

# PLEN:bit Assembly Manual

PLEN Project Company

2021/10/21

---

# Table of Contents

---

1. Cautions on Assembly. .	3
2. Table of Contents	
i. Common Parts. . . . .	4
ii. special kit. . . . .	5
3. About the angle of Servo horn. .	6
4. Assembly	
i. Preparation. . . . .	8
ii. Switch board assembly. . . . .	9
iii. Circuit board and battery wiring. .	11
iv. Servo motor set-up. . . . .	16
v. Assembling the Thighs. . . . .	19
vi. Attaching leg parts. . . . .	23
vii. Shoulder parts assembly. . . . .	27
viii. Arm parts assembly. . . . .	31
ix. Servoxer attachment. . . . .	35
x. Control board wiring. . . . .	38
xi. Head part assembly. . . . .	41
xii. Chest assembly. . . . .	46
5. Motion check	
i. Let's walk the PLEN:bit!. . . . .	51
ii. How to adjust ServoMotor position	
6. How to charge battery. .	52
7. How to BLE ver. head board	
8. Appendix	
i. PLEN:bit servo numbering. . . . .	53
ii. Control board terminal labelling	

# 1. Cautions on Assembly

There will be some steps where force is necessary. Please take the proper measures and precautions to not hurt yourself or damage the parts and follow the instructions as described.

You will need a phillips screwdriver (+ head) for assembly.

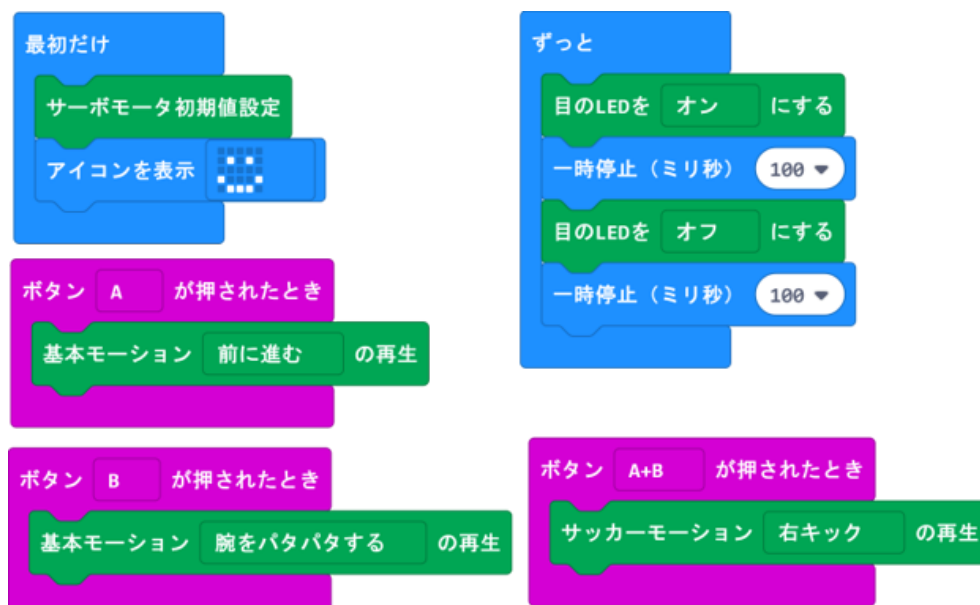
Please use the provided pictures as a reference during assembly.

Please be aware that the colours and/or appearance of some parts in the provided pictures and those provided may be slightly different.

The required program for the micro:bit has already been included. If another program is found to have been written in the micro:bit please follow the link below to install the appropriate program for use.<br /> PLEN-Basic [https://makecode.microbit.org/\\_4e7MEqgEHaw5](https://makecode.microbit.org/_4e7MEqgEHaw5)<br /> PLEN:bit Extensions [https://makecode.microbit.org/\\_0960M8DsVKgc](https://makecode.microbit.org/_0960M8DsVKgc)

When assembling the servo motors, the initial rotational position of the gear on the motors is important. The assembly instructions includes initial positioning for the motors. Please ensure all motors are properly set.

When setting the servo motors, make sure you wait at least 2 seconds after turning the power switch on until the servo motors automatically set to their initial position. If the servo motors do not move after 2 full secods, please if check they are connected properly.



---

## 2. Contents list

---



*Contents list*

### 2.1 Common Parts

1. micro:bit
2. Battery
3. Control Board
4. Switch Board set (switch board PCB, , screw x2)
5. Servo Motors x8
6. Head Board Cable
7. Power Cable
8. USB Cable
9. Head Parts(top, bottom)
10. Chest Parts
11. Servo Bracket
12. Servo Fixer
13. Back Parts
14. Switch Board Holder
15. Shoulder Parts
16. Arm Parts×2
17. Thighs Parts×2
18. Legs Parts×2
19. Black Screw
20. Silver Screw×6
21. Servo Horn×6
22. Distance Sensor
23. Sound Sensor
24. Label Sticker
25. head board
26. Connector tool



## 2.2 special kit

1. BLE ver. head board
2. IR sensor
3. PIR sensor

---

## 3. About the Servo motor

---

### 3.1 Connector orientation

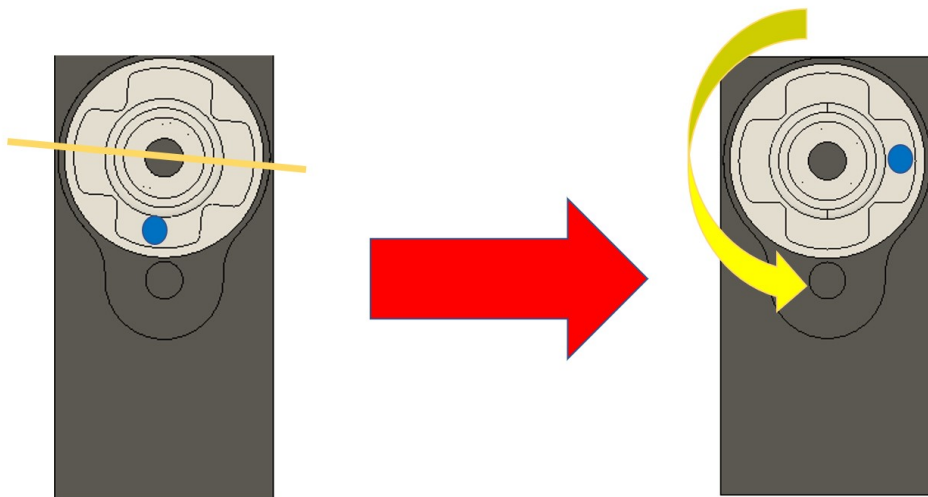
1. There is a direction in the connector of the servo motor. Make sure that the white cable is on the inside.



*Connector orientation*

### 3.2 About the angle of Servo horn

1. Body balance is important for biped robots. but, since servomotors have individual differences in rotation angle, it is necessary to absorb the individual differences by the servo horn attached to this. Therefore, the angle of the servo horn needs to be precisely adjusted. If this adjustment is not successful, you will not be able to walk or fall easily. Here we will explain how to make this adjustment.
2. The servo horn has a slight offset between the inner serration and the front cross. Therefore, when rotating the cross of the servo horn by 90 degrees, there is a point where the cross is just horizontal. Find this and fix the servo horn.
3. As a method other than servo horn adjustment, a method to adjust by program is also prepared. (Coming soon) The shoulder parts are integrated with the servo horn and can not be rotated by 90 degrees, so they need to be adjusted in the program.



①サーボホーンをはめると、  
少しずれている

②サーボホーンを90度左に  
回転すると水平に

*servo horn fix image*

---

## 4. Assembly

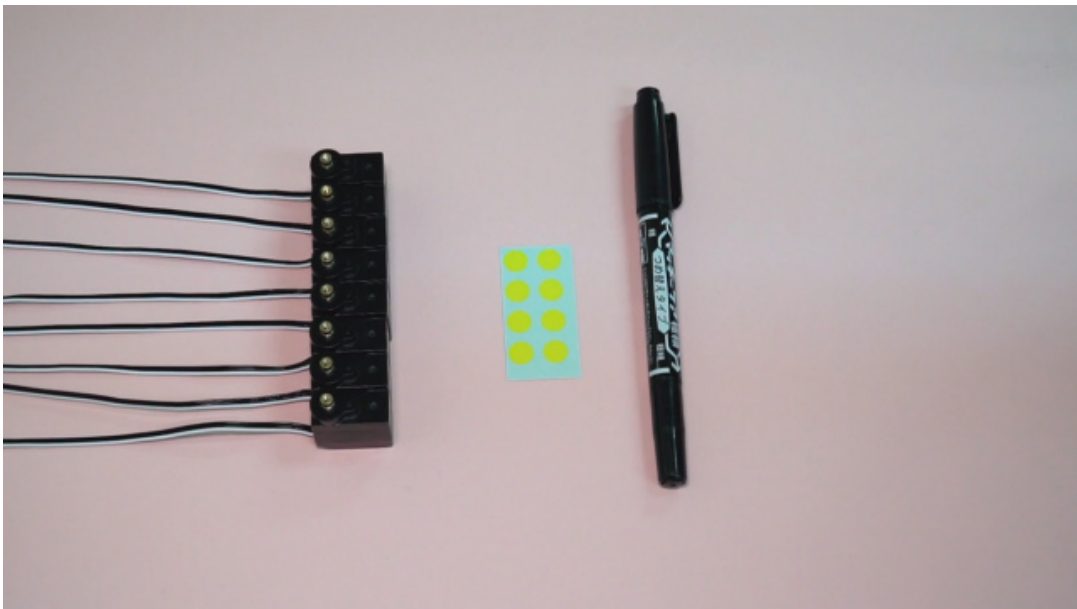
---

### 4.1 Preparation

#### Necessary items

---

1. Servo Motors x8
2. Label stickers or Circular Stickers
3. Pen

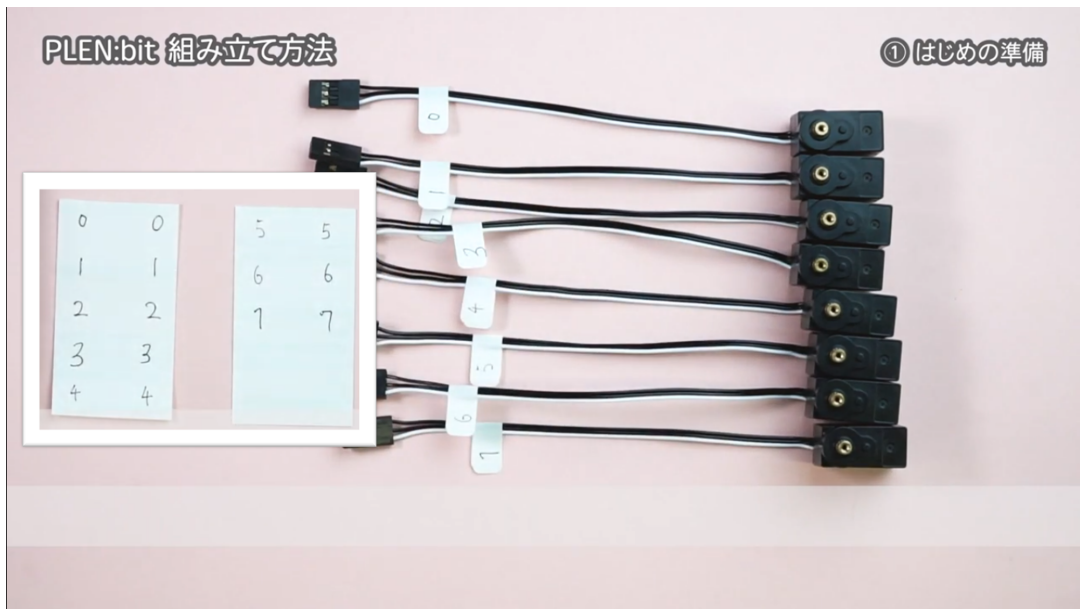


*Necessary items*

#### Procedure

---

Fix the servo number stickers to each Servo motor cable. Write the numbers 0-7 on eight stickers and place them. Attach the sticker in a half-folded form to the servo motor cable.



*Sticker placement*

## 4.2 Switch board assembly

### Necessary items

---

1. switch board set (switch board PCB, switch board holder, screw x2)



*Necessary items*

# Procedure

1. Align the circuit board and plastic part



2. Screw in the circuit board using the two screws at the corners



## 4.3 Circuit board and battery wiring

### Necessary items

1. back part
2. switch board
3. battery
4. control board
5. micro:bit
6. power cable



Necessary items



# Procedure

1. Connect the power cable to the switch board



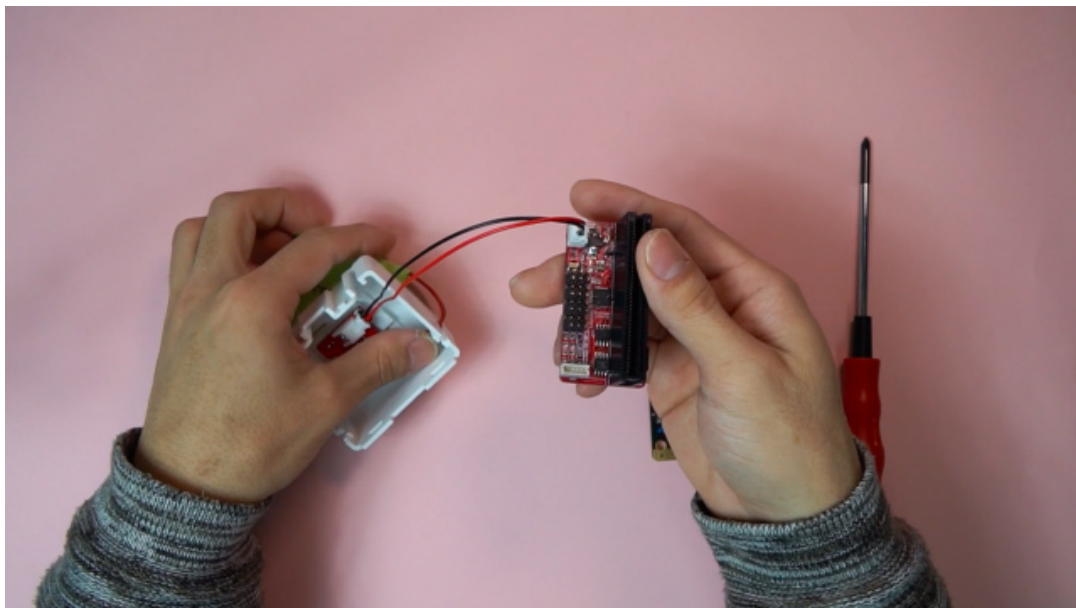
2. Insert the switch board into the back plastic part with the switch and connector going through the appropriate holes as shown in the picture.



3. Connect the battery to the switch board following the below reference picture.

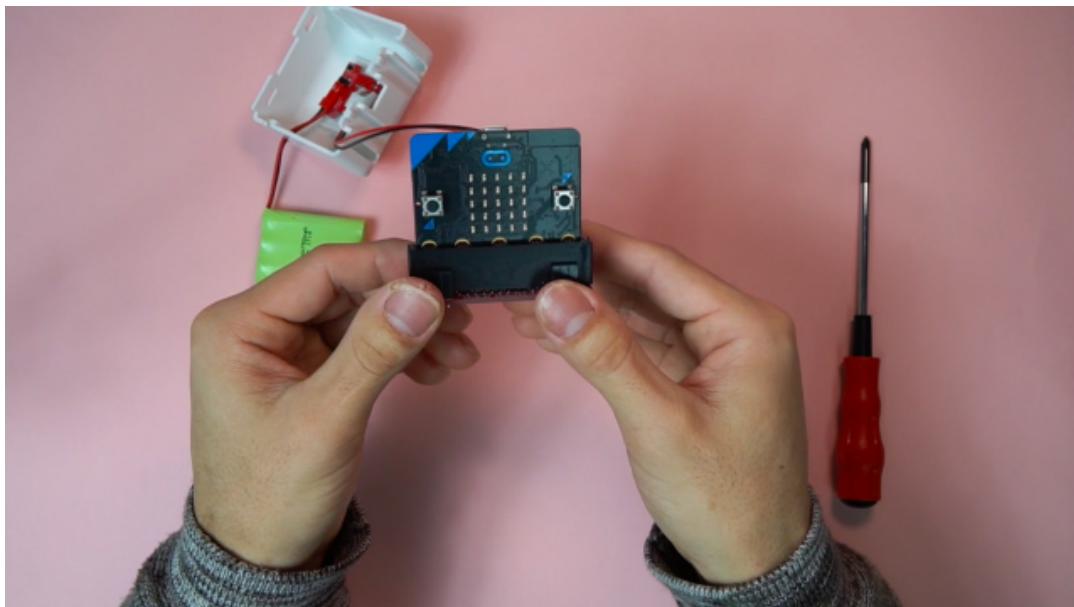


4. Connect the control board and switch using the power cable. The connectors are different so please ensure the correct connector slides smoothly into the pins. <br /> \* It is necessary to remove the power cable at the time of \"Control board wiring\" mentioned later. In this case, since it is hard to remove the cable from the connector, for children and people with weak force, use the supplied connector tool. This is a tool to make it easy to remove by holding this tool between the power cable and the connector.

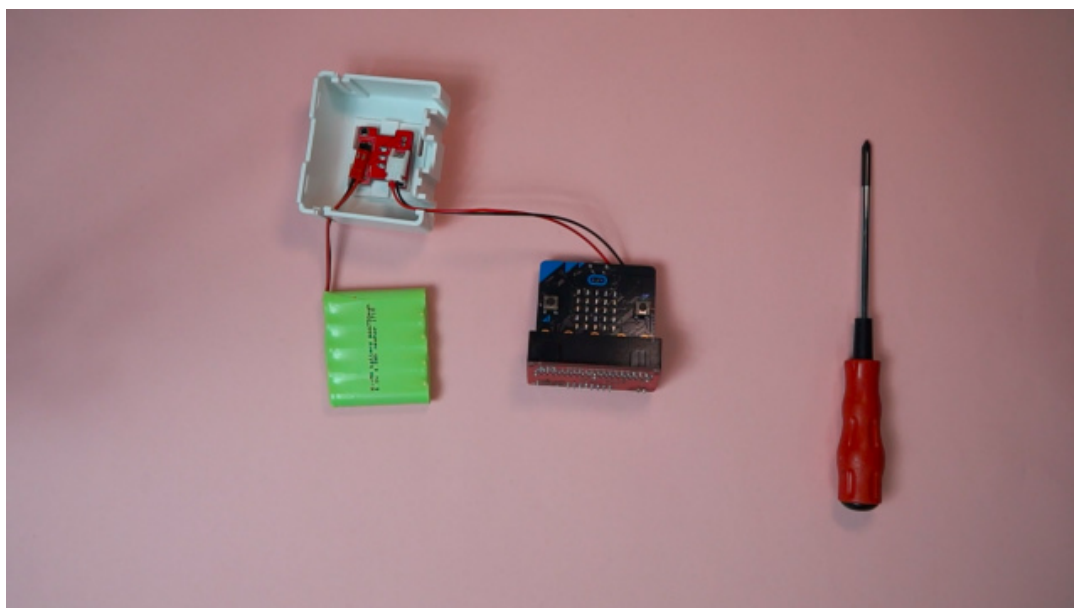


*connector tool use example*

5. Plug in the micro:bit to the control board.



6. complete set of board assembly is seen below

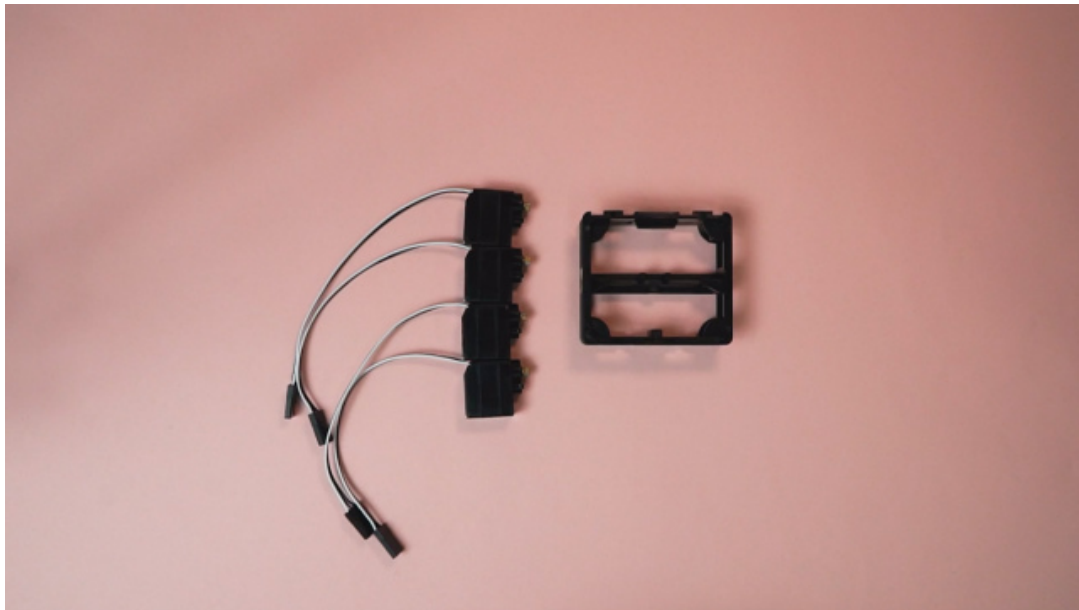


## 4.4 Servo motor set-up

### Necessary items

---

1. Servo motors ×4 (numbers 0,1,4, and 5)
2. Servo bracket



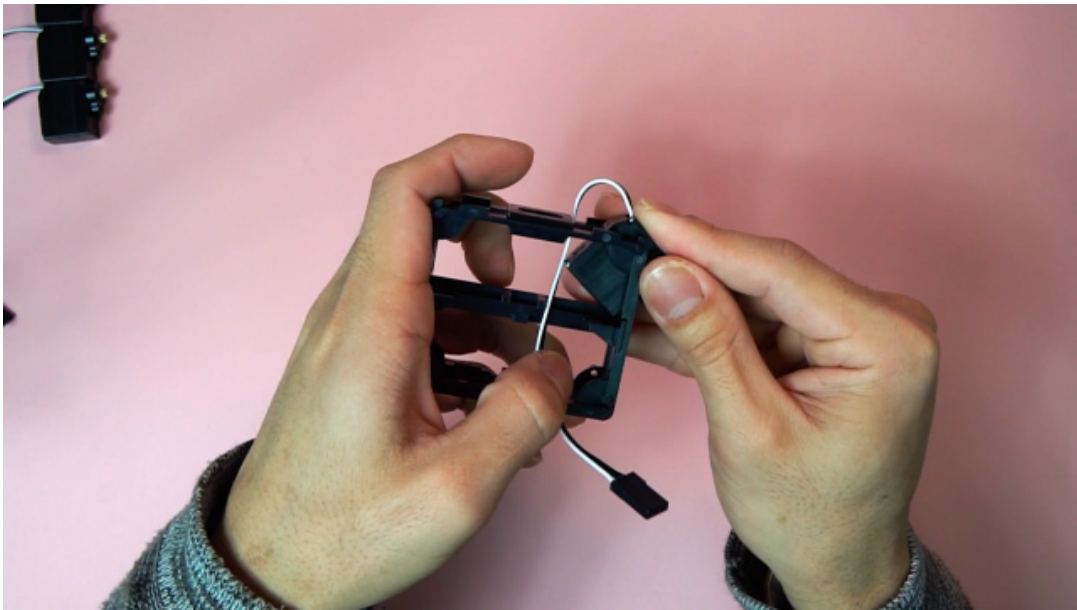
*Necessary items*



## Procedure

---

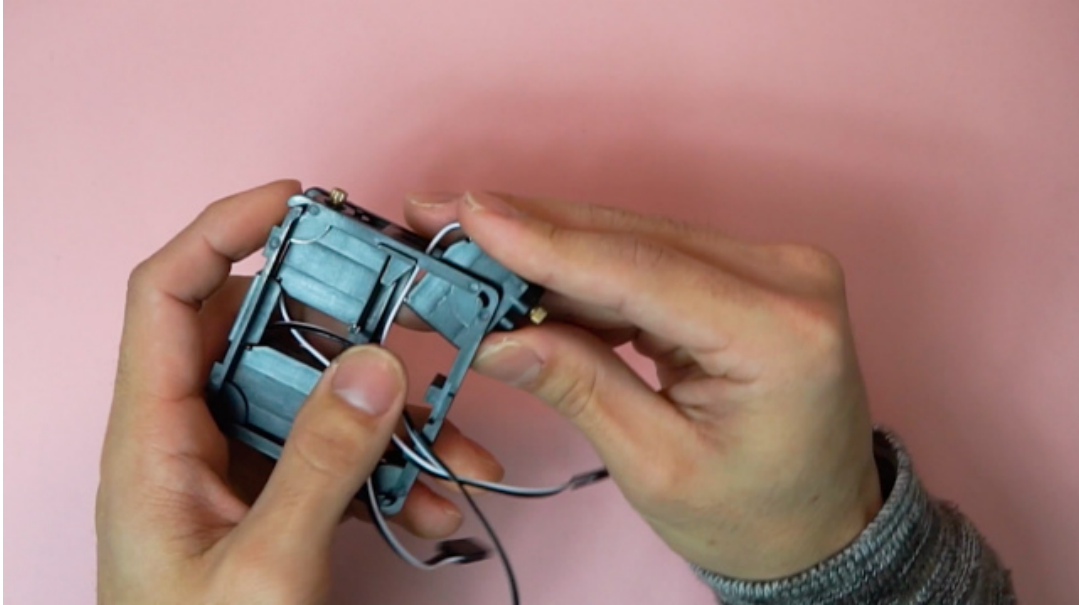
1. Orient the servo bracket such that the long back is horizontal and towards the back when inserting the servo motors. The side of the bracket with this long bar in the middle is the "back" of the part and concordantly the back of the robot. Insert servo motor #0 into the servo bracket as shown. This will be the robot's left arm. Be careful not to have the cable of servo motor #0 pinched between the motor casing and plastic parts when assembling. Have the servo motor cable come out the "front" side of the bracket.



2. Insert servo motor #4 following the same procedure as #0 on the opposite side of the bracket.



3. Again, be careful not to have the cable of servo motor #1 pinched between the motor casing and plastic parts when assembling.



4. Insert servo motor #5 following the same procedure as #1 in the last available position in the bracket. Ensure all servo motor cables are coming out the "front" face of the bracket.

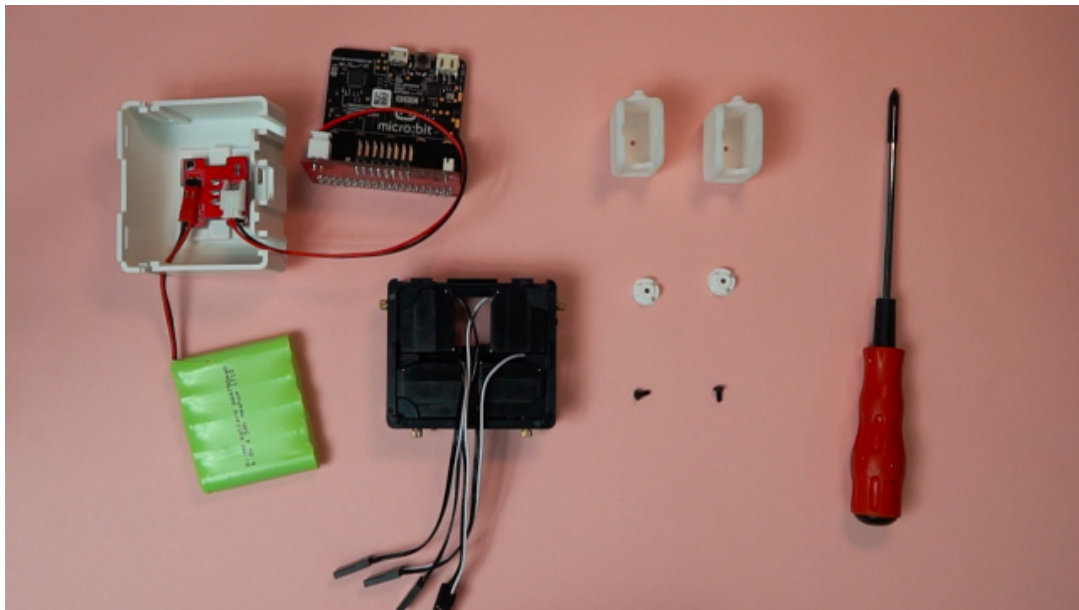


## 4.5 Assembling the Thighs

### Necessary items

---

1. The previously assembled servo bracket with servo motors.
2. The previously assembled control board  
battery  
switch board
3. Thigh plastic parts ×2
4. Servo horn ×2
5. Screws ×2



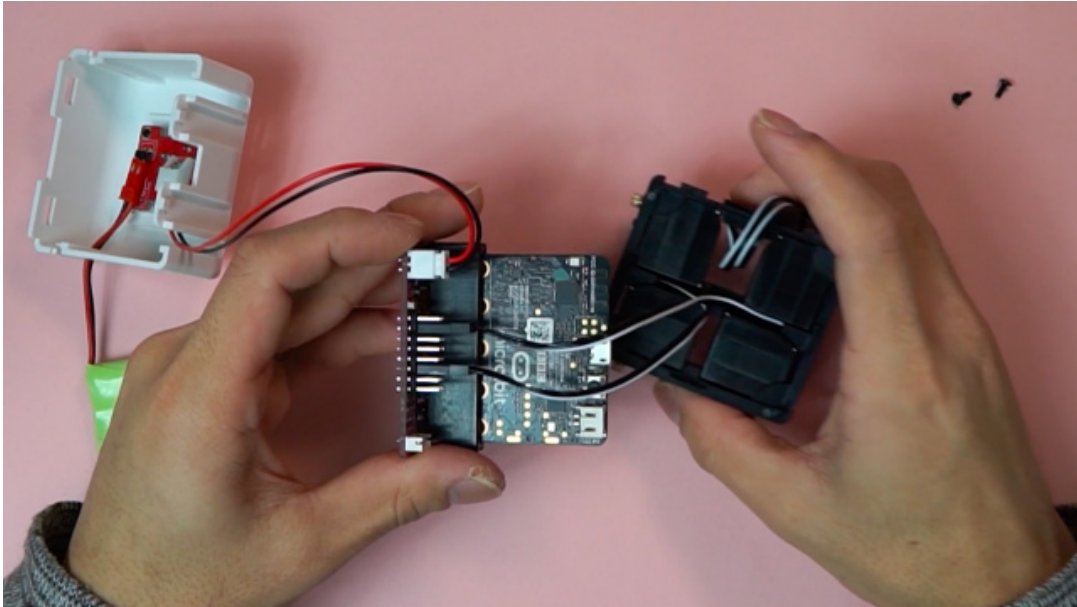
*Necessary items*



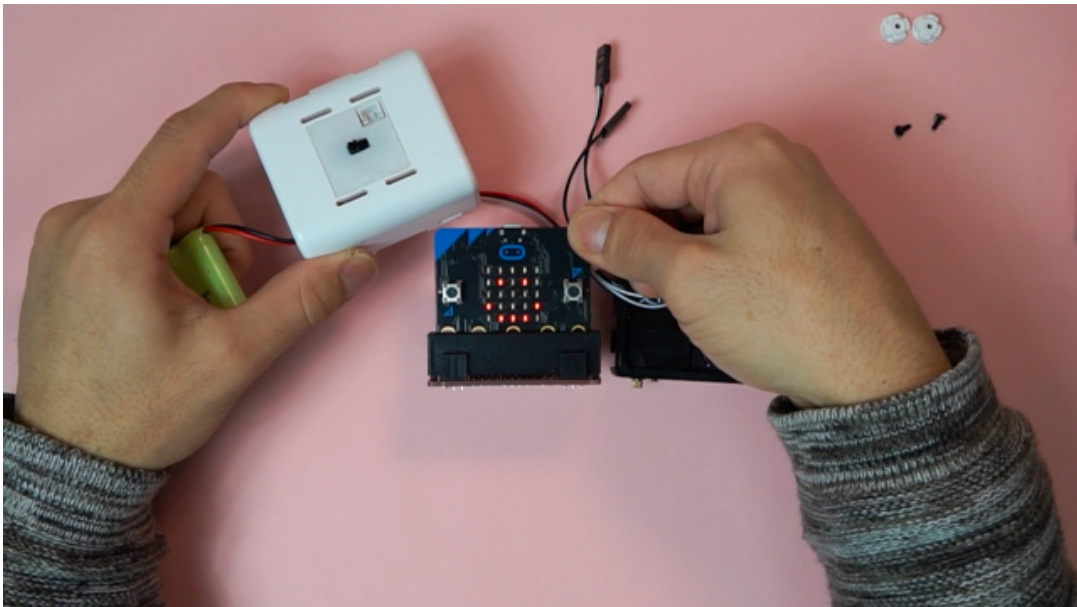
# Procedure

---

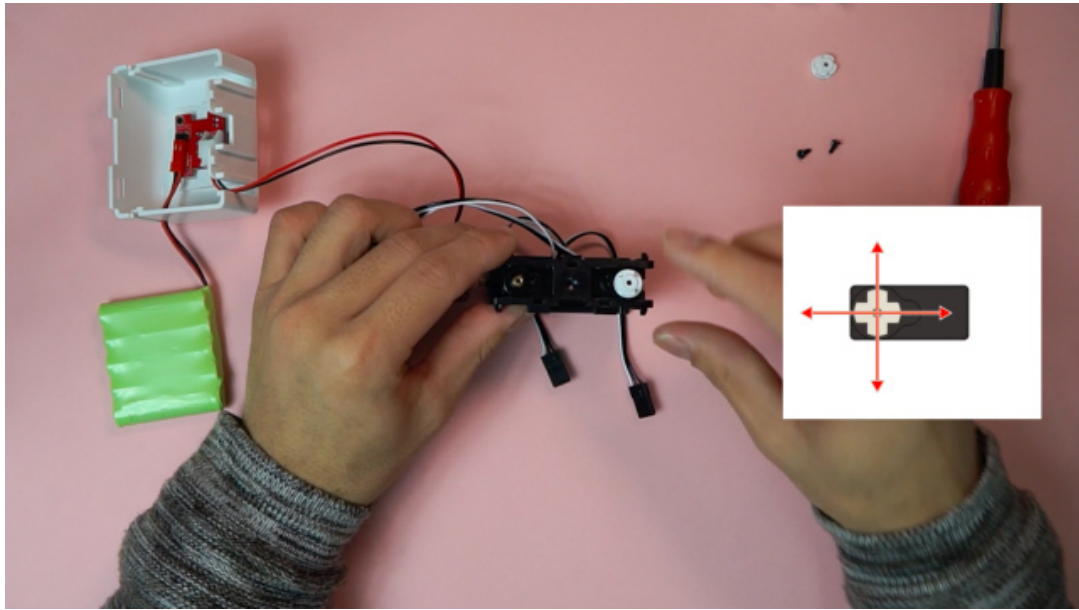
1. Ensure the switch board switch is in the off position. Connect servo motors #1 and #5 to the control board pins as shown. The servo motor pins numbering is given in the Appendix 5.2 picture. When connect the motors into the pins, ensure that the black (ground) cable is towards the outside of the control board. Turn the switch on the switch board on.



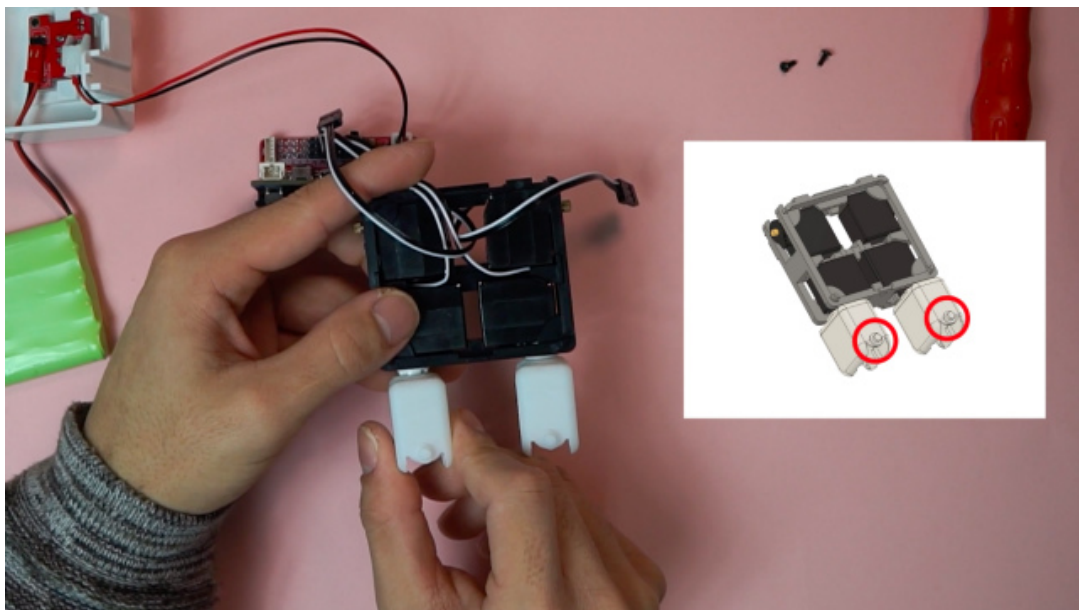
2. The servo motors should rotate automatically to their initial position.



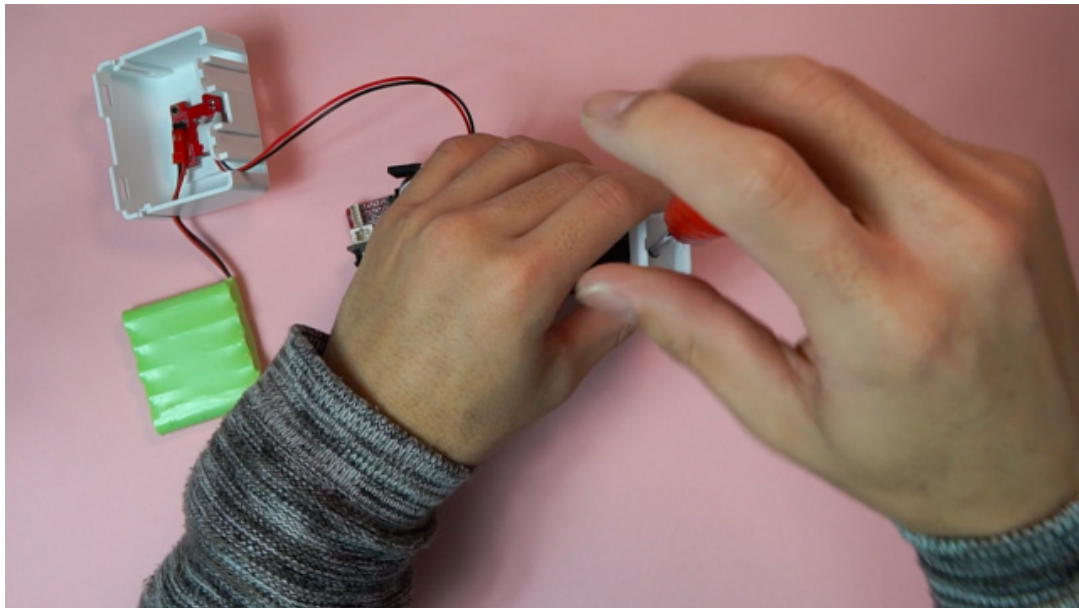
3. Attach the servo horn plastic parts to servo motors #1 and #5 as shown in the photo. Ensure the axis of the + on the horn is aligned with the edges of the servo motors.



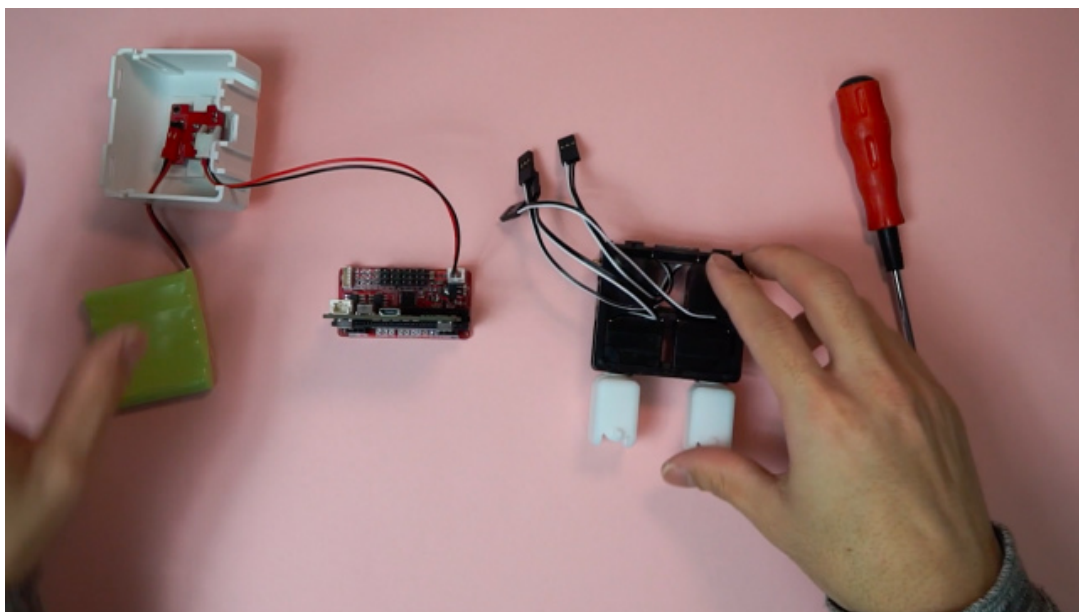
4. Orient the servo bracket such that the bar across the center of the bracket is horizontal and at the back of the assembly. The orientation in the photo below shows the bracket such that the robot's front is being looked at and the head is on top. Attach the plastic thigh parts onto the servo horns as shown, such that the bump on the plastic parts are pointing in the same direction as the "front" of the servo bracket.



5. Fix the thigh parts to the horn with the screws.



6. After fully screwing in each of the thigh screws, remove the servo cables from the control board.

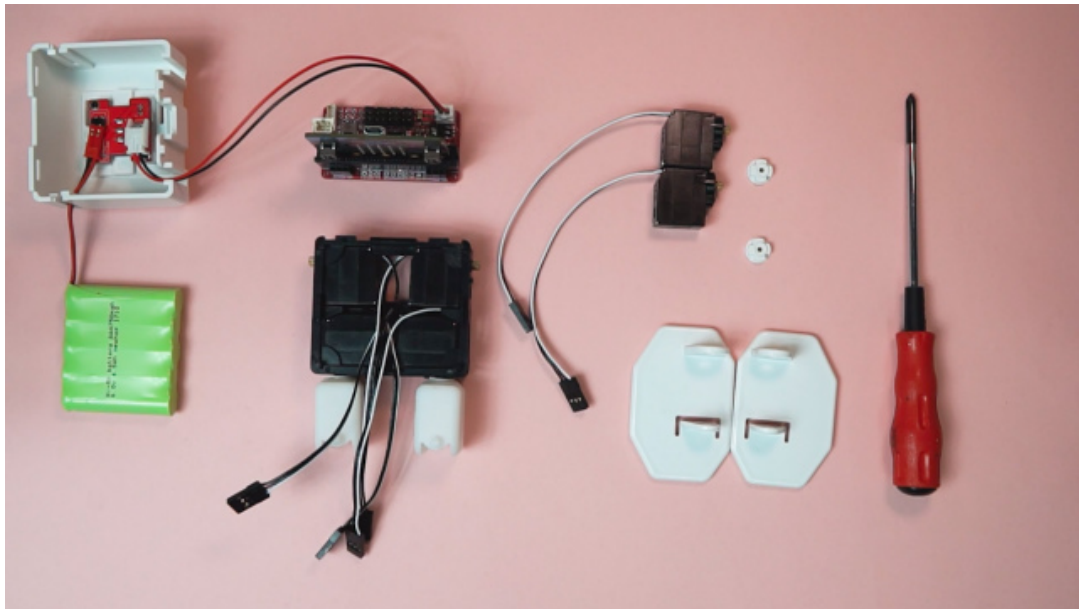


## 4.6 Attaching leg parts

### Necessary items

---

1. body sets
2. circuit sets
3. servo×2 (3,7番)
4. legs×2
5. servo horn×2



*Necessary items*



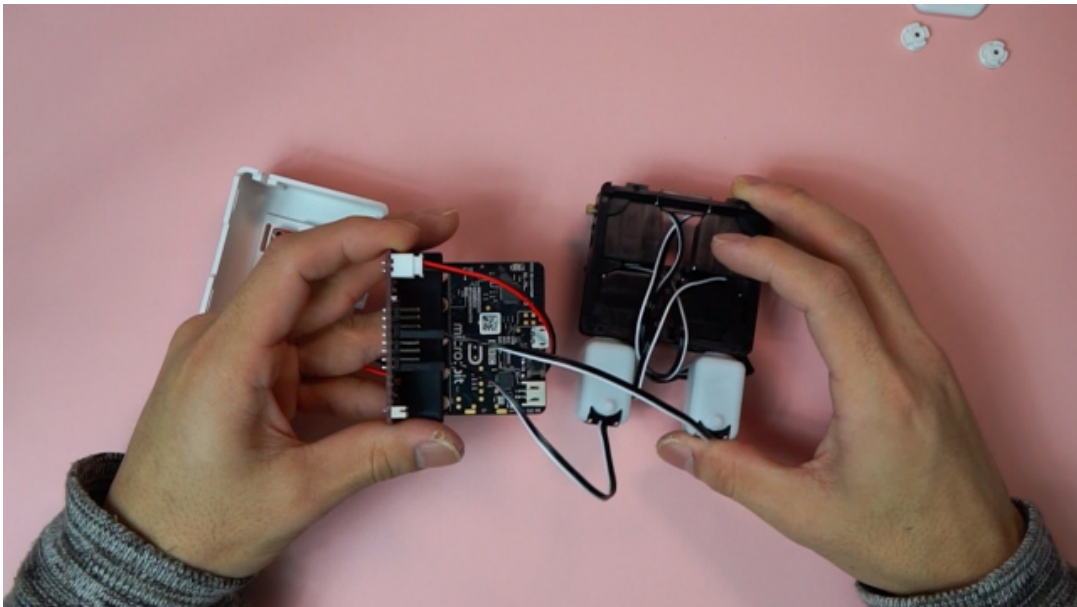
# Procedure

---

1. Insert servo motors numbers 3 and 7 into the thigh parts as shown.  
The gears of the servo motors will be pointing towards the "back" of the robot.



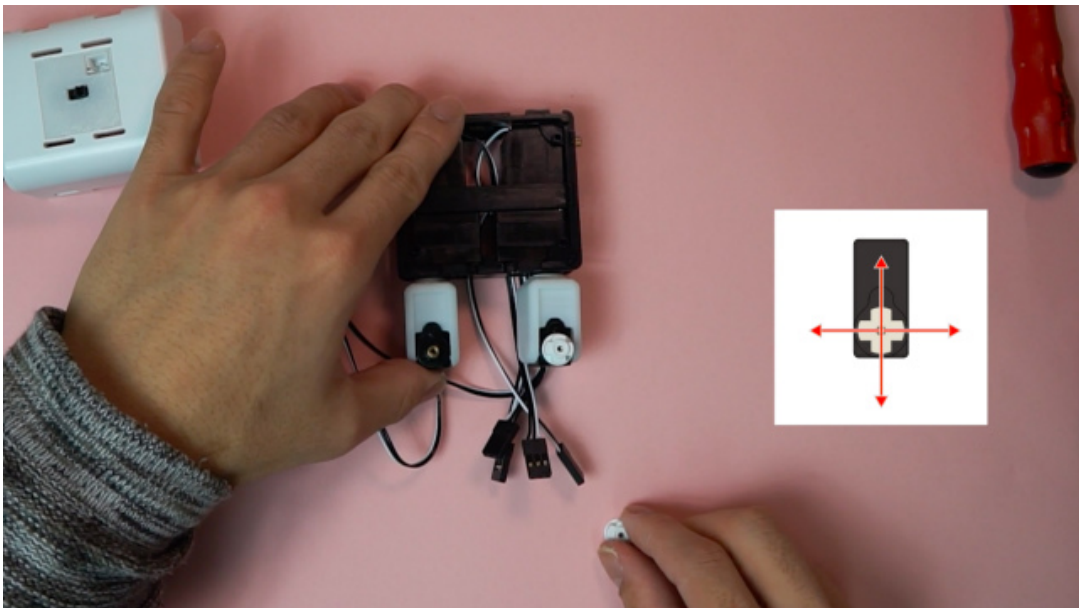
2. Connect the servo cables for motors 3 and 7 into the control board.  
Servo motor number 3 is to be placed as the robot's left leg. Motor number 3 is connected to the corresponding pin set #3 again with the black (ground) cable towards the outside of the control board.  
Repeat for motor #7. Turn the switch board back on.



3. The servo motors should rotate automatically to their initial position.



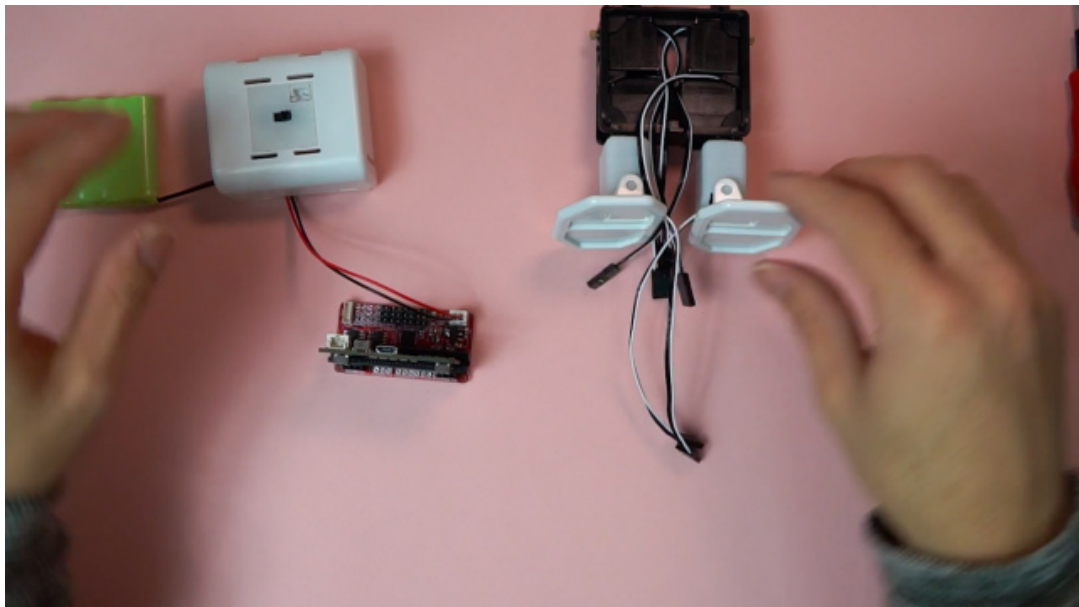
4. Similar to servo motors #1 and #5, attach the servo horns to each servo motor such that the axis of the + on the horn is aligned with the edges of the servo motors as closely as possible.



5. Attach the feet plastic parts while paying attention to ensure the wider side of the feet are towards the outside of the robot. Insert the + side of the foot into the servo horn and then insert the opposite side of the foot into the bump on the front side of the thigh. \*This may take some strength.



6. After fixing the feet to the servo motors, unplug the servo motors from the control board and turn the power switch off.

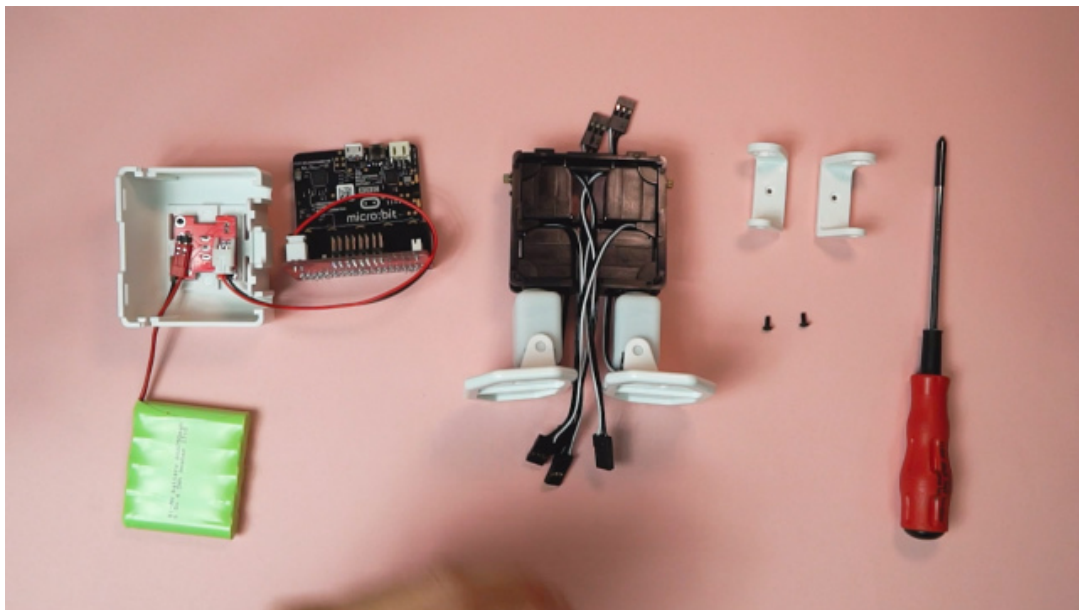


## 4.7 Shoulder parts assembly

### Necessary items

---

1. body sets
2. circuit sets
3. shoulder×2
4. screw×2



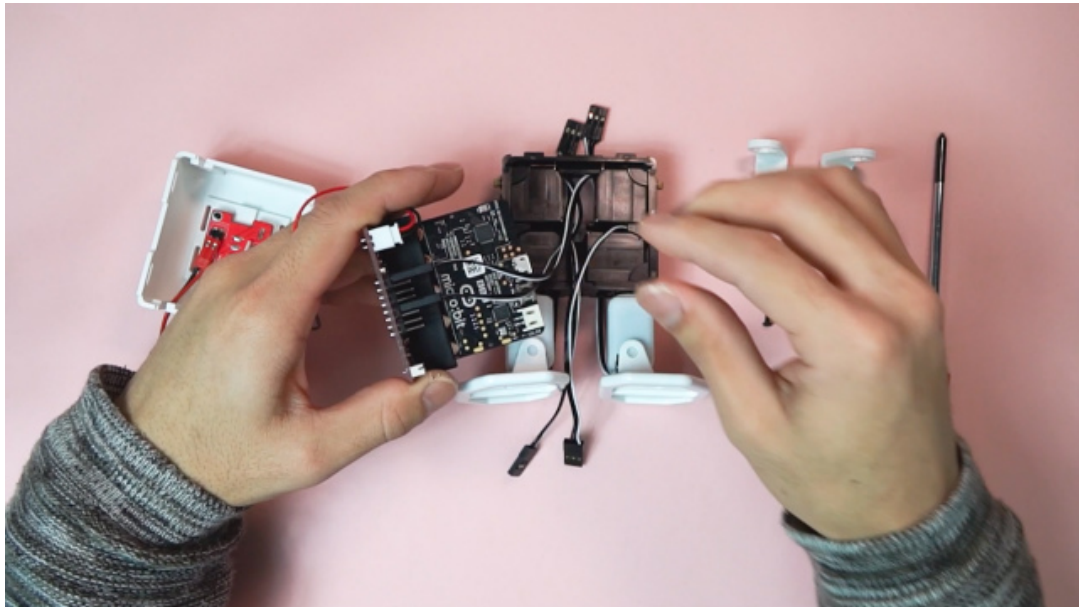
*Necessary items*



## Procedure

---

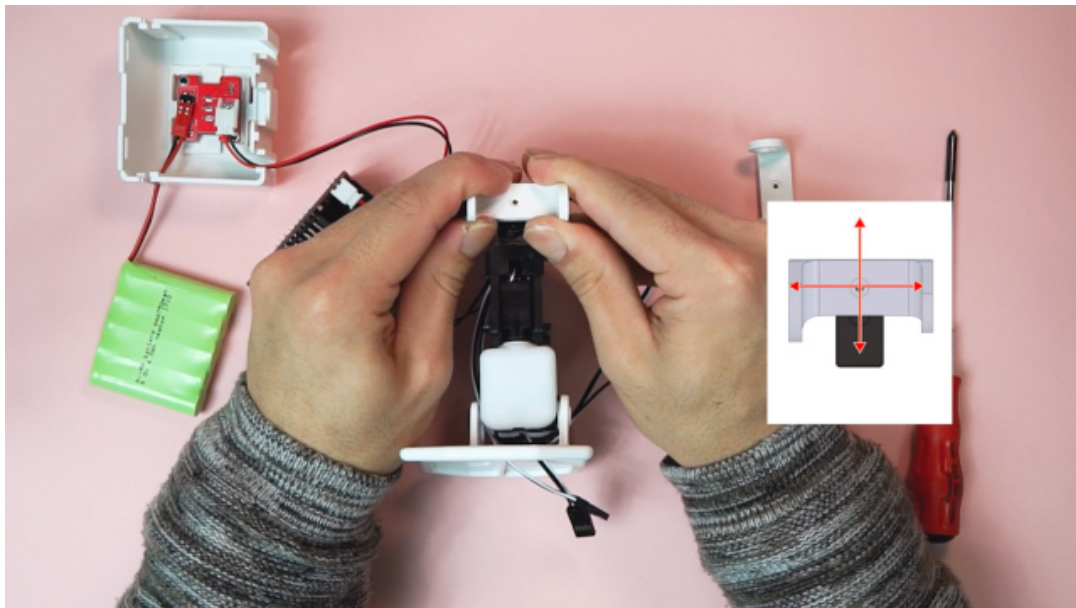
1. Connect servo motors #0 and 4 from the servo bracket into their respective pins on the control board and turn the power switch on.



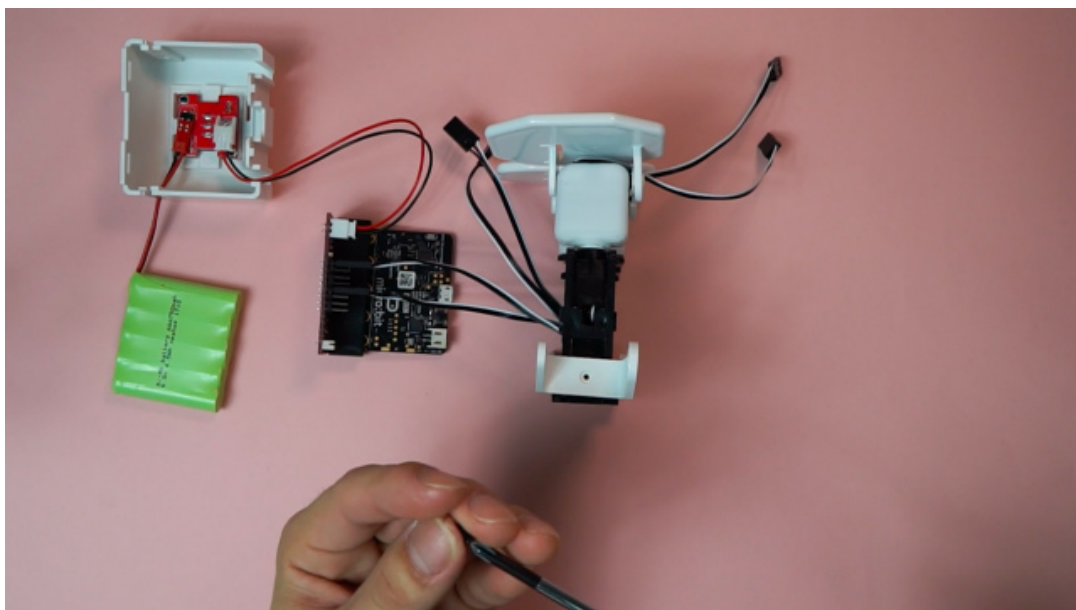
2. The servo motors should rotate automatically to their initial position.



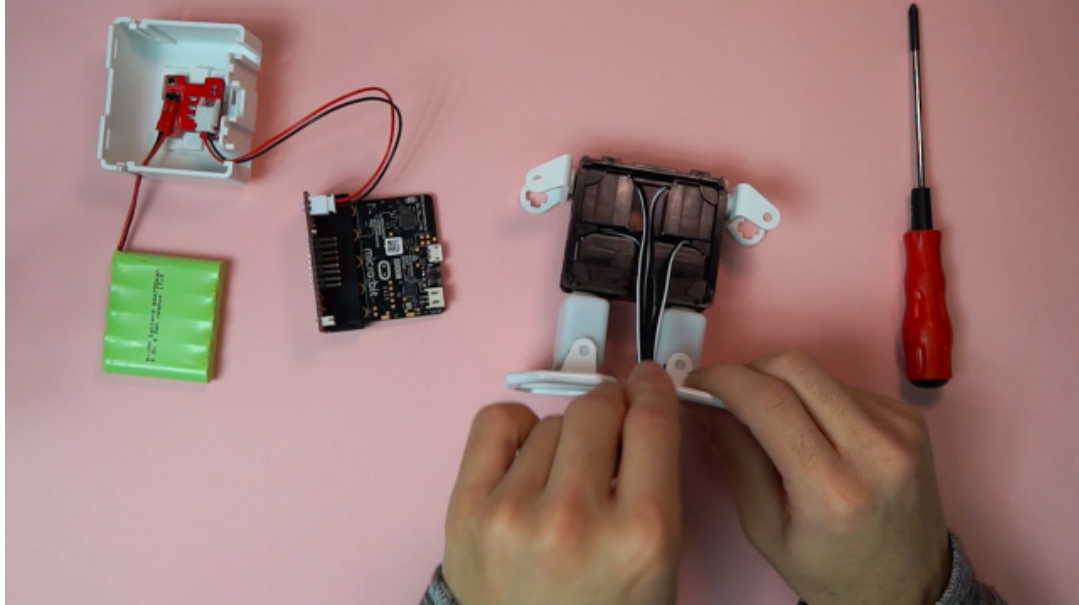
3. Insert the shoulder parts into servo motors 0 and 4 such that the flat edges are aligned with the servo motor as closely as possible. The wider side of the shoulder parts with the + cut should be towards the back of the robot. Screw in the plastic shoulder part into the servo motor.



4. Repeat the previous step for the opposite shoulder



5. Unplug the servo motors from the control board and turn the power switch off.

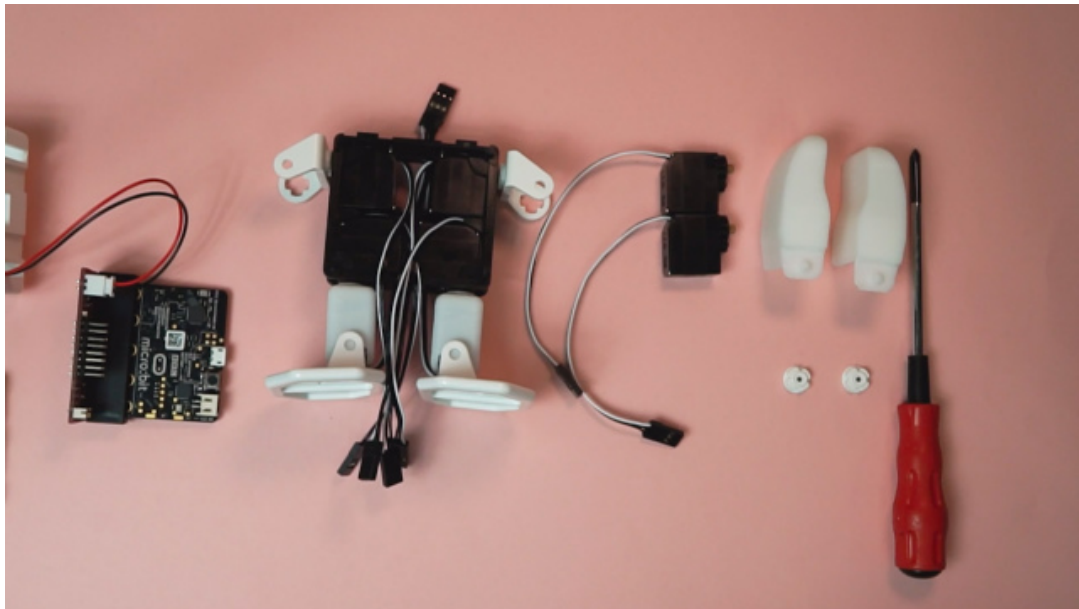


## 4.8 Arm parts assembly

### Necessary items

---

1. body sets
2. circuit sets
3. arm×2
4. servo×2 (2,6番)
5. servo horn×2



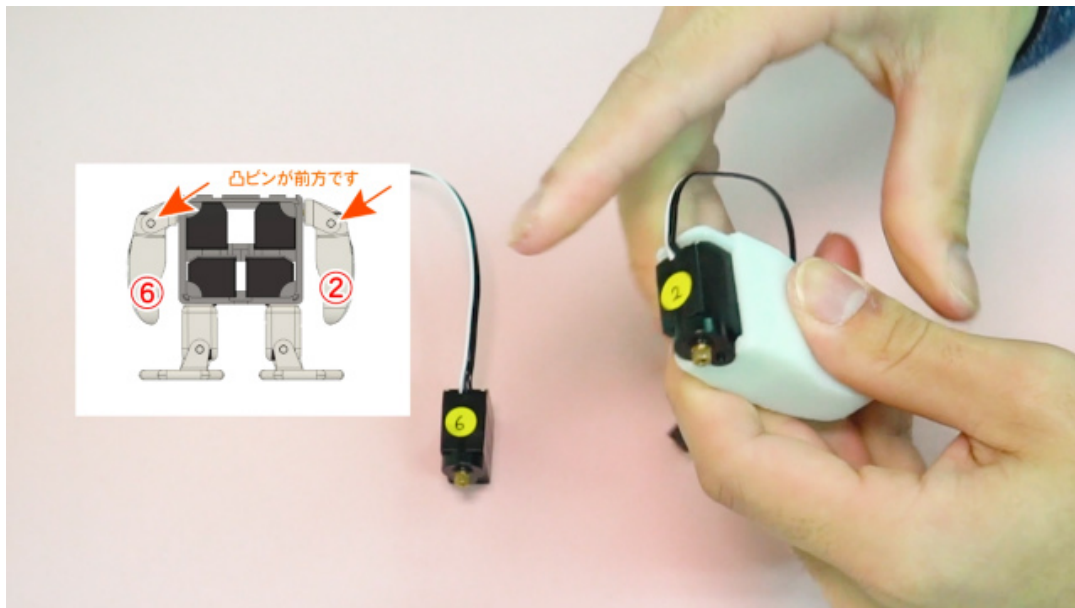
*Necessary items*



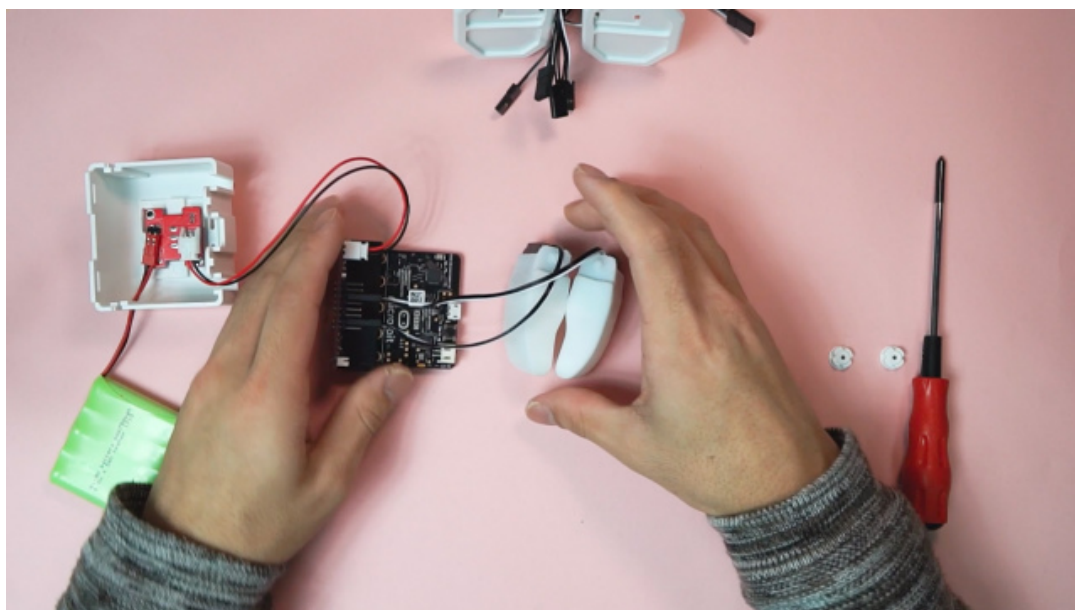
# Procedure

---

1. Place the servo motors #2 and 6 into the plastic arm parts such that motor #2 is the robot's left arm.



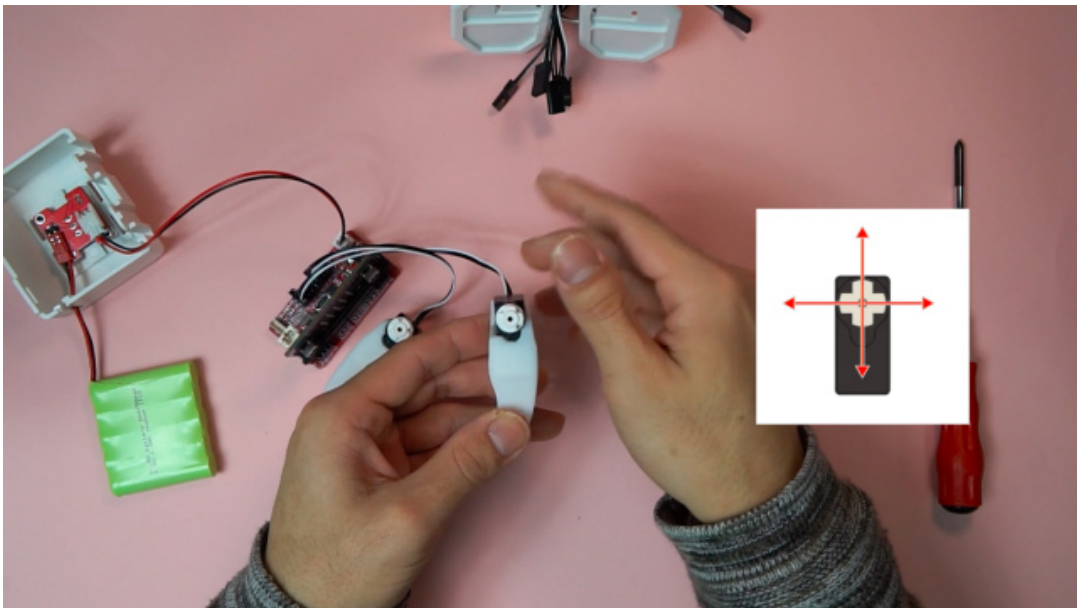
2. Directly connect servo motors #2 and 6 into their respective pins on the control board and turn the power switch on.



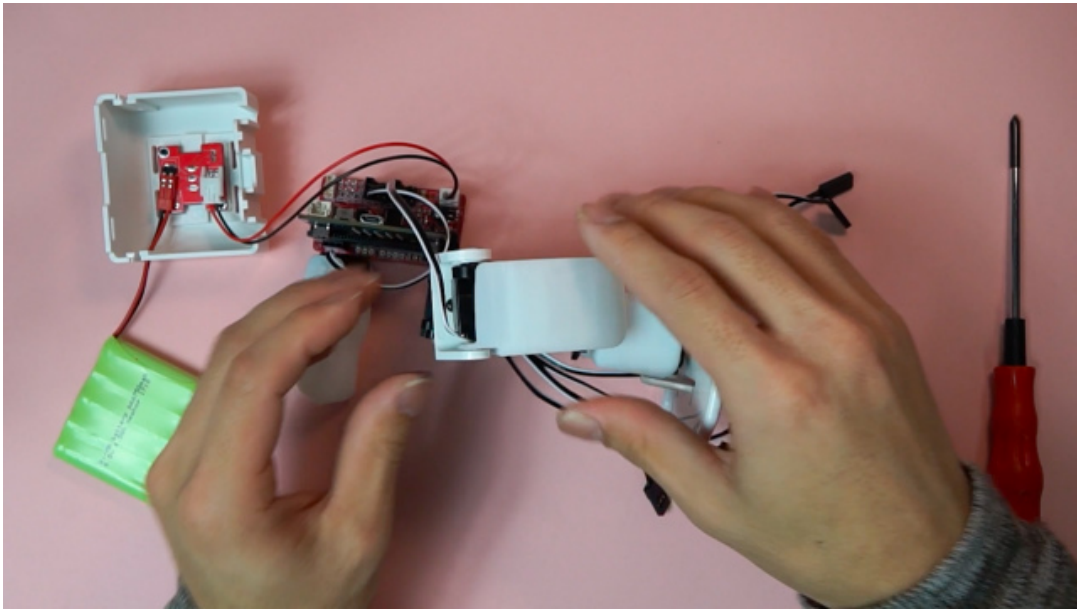
3. The servo motors should rotate automatically to their initial position.



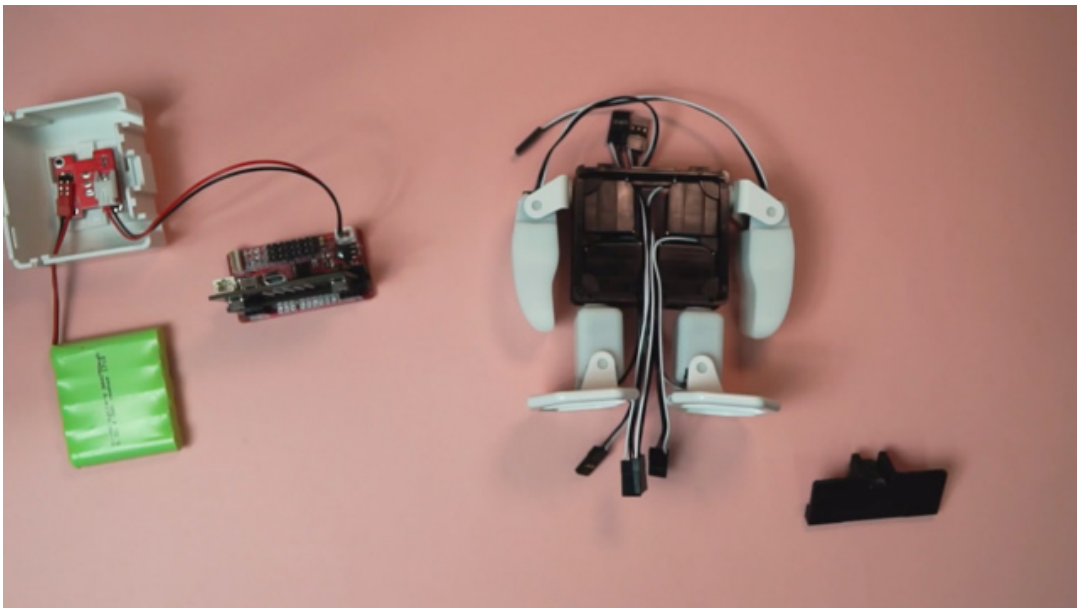
4. Attach the servo horns to each servo motor such that the axis of the + on the horn is aligned with the edges of the servo motors as closely as possible.



5. Insert the left and right arms into the shoulder pieces lining up the servo horn with the cut + shape on each shoulder. \*Ensure the arms are inserted pointing down.



6. After fixing the arms to the shoulder parts, unplug the servo motors from the control board and turn the power switch off.

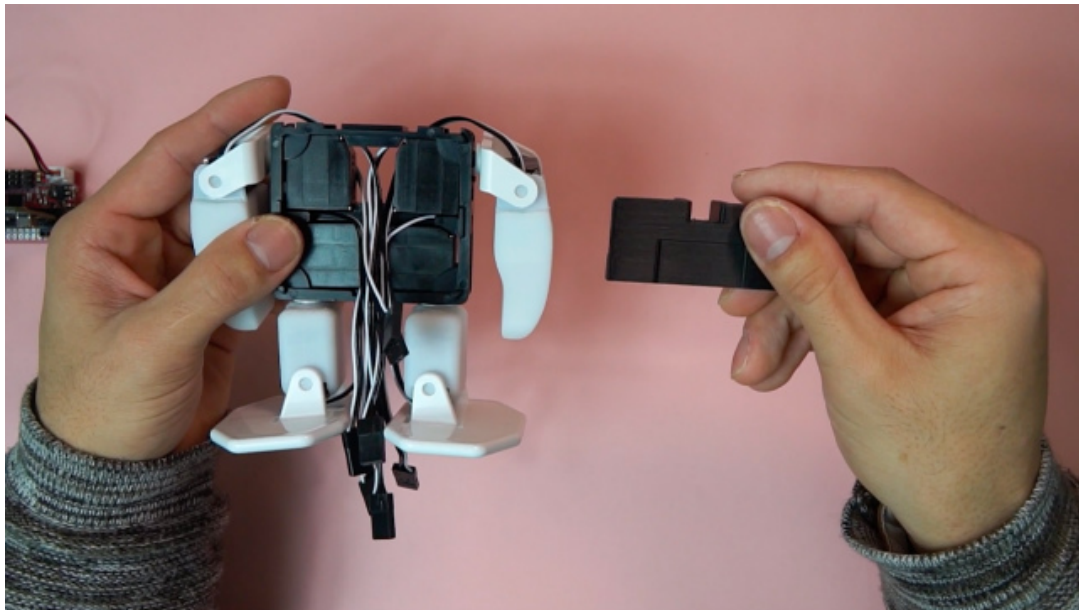


## 4.9 Servo fixer attachment

### Necessary items

---

1. Body assembly set
2. Servo fixer part



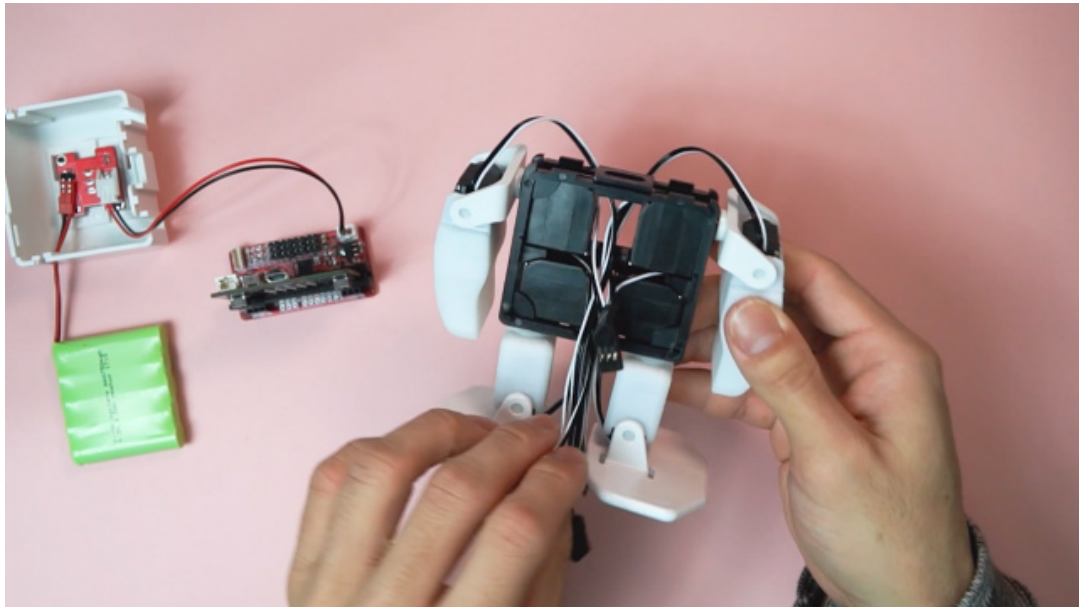
*Necessary items*



# Procedure

---

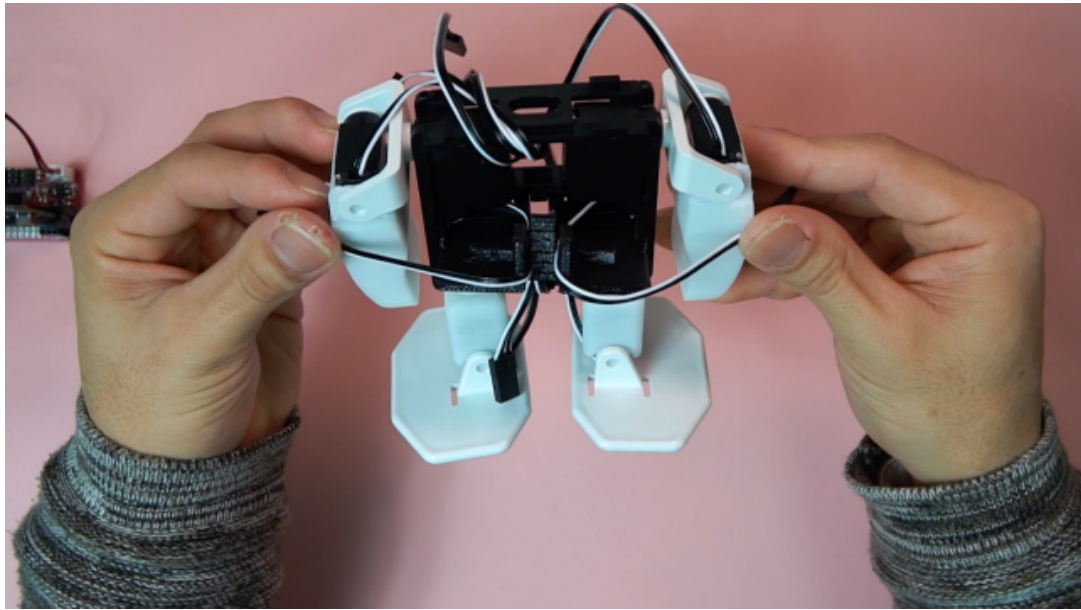
1. Pass the cables of the eight servo motors through the servo bracket and through front as shown.



The cables of motors #3 and 7 are passed through the lower hole of the bracket, and left there for later.



2. Servo motors #1 and 5 are passed between the opening in the servo fixer, while the remaining cables are temporarily wrapped up around the top of the body to keep them out of the way.



3. Attach the servo fixer part so as to not catch and pinch any of the other servo motor cables.

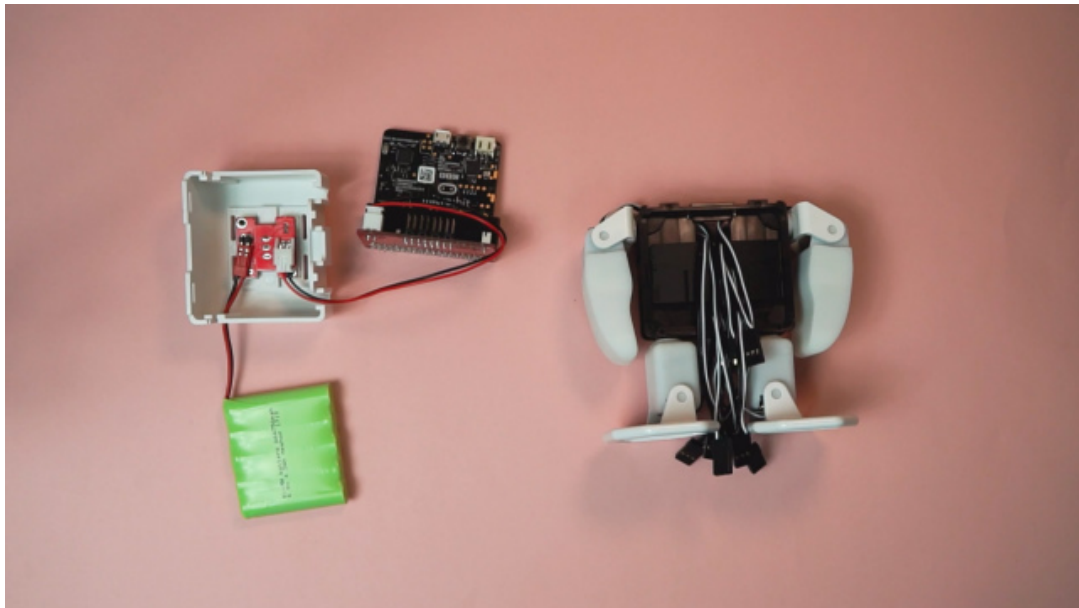


## 4.10 Control board wiring

### Necessary items

---

1. Battery assembly
2. Control board assembly

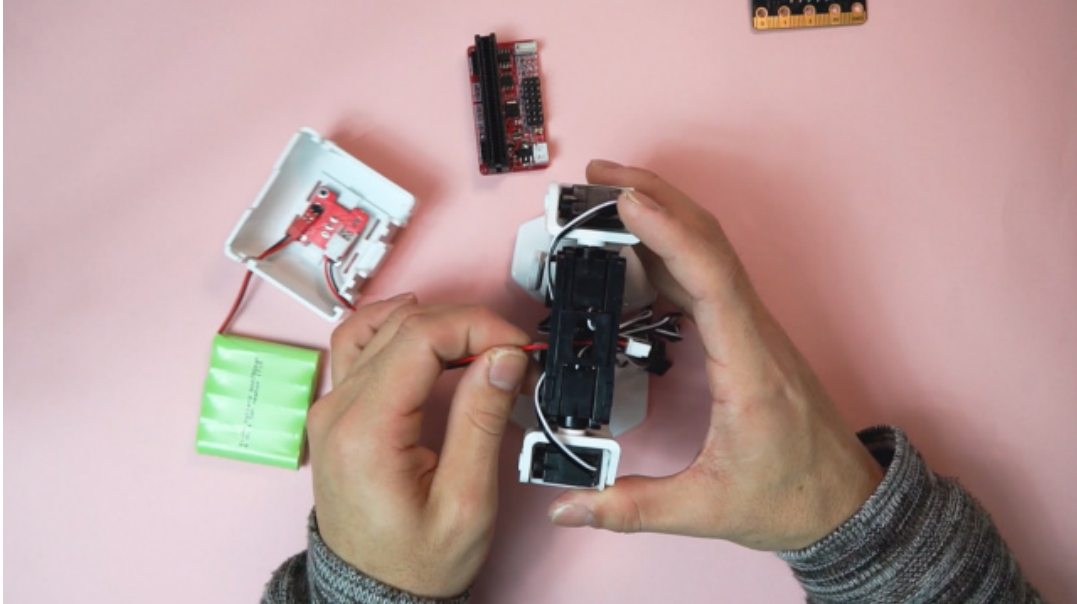


*Necessary items*

## Procedure

---

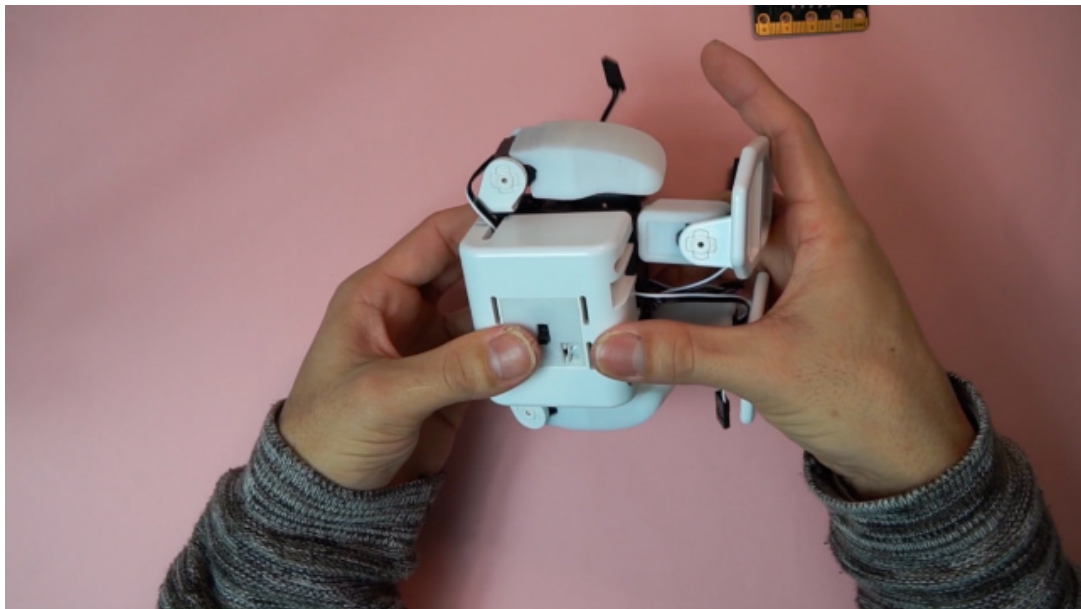
1. Remove the micro:bit and the power cable from the control board.  
Pass the power cable along with the servo motor cables from the back side through the front hole in the body and reconnect the power cable to the control board again.



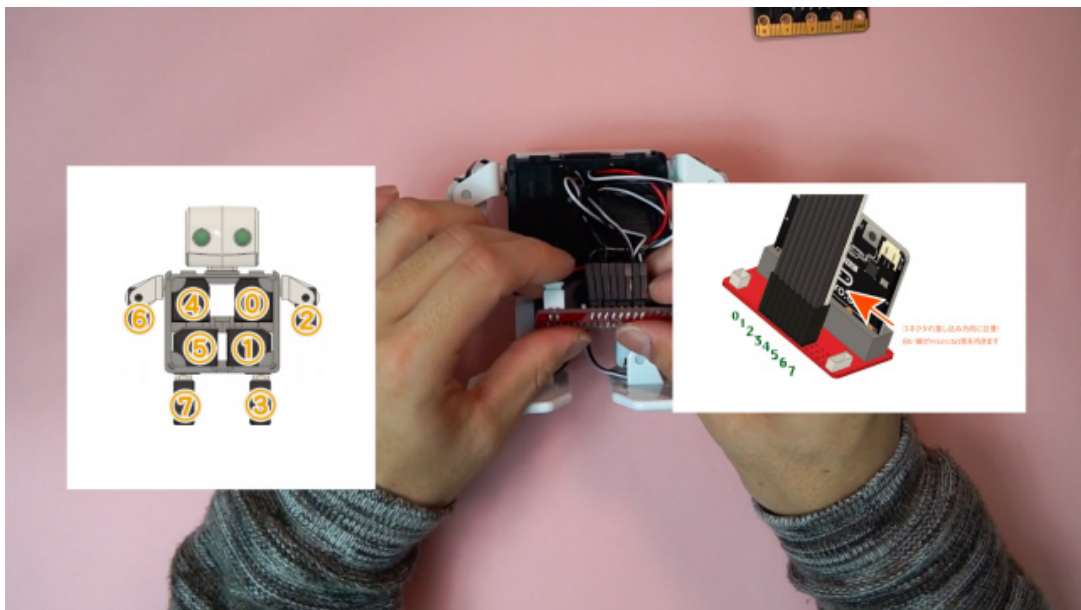
2. Put the battery into the back plastic part on top of the switch board and keep the battery cable underneath the battery. Attach the back plastic part to the back of the servo bracket.







3. Connect all servo motor cables following the appropriate order with servo motor number matching pin number.

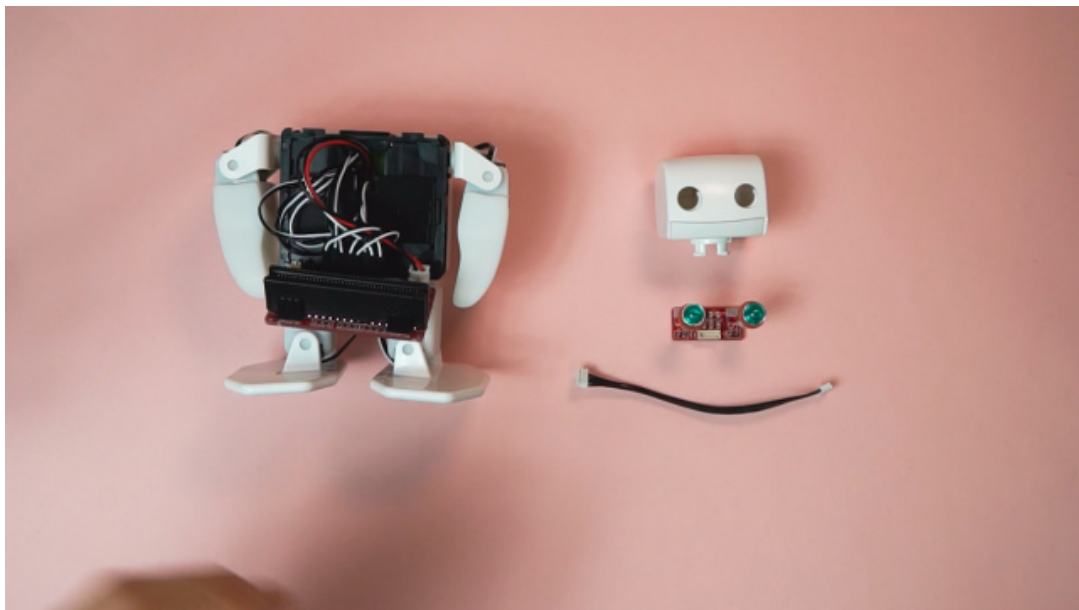


## 4.11 Head part assembly

### Necessary items

---

1. body sets
2. head parts(top, bottom)
3. head board
4. head board cable



*Necessary items*



# Procedure

---

1. Take apart the top and bottom plastic parts of the head



2. Connect the final head-board control cable to the head-board



3. Unscrew the nuts on each LED down about 3mm.



4. Pass the head-board cable through the hole in the bottom side of the head plastic part.



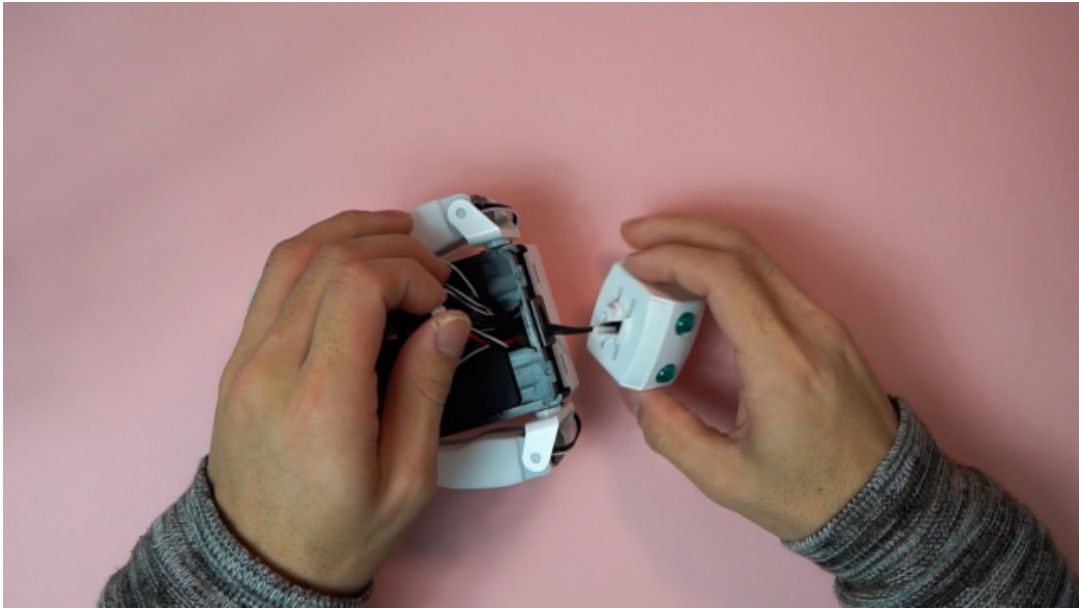
5. Bend the LED legs 90 degrees such that the head-board is rotated up, and insert both LEDs into the semi-circular grooves in the bottom plastic heat part such that the nuts on each LED are on the inside of the head.



6. Align and place the top plastic head part onto the bottom part by first passing the LED bulbs through the top heat eye holes.



7. Insert the head-board cable through the top hole in the servo bracket and pass through the front side of the body. Insert the assembled head into the same hole to fix the head to the servo bracket.



8. Connect the head-board cable into the control board.



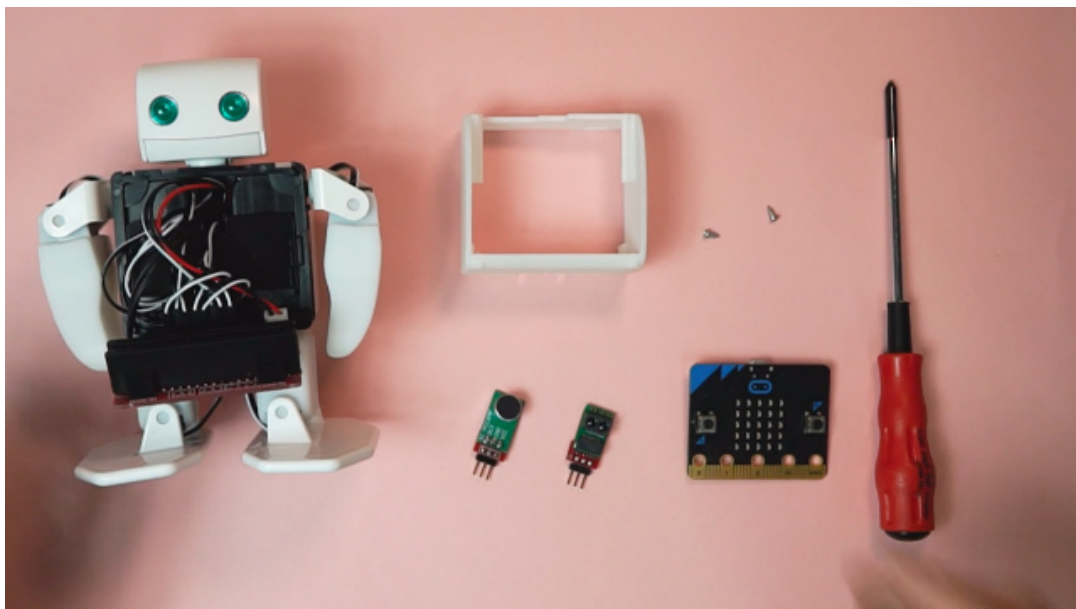


## 4.12 Chest assembly

### Necessary items

---

1. body sets
2. chest
3. micro:bit
4. sound sensor • distance sensor
5. screw×2

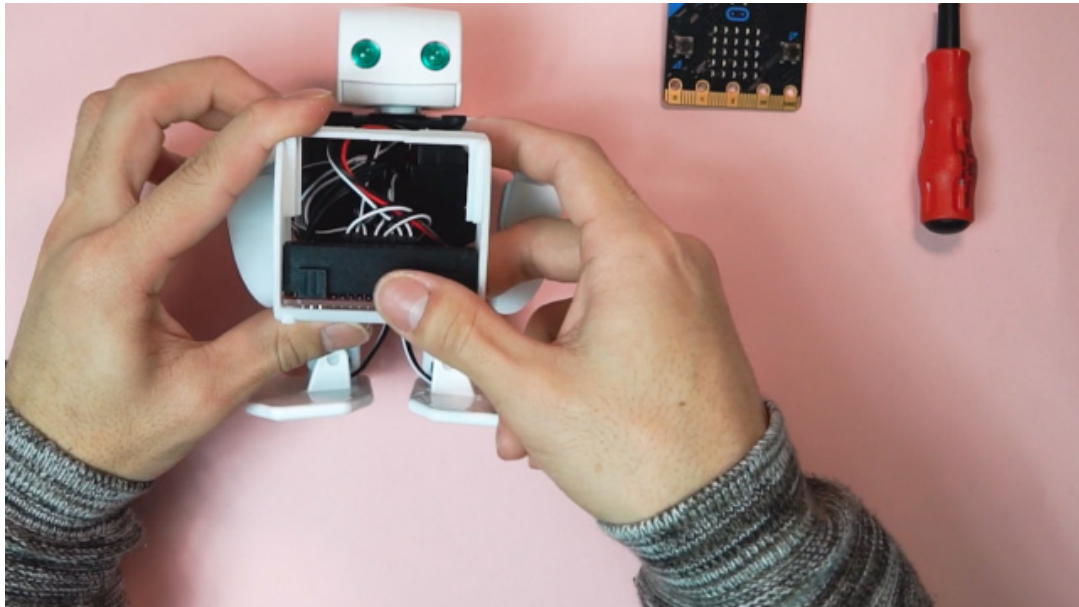


*Necessary items*

## Procedure

---

1. First slide the control board into the chest part from the front oriented as shown in the photo.

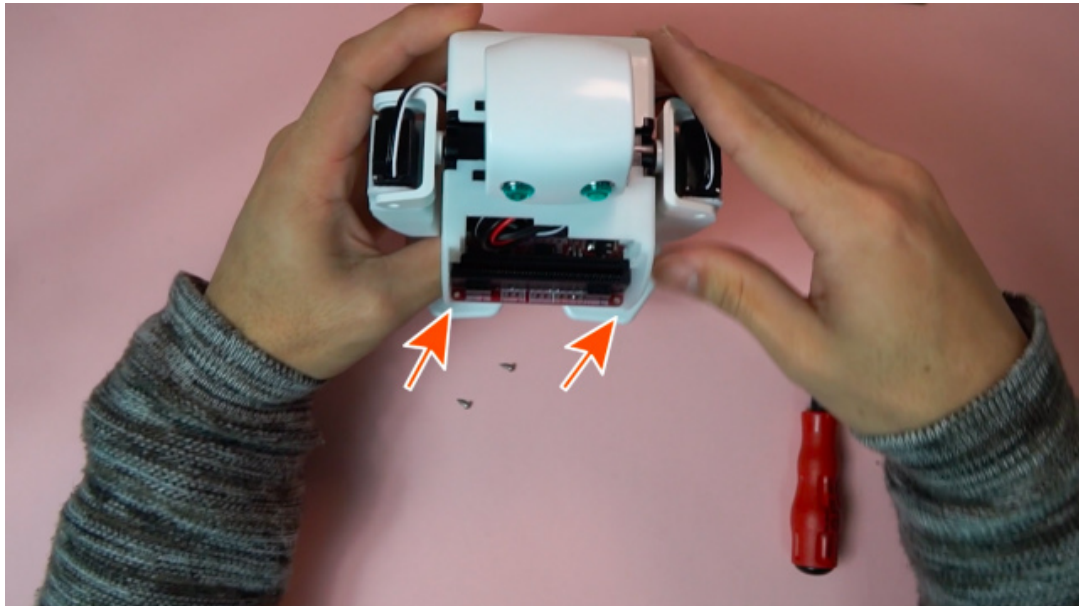


2. Attach the control board and chest assembly to the servo bracket body.

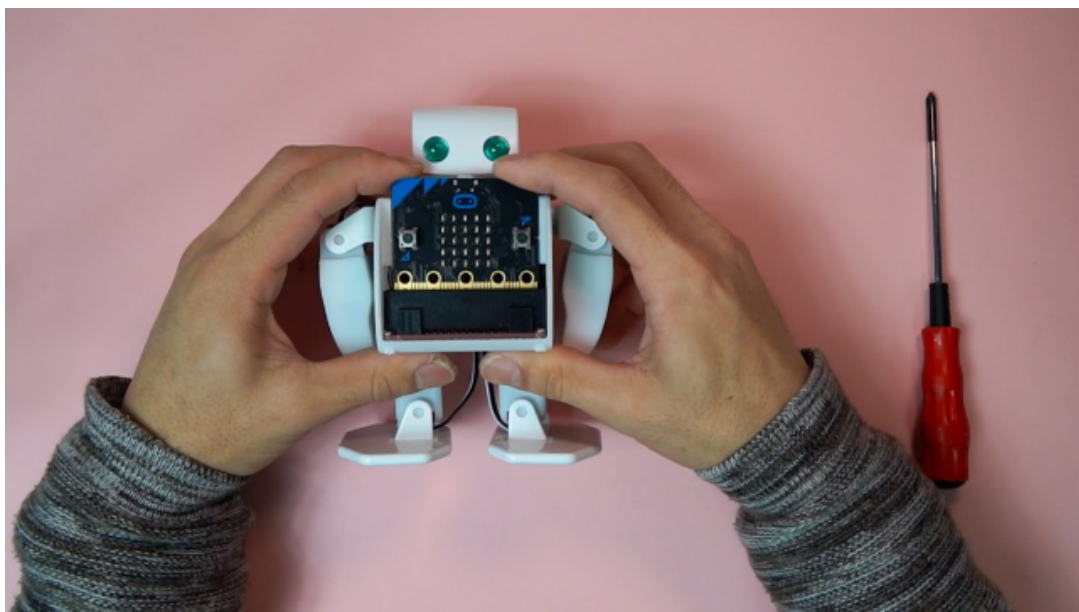




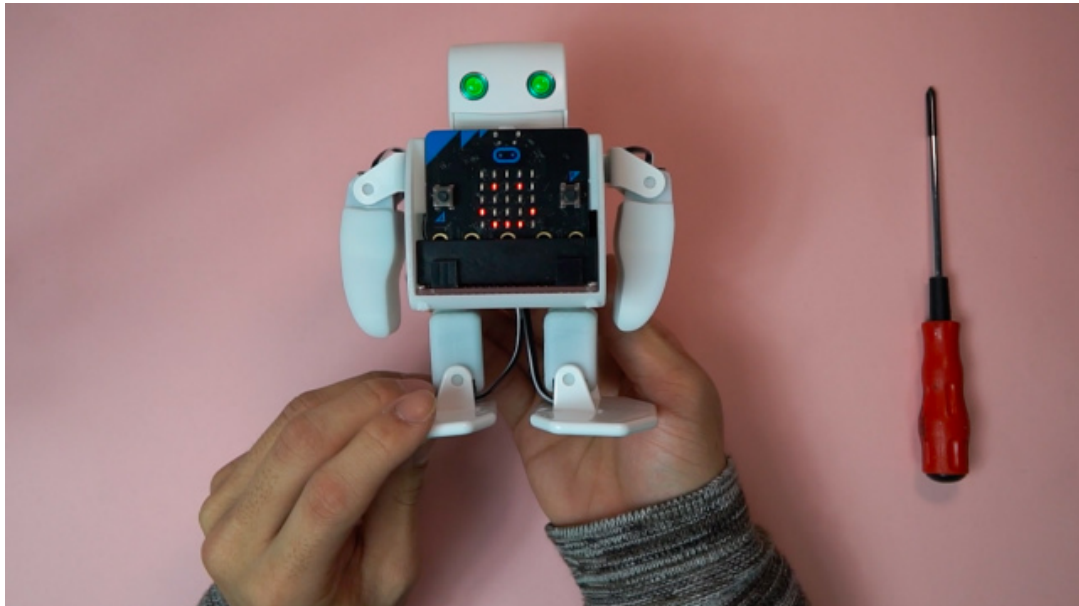
3. Screw the control board into the chest through the two screw holes in the corners of the control board.



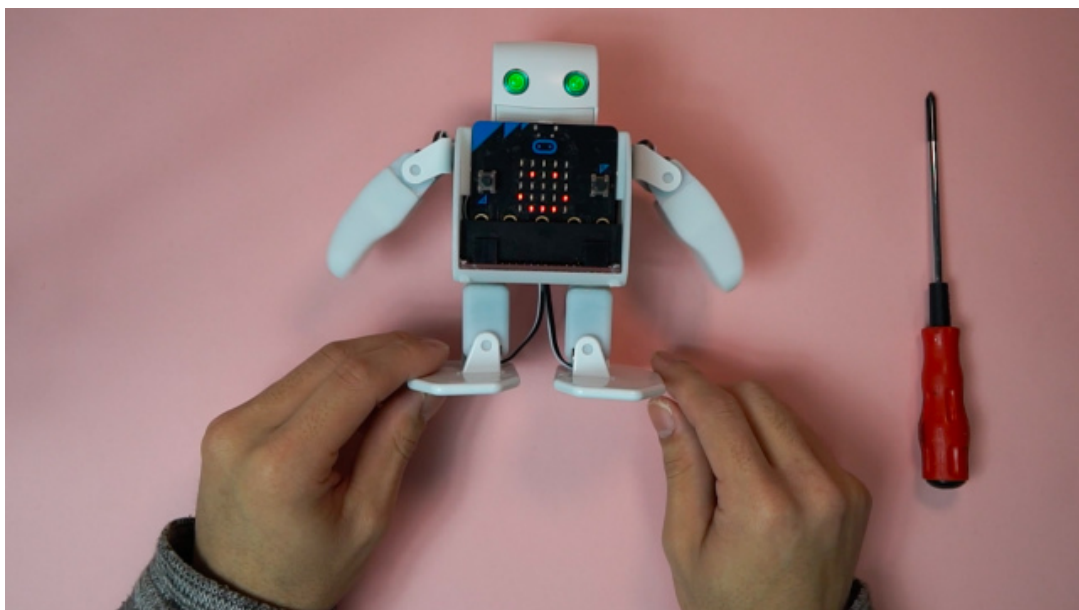
4. Insert the micro:bit.



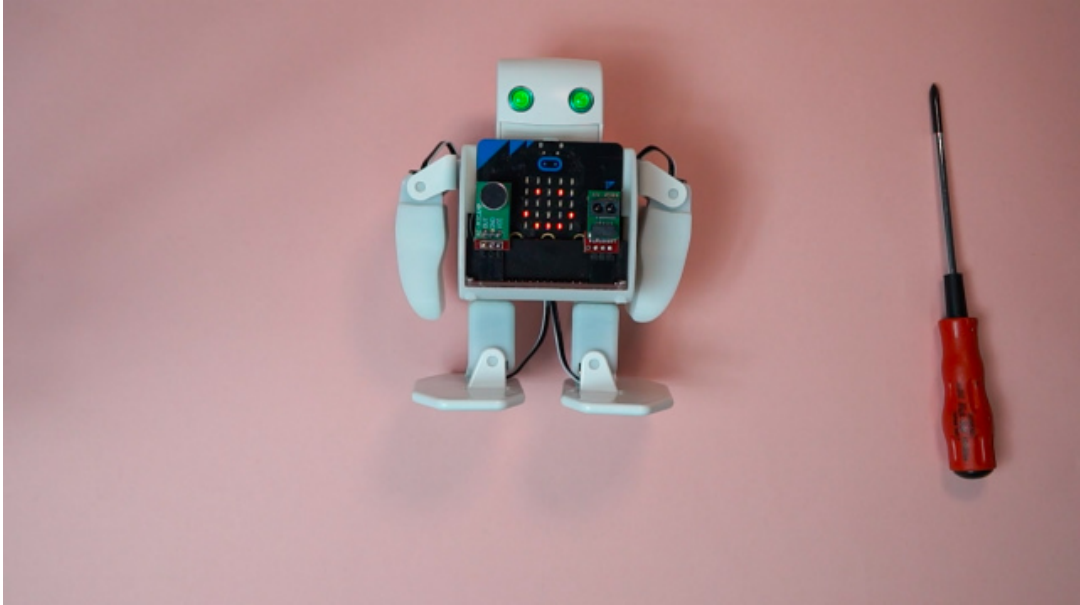
5. Switch the robot on and confirm if all servo motors have rotated and initialized.



6. Press the micro:bit A and B buttons to check that the limbs work.



7. Plug the sound sensor and the distance sensor into the pin terminals on the front of the control board on PLEN:bit.



---

## 5. Motion check

---

### 5.1 Let's walk the PLEN:bit!

1. Press A Button to check if PLEN:bit walks.
2. Enjoy PLEN:bit!
3. if can't walk PLEN:bit...<br /> Use this ->[https://makecode.microbit.org/\\_Veh6c5AVMawp](https://makecode.microbit.org/_Veh6c5AVMawp)
4. Plug in the USB cable into PLEN:bit and your computer. A new drive will appear in your file explorer.
5. When you download the files they may be downloaded directly to your computer as a .hex file. Simply move these files into the new PLEN:bit drive that was created when it was plugged in and they will be uploaded into the micro:bit.

### 5.2 How to adjust ServoMotor position

1. Download this program  
->[https://makecode.microbit.org/\\_3crgeTemLVUY](https://makecode.microbit.org/_3crgeTemLVUY)
2. Push A to start correction
3. Push A or B to move each servo
4. Push A+B to switch to next servo
5. Loop
6. Ends when smile is displayed
7. Reset, then Push B to walk. If PLEN does not fall over, setting is complete

---

## 6. How to charge battery

---

1. Connect PLEN:bit ( back Switch Board ) and PC ( or USB charger ) with cable.
2. Charging : LED ON
3. Full charge : LED OFF

---

## 7. How to BLE ver. head board

---

1. change [head board] and [BLE ver. head board]
2. You can control from PLEN Connect(APP)<br /> iPhone :  
<https://itunes.apple.com/jp/app/plen-connect/id990980940?mt=8>  
Android : <https://play.google.com/store/apps/details?id=jp.plen.plenconnect2>

最初だけ

アイコンを表示



ずっと

スマホからコントロールできるようにする

---

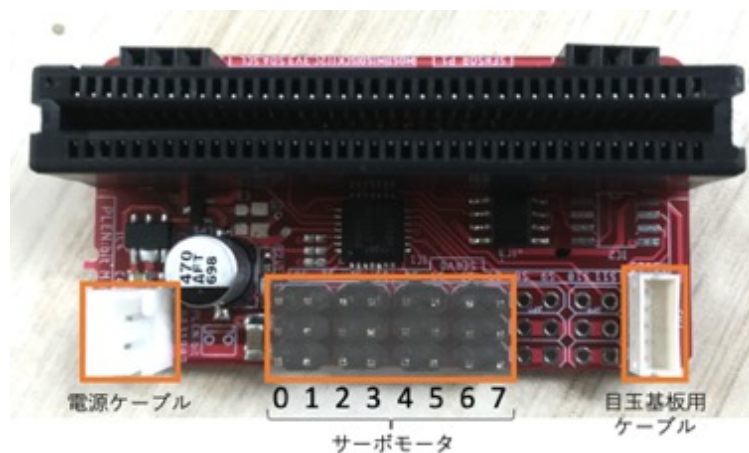
## 8. Appendix

---

### 8.1 PLEN:bit servo numbering



### 8.2 Control board terminal labelling



---

## PLEN:bit Support

---

If you have any questions, please contact one of the following



PLEN Support : <https://plen.jp/wp/contact/>