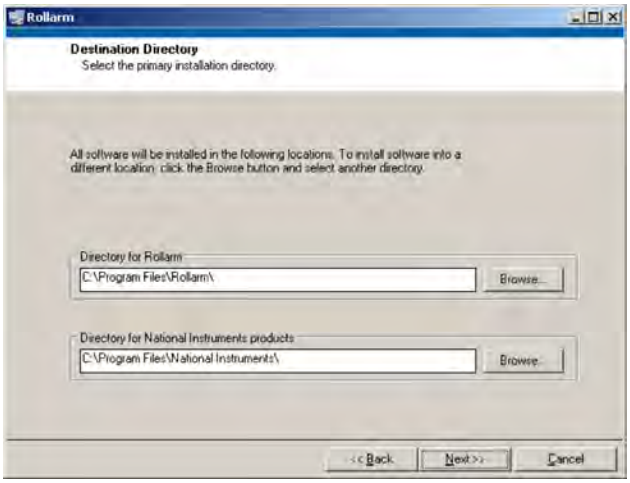
Download software from the link below:

http://v3.hamiltonbuhl.com/uploads/roboarm/Labview.zip

After downloading, unzip and open it. If you haven't installed the **Labview Runtime**, you can get into the **Labview\Rollarm\Rollarm Installer** folder, install the setup file:

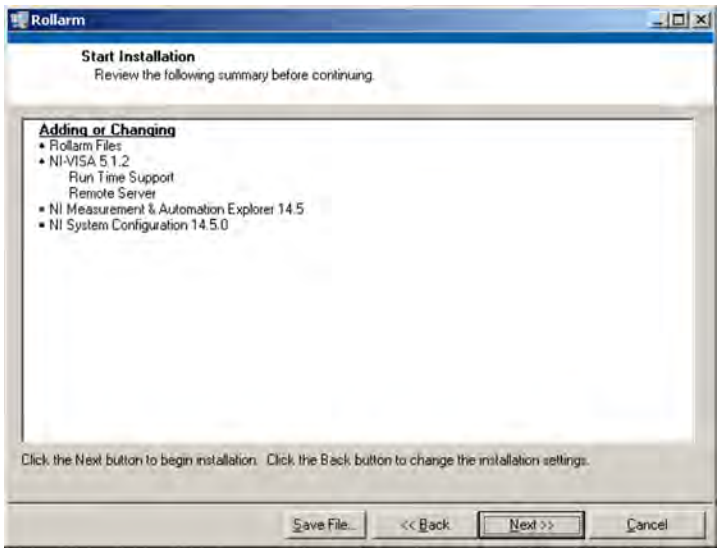


Choose a destination directory and click "Next".

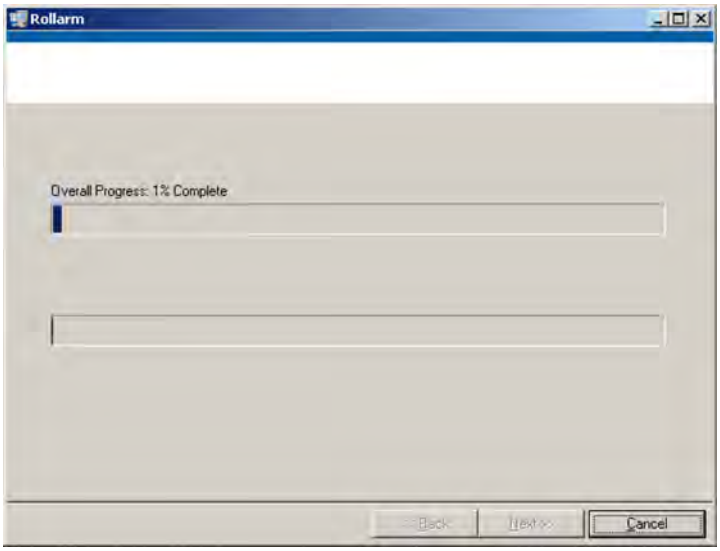


Accept the License Agreement and click "Next".

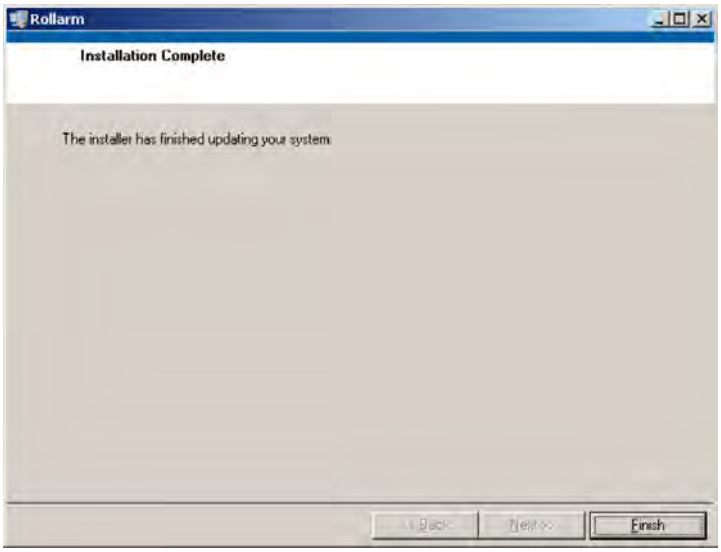
Begin the Installation by clicking "Next".



Software is installing.

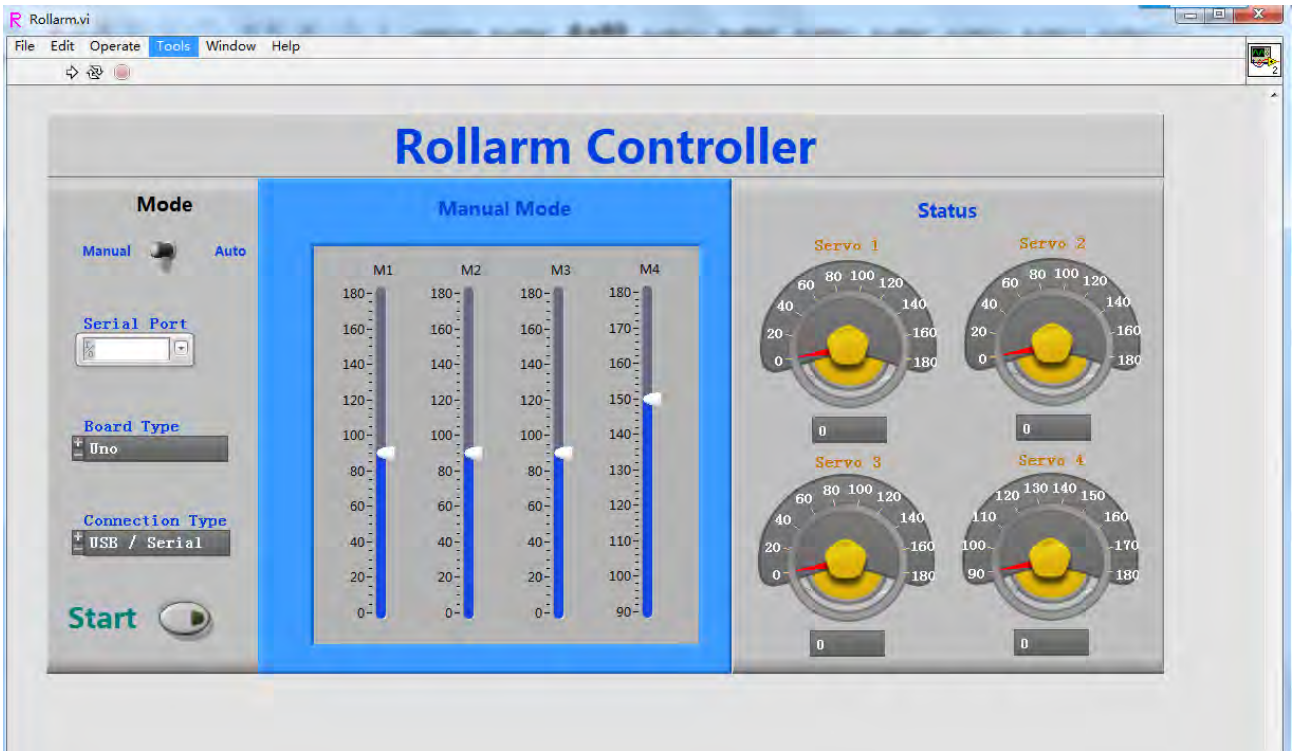


Installation complete.
Click finish to continue.



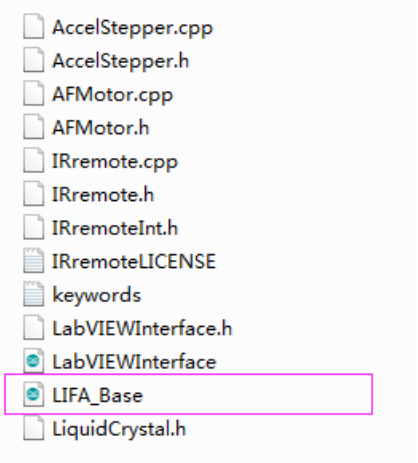
Go to your Programs, in the Rollarm folder and find the Rollarm icon.

The following interface will be displayed:



6.4.2 Running the Labview Software

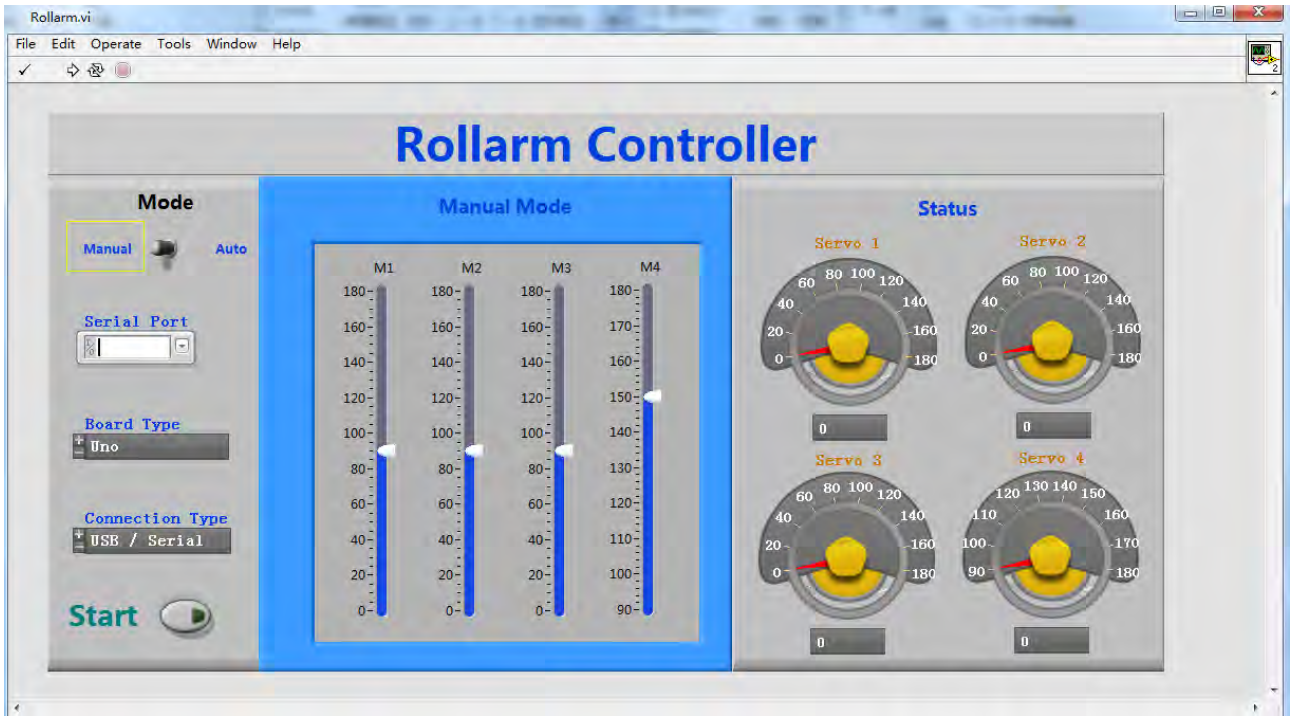
Before running the software on your computer, install a driving program into Arduino. Open the folder ***LIFA_Base*** under path *DIY Control Robot Arm kit for Arduino-Rollarm\Arduino Code*



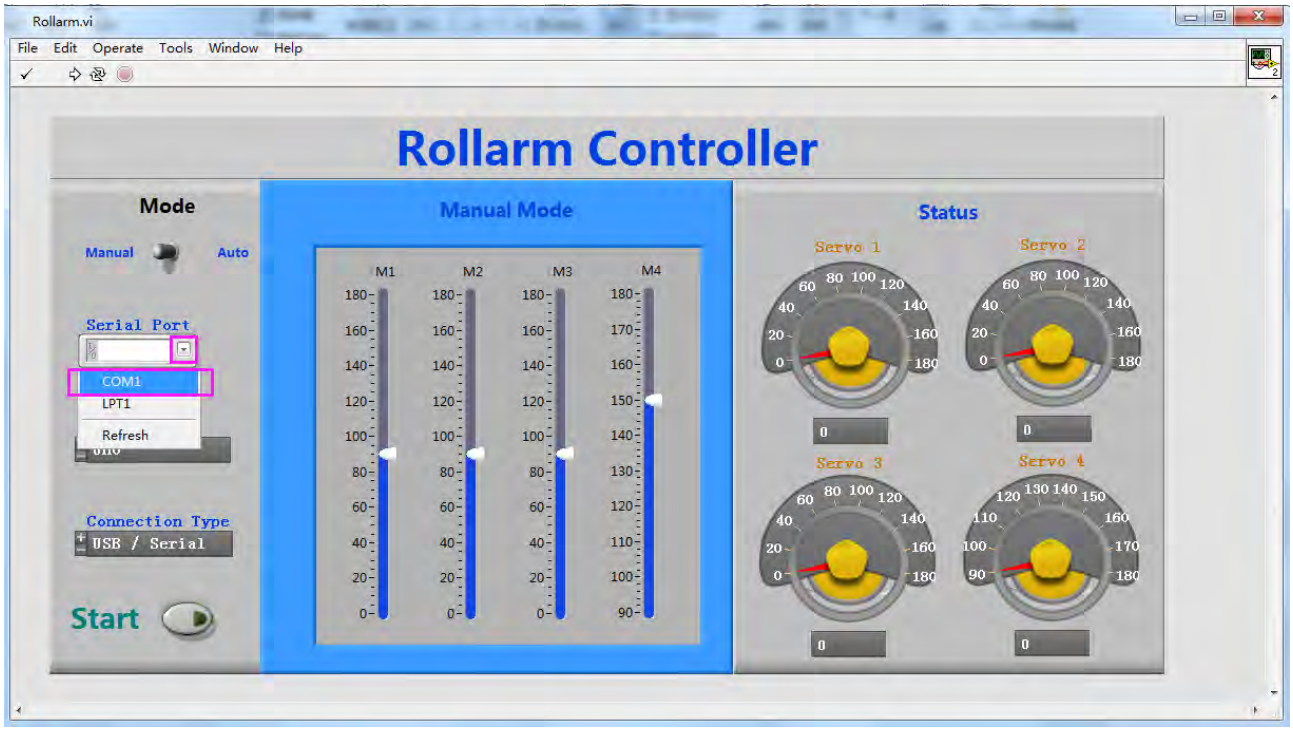
Open the file ***LIFA_Base.ino***. Upload the sketch to the Arduino. DO NOT unplug the USB cable at the moment. Open the software, which includes two parts: **manual** control and **automatic** control.

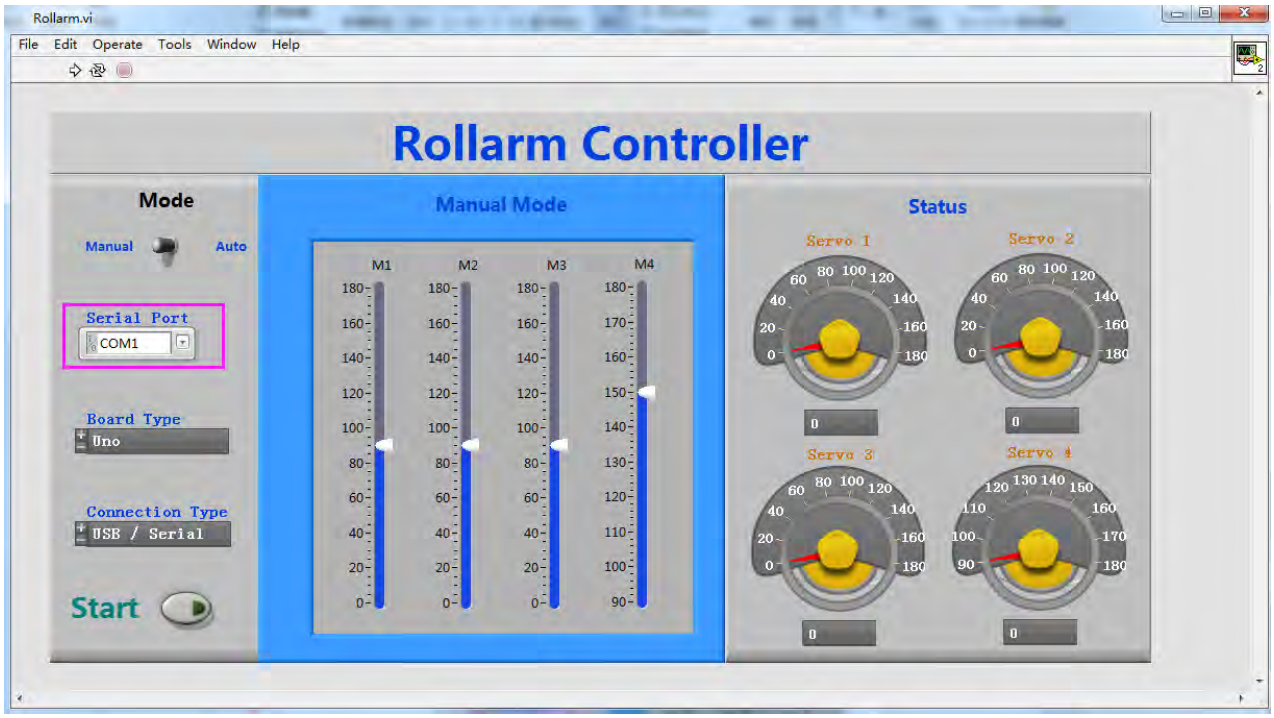
1) Manual Mode

a) See the interface of manual control below. After Labview is installed and running, this mode is enabled by default.

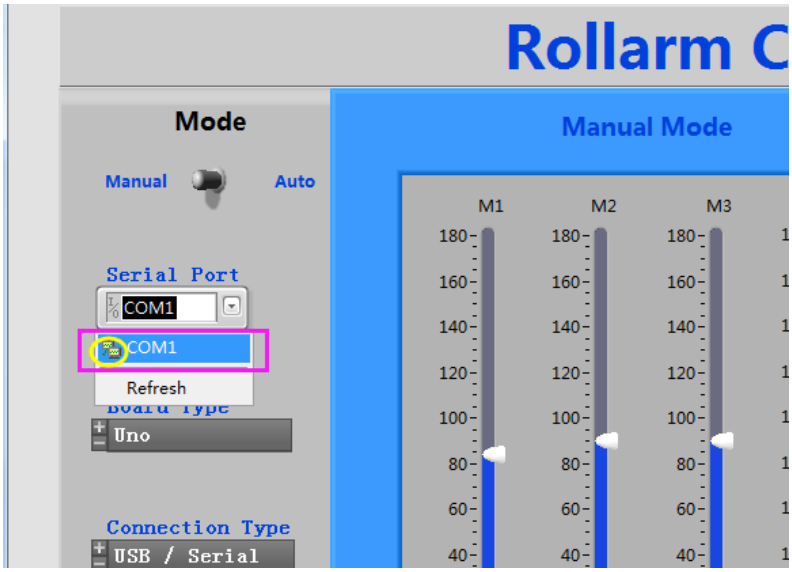


b) Click the menu downlist icon for **Serial Port**, select the port according to your COM port. Here is COM1, which varies for different computers.



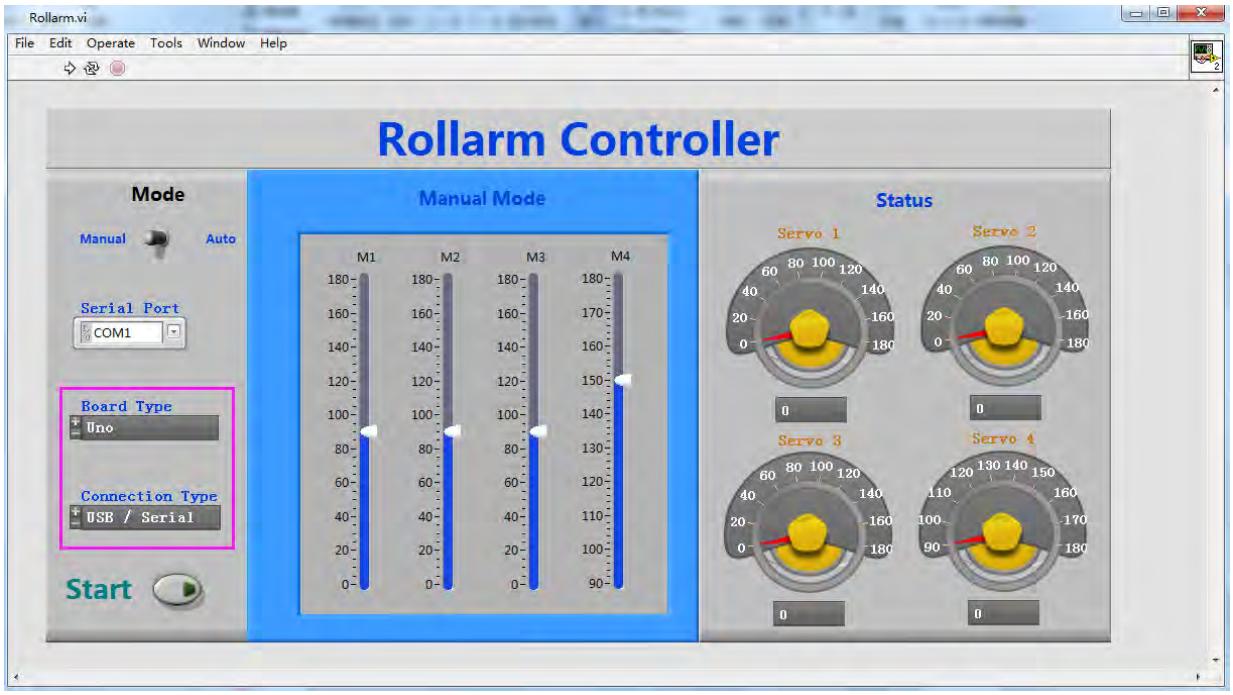


If such an icon appears before the port, it indicates something goes wrong with the port:

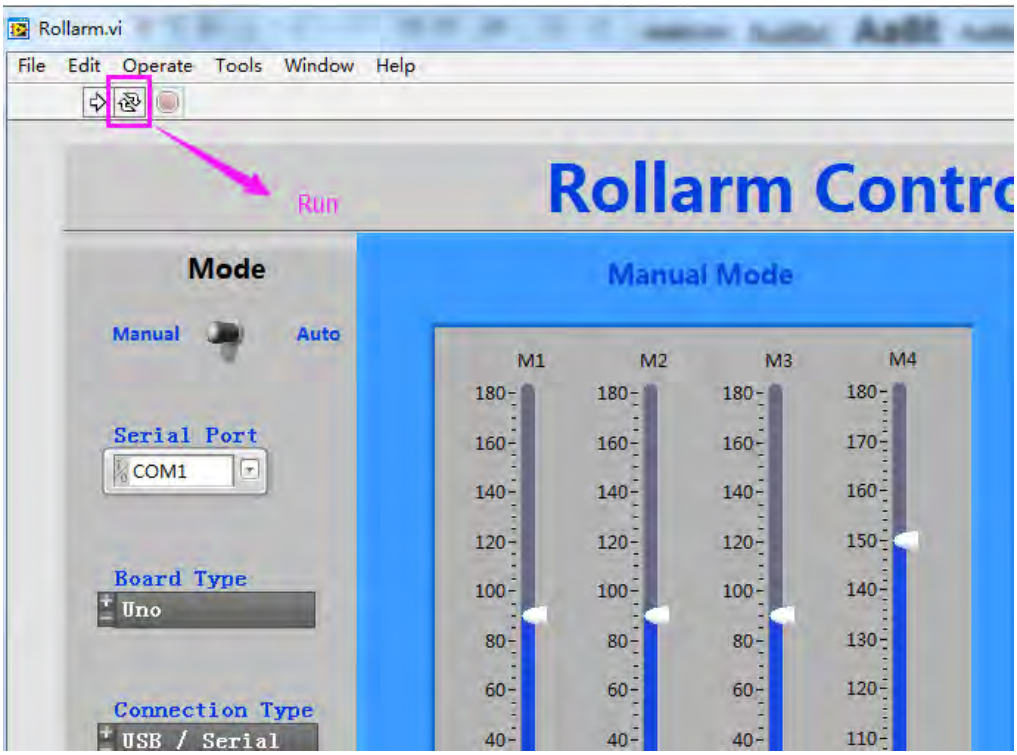


To solve the problem, just replug the USB cable. Then start from sketch upload again.

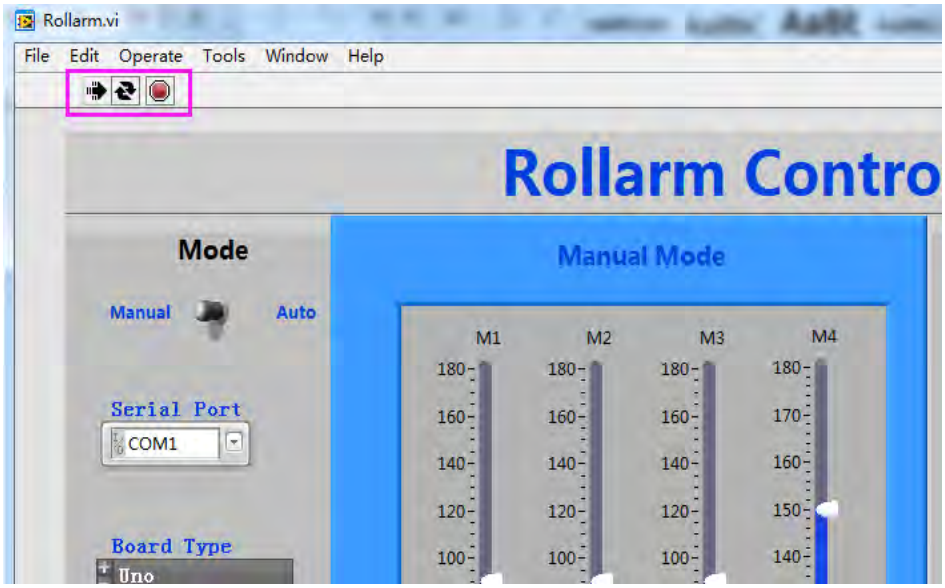
Select the **Board Type** and **Connection Type**, here we take Uno and USB connection type as an example:



c) There are **three** small icons at the top left. Click the middle one to run the software.

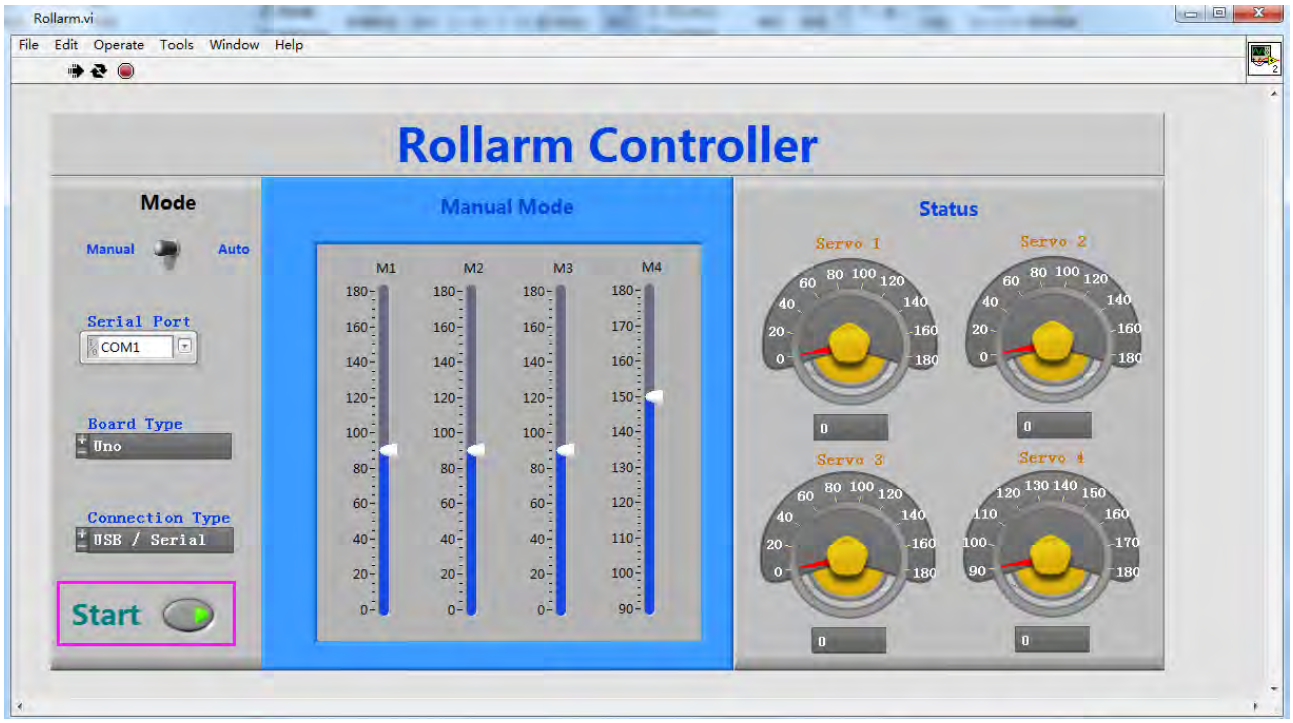


Then, the three icons will look like this:



The initial position of the four axes are respectively set to 90°0°, 90°, 90°, and 150°, from bottom to top, so the corresponding servos should look like this:

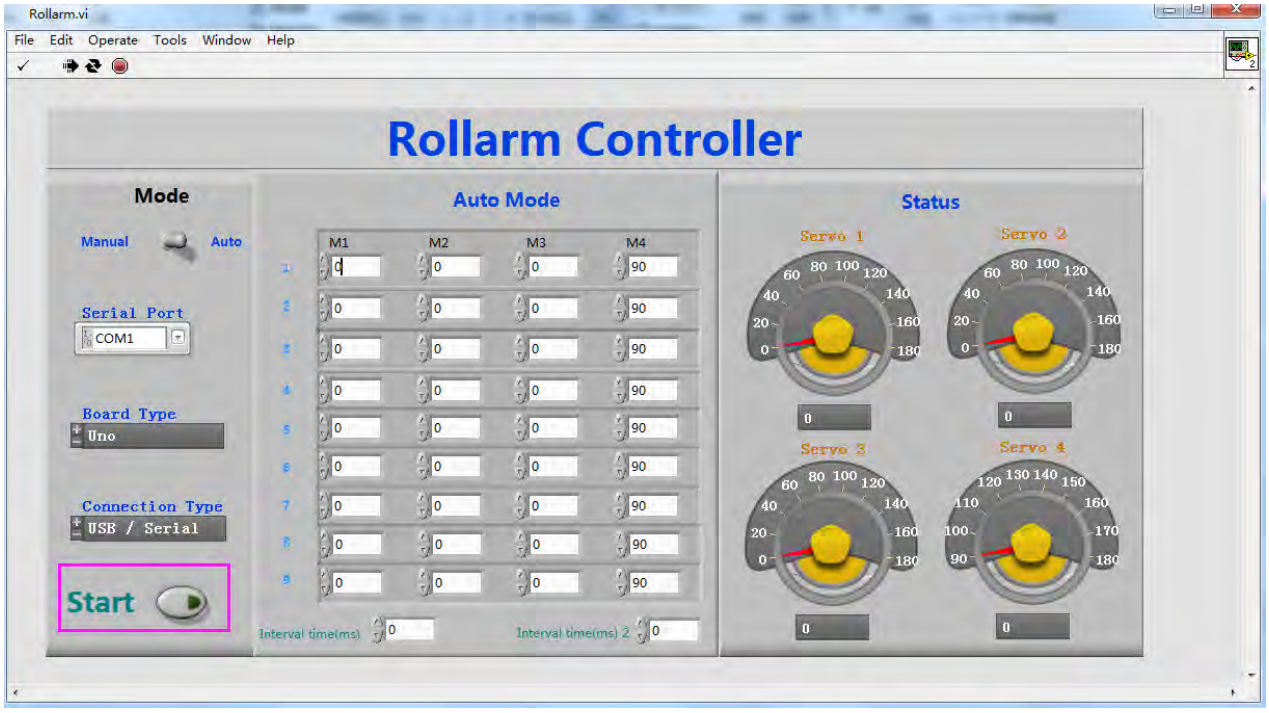
d) Click **Start**, and the button will change from dark to light green, as shown below:



You can move the slider in this window to control Rollarm. On the right, there are 4 dashboards, 1, 2, 3 and 4, which correspond to the four servos respectively.

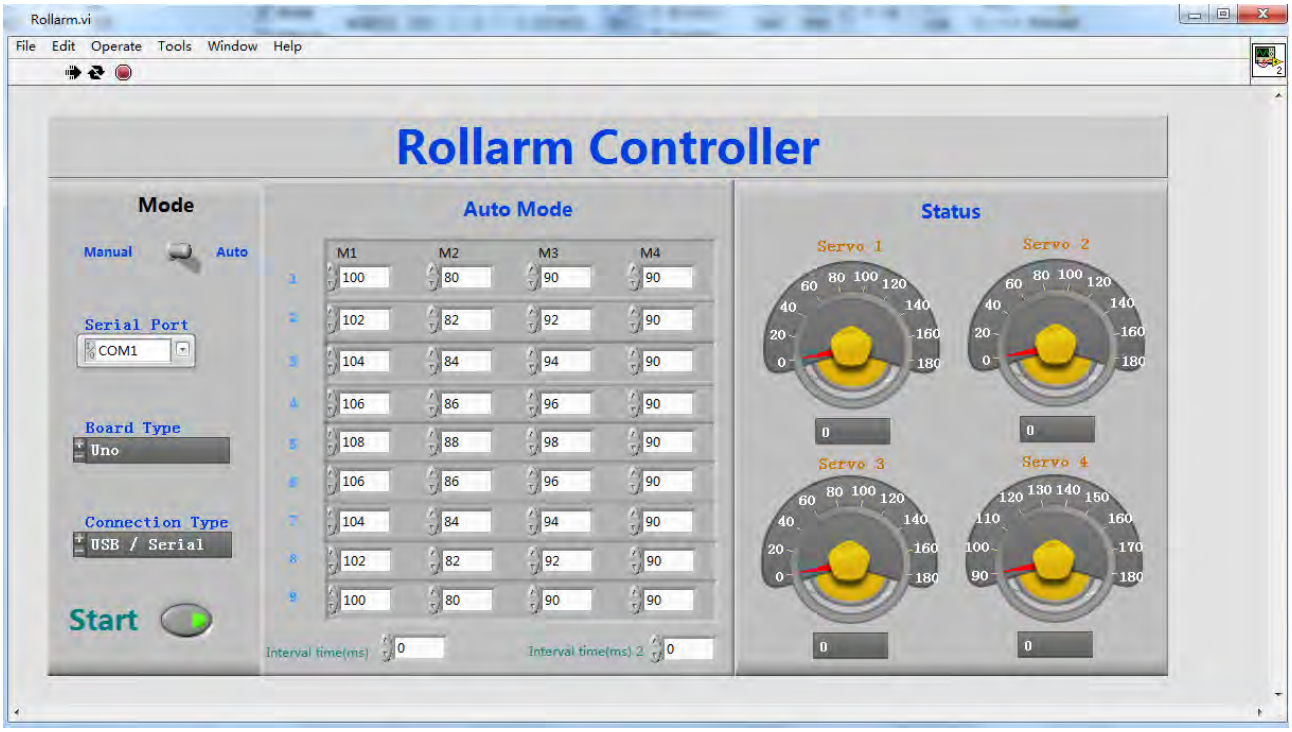
2) Automatic Mode

You can switch between manual and automatic controls through the rocker switch – **Manual** and **Auto**. To switch to automatic control, click the **Start** button to disable it and the following interface will appear:



Fill the value of the rotating angle of the servos into the table under **Auto Mode,** one-by-one.

Enter the interval time at the bottom of the table. The first interval time refers to the time between setting the rotating angles of two groups, each row considered as a group. Here, the interval time on the left refers to the time between setting the rotating angle between M4 in row 1 and M2 in row 2 or M4 in row 2 and M1 in row 3, etc. The interval time on the right refers to the one between setting the two adjacent rotating angles within a group. After filling in the figures, click the Start button.



Robo-Arm will then perform the tasks as you have set.

Note that the range of the data for Mode 4 should be 90~180. Otherwise, it will get stuck and may be damaged.

FAQ

1) Assembly

Q1: After assembly and program download, the rollarm's 4 axes are in wired position, some may be out of control. What should I do?

A: Remember to power on and calibrate each servo before assembly.

Q2: When I mount the rocker arm, the acrylic plate cracks.

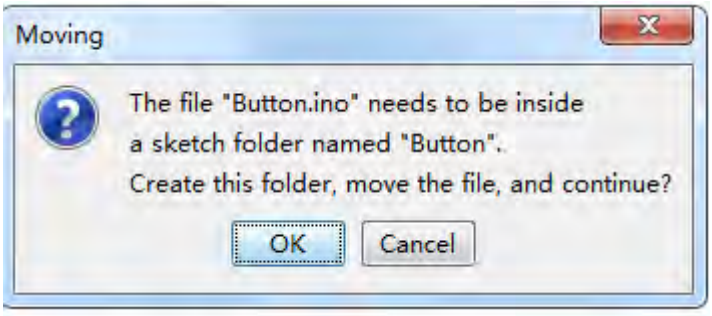
A: Be careful to not overtighten screws.

2) Arduino Code

Q1: When I open a program, it prompts me that a new folder should be created. After I click Yes and a new folder is created, the main program reports an error when I want to open the main program. What is wrong?

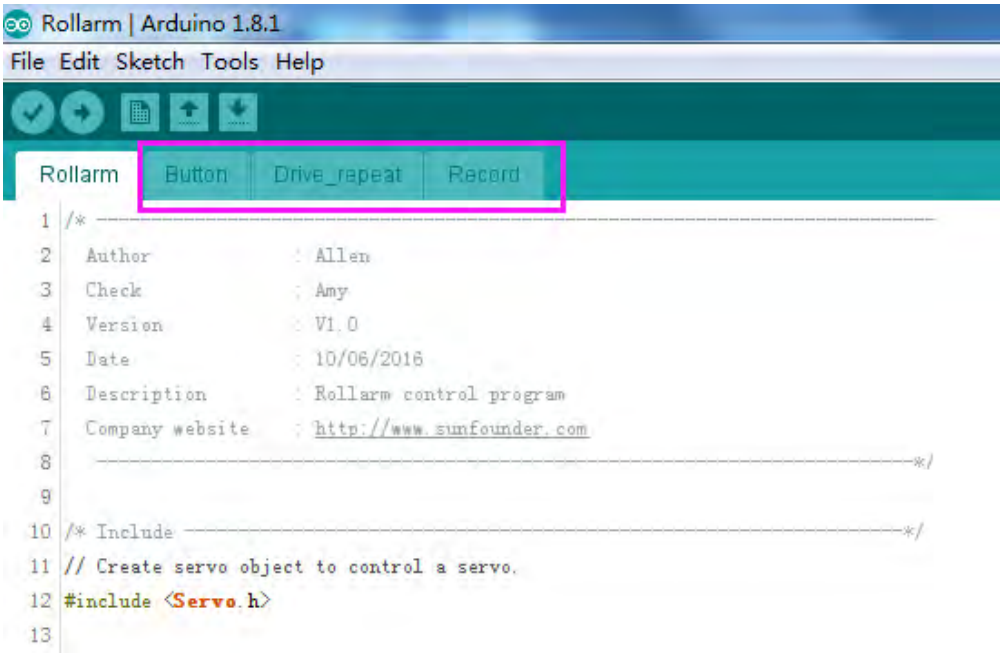
A1: DO NOT open these subprograms under *Arduino Code\Rollarm* separately.

If you open the subprograms separately, a dialog box will pop up like this:



If a new folder has been created for the subprogram, please cut the subprogram file to the original directory *Arduino Code\Rollarm*. Reopen the main program:

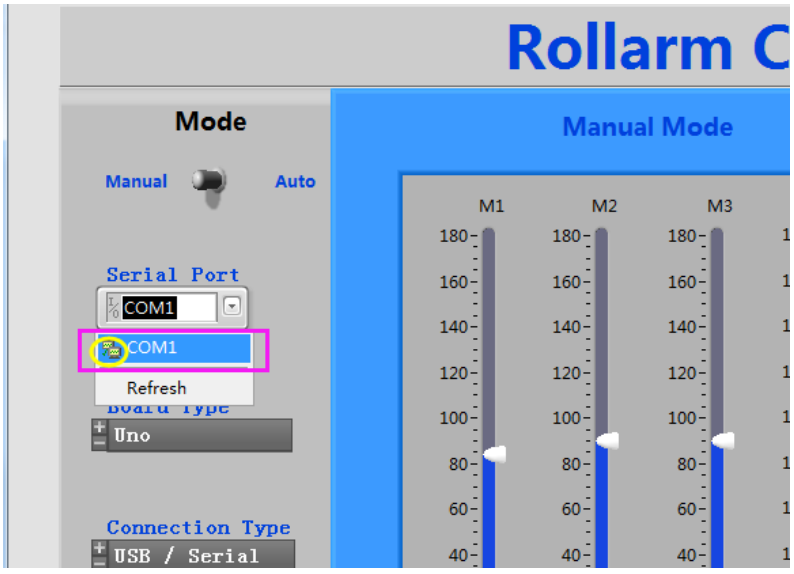
Then you can see the subprograms have been opened too:



3) Labview Software Control

Q1: After powering on Robo-Arm, why do the servos shake when there's no movement?

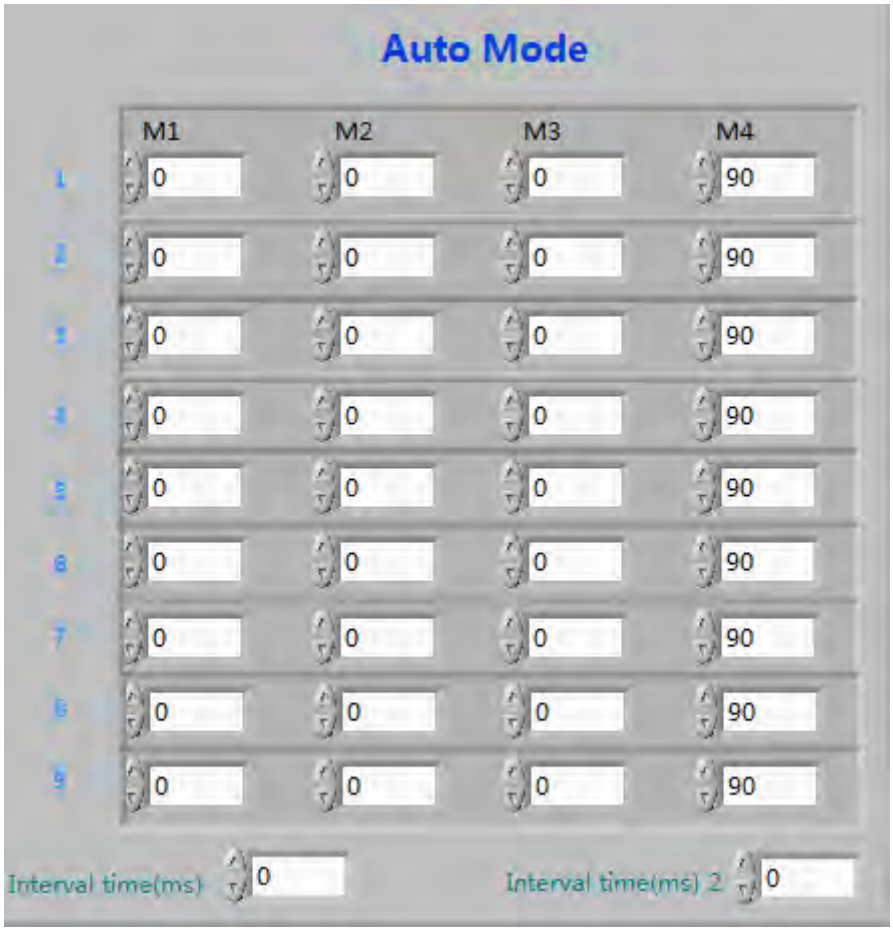
A: There may be something wrong with the serial port. For example, the following may appear:



Turn off Robo-Arm; power on again, reconnect the serial port, and try again.

Q2: The rollarm is in a strange position when I click **Start** and it's in the automatic mode. Is anything wrong?

A: Below, there is no value entered in the table yet.
The first 3 axes are in 0°, and the last one is in 90°.
Fill in the correct value of the rotating angle first, and click **Start** to run.



Before clicking **Start**, fill in the rotating angle for each axis in the different steps, and the interval time between them. If you don't know the exact angle, shift to manual mode, noting the angle values for each step. Then, return to update the entries. When all the steps above are complete, click **Start** and Robo-Arm will perform it's automated functions.