
Mini Pupper

Release 1.0.0-alpha

MangDang Technology Co., Limited

Apr 04, 2024

GUIDE

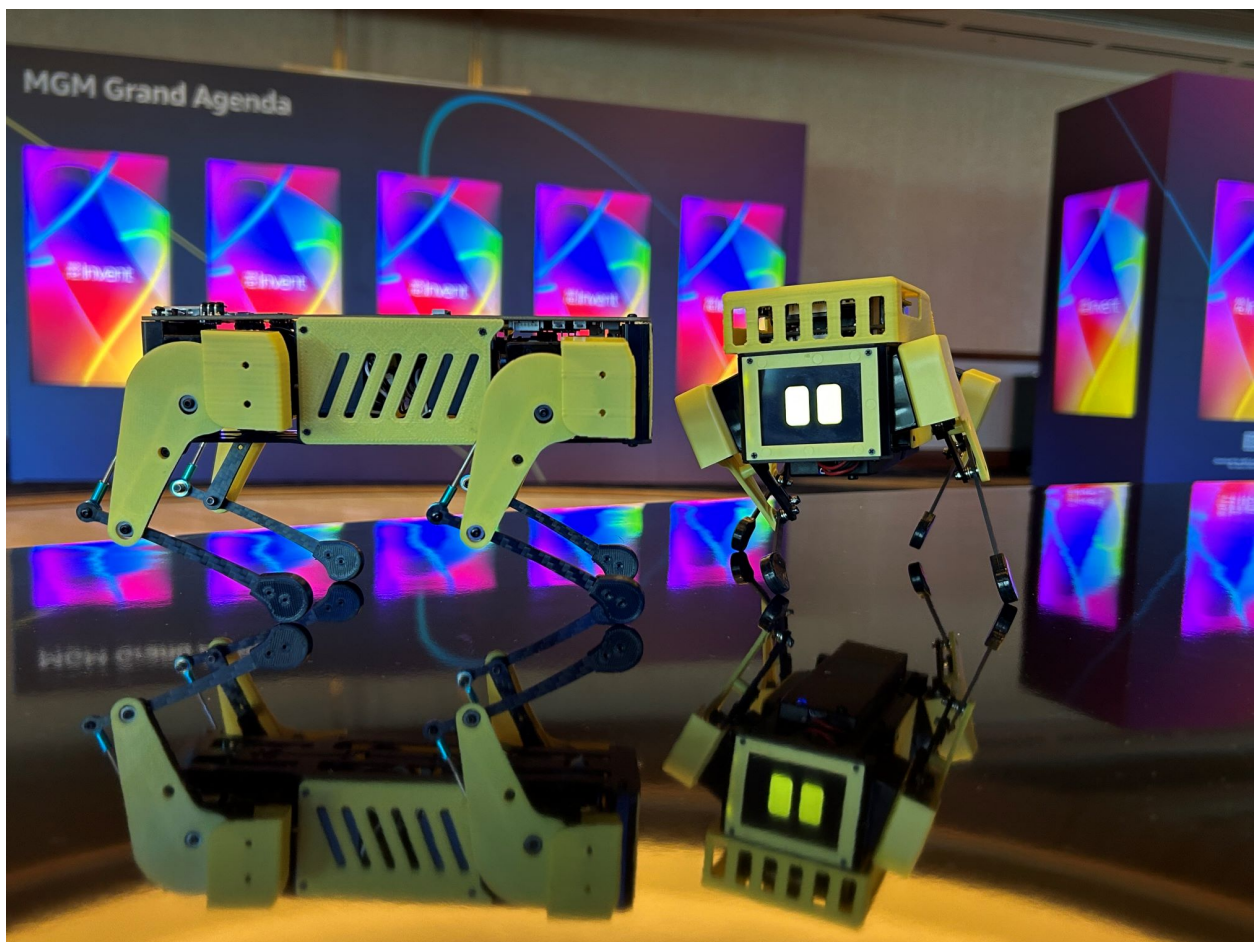
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ROS2, OPEN-SOURCE, EDUCATION ROBOT KIT

Our channels: [Discord](#) , [Twitter](#) , [FaceBook](#) , [Github](#)

Mini Pupper will make robotics easier for schools, homeschool families, enthusiasts, and beyond.



※ Key Features:

- AWS LLM(large language model) service can be built-in and released at the workshop of AWS re: Invent, NOV. 27 – DEC. 1, 2023 | LAS VEGAS, NV.
- ROS: support ROS1 & ROS 2 SLAM&Navigation.
- OpenCV: support single camera and OpenCV official OAK-D-Lite 3D camera module.
- Open-source: DIY and custom what you want.

- Raspberry Pi: it's super expandable, endorsed by Raspberry Pi.

* Mini Pupper News:

- Mini Pupper will join CES 2024, JAN. 9 – JAN. 12, 2024 | LAS VEGAS, NV.
- Mini Pupper 2 competition will be held at the IEEE R1&R1 Student Activities Conference, in April 2024.

* Mini Pupper Activities Before

- AWS LLM(large language model) service workshop at AWS re: Invent, NOV. 27 – DEC. 1, 2023 | LAS VEGAS, NV.
- Mini Pupper 2 workshops at the Student Activities Conference (SAC) sponsored by IEEE Region 2 & Region 1, 21 Oct 2023.



- Mini Pupper workshops in 2022.

1.1 What is Mini Pupper?

Mini Pupper, inspired by [Stanford Pupper](#), is a low-cost, personal quadruped kit with open-source software. With Mini Pupper, you can build a robot dog that can drive around and have enough horsepower to create exciting applications.

Some useful links:

- [Mini Pupper Kickstarter Campaign](#)
- [Mini Pupper Makuake Campaign](#)
- [Mini Pupper 2 Kickstarter Campaign](#)
- [Amazon AWS Robotics Blog](#)
- [Amazon 2022 Dance Robot Workshops Guide](#)

- Amazon 2023 LLM(large language model) Workshops Guide

1.2 About MangDang Technology Co., Limited

Founded in 2020, MangDang specializes in the research, development, and production of robot products that make people's lives better. MangDang is headquartered in Hong Kong. We are a global team with members from many countries and regions such as the United States, Japan, Canada, Europe, China, and so on.

We are all dreamers, and we look forward to connecting talents worldwide and innovating together to perform splendid times!

1.2.1 Features

Contents

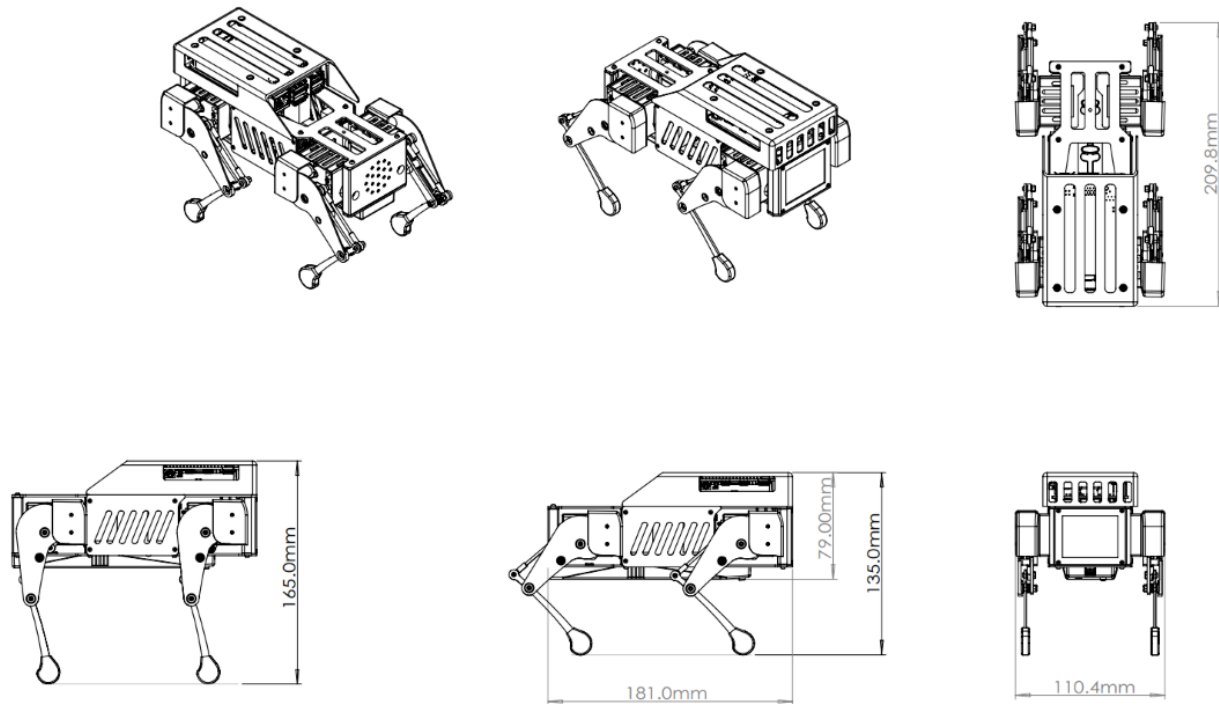
- *Features*
 - *Hardware Specifications*
 - *Dimension*
 - *Open Source Hardware*



Hardware Specifications

- Dimensions: 210x110x165mm
- Weight: 509g
- Battery: 1000mAh / micro-usb charge
- Processor: Raspberry Pi 4B
- Screen: 240x320 ISP LCD
- Input charger: 5V 1A
- OS: Ubuntu/ROS

Dimension



Open Source Hardware

- Lidar module

If you want to explore ROS SLAM, Navigation functions based on Lidar, you also need a Lidar module. We can ONLY ensure the Lidar module can work well based on our source code, and NOT ensure that you get from other channels. We already tested some Lidar modules, such as, PRLidar A1, YDLidar X2L, and LD06. For Mini Pupper, we refer to LD06 as it is smaller.

- OpenCV Camera module

For potential security issues, the camera module is not included in our default package. If you want to explore camera AI functions, you can choose a normal USB camera module, of course, a 3D camera module is better for study. If try the 3D camera module, we recommend you OpenCV's latest 3D camera module, named OAK-D LITE, comes from OpenCV&Luxonis. We have good relationship with Luxonis, their RobotHub will release more interesting demos soon.

1.2.2 How To Order

Contents

- *How To Order*
 - *Order parts individually*
 - *One-stop channel*

Order parts individually

You can order all the parts one by one, Please find the BOM list to order [here](#) .

However, you can purchase a kit to build the robot from MangDang channel for cheaper and one-stop shopping.

One-stop channel

World Wide

- [Shopify](#)
- [Aliexpress](#)

North America

- [Amazon](#)
- [RobotShop](#)

Japan

- [Amazon](#)
- [Makuake](#)
-

China

- [Taobao](#)

1.2.3 Quick Start Guide

Contents

- *Quick Start Guide*
 - *Run Pupper Robot*
 - *Pupper Robot controls*
 - *Important Notes*

Run Pupper Robot

1. Power On Mini Pupper

- Push on the battery power button for at least 3 seconds to power on Mini Pupper. After power on, if you push on the power button for at least 3 seconds again, it will power off.

2. Connect the controller to the Pi by putting it pairing mode.

- To put it into pairing mode, hold the share button and home button at the same time until it starts making quick double flashes.
- If it starts making slow single flashes, hold the home button down until it stops blinking (about 15s) and try again.



3. Wait until the controller binds to the robot, at which point the controller should turn a dim green (or whatever color you chose in pupper/HardwareConfig.py for the deactivated color).
4. Press L1 on the controller to “activate” the robot. The controller should turn bright green (or again, whatever you chose in HardwareConfig).
5. You’re good to go! Check out the controls section below for operating instructions.

Pupper Robot controls

- L1: Press to toggle active mode and deactivate mode.
 - Note: the controller's front light will change colors to indicate if the robot is deactivated or activated.
- R1: Press to transition between Rest mode and Trot mode.
- Left joystick
 - Forward/back: moves the robot forward/backward when in Trot mode.
 - Left/right: moves the robot left/right when in Trot mode.
- Right joystick
 - Forward/back: pitches the robot forward/backward.
 - Left/right: turns the robot left/right.
- D-Pad
 - Forward/back: raises and lowers the body.
 - Left/rights: rolls the body left/right.
- “X” button: Press it three times to complete a full hop.
- Shut down the system to press controller circle button for 3 seconds.



- Power off the battery

Important Notes

- Controller pairing instructions (repeat of instructions above)
 - To put it into pairing mode, hold the share button and home button at the same time until it starts making quick double flashes.
 - If it starts making slow single flashes, hold the home button down until it stops blinking and try again.
- Battery voltage
 - If you use external power supply to power the robot with anything higher than 8.4V (aka >2S) you'll almost certainly fry all your servos!

1.2.4 Assembly

Contents

- *Assembly*
 - *0. Update change points after April 15 2022*
 - *1. Write the pre-built image into microSD*
 - *2. Position of the screws*
 - *3. Legs Assembly*
 - *4. Hips Assembly*
 - *5. Body Frame Assembly*
 - *6. Cover Assembly*
 - *7. Add-On Assembly*

This is the video clip for the pre-assembled leg kit, please refer to the below sections for more detailed steps.

Please also refer to Mini Pupper Fusion 360 CAD model: <https://a360.co/3wFLSiT>

0. Update change points after April 15 2022

- Updated the body and hip parts from 3D printed to mold.
- Re-designed and unified the original four hip parts into one for mold, for the detailed info, please refer to the mechanical design section.
- If you get your Mini Pupper kit after April 15 2022, it will be easier to assemble.
- If you have 3D printer and still hope to use the previous 3D printed design, that's OK.

1. Write the pre-built image into microSD

Tools

In addition to the tools included in the kit, the following items are required for assembly.

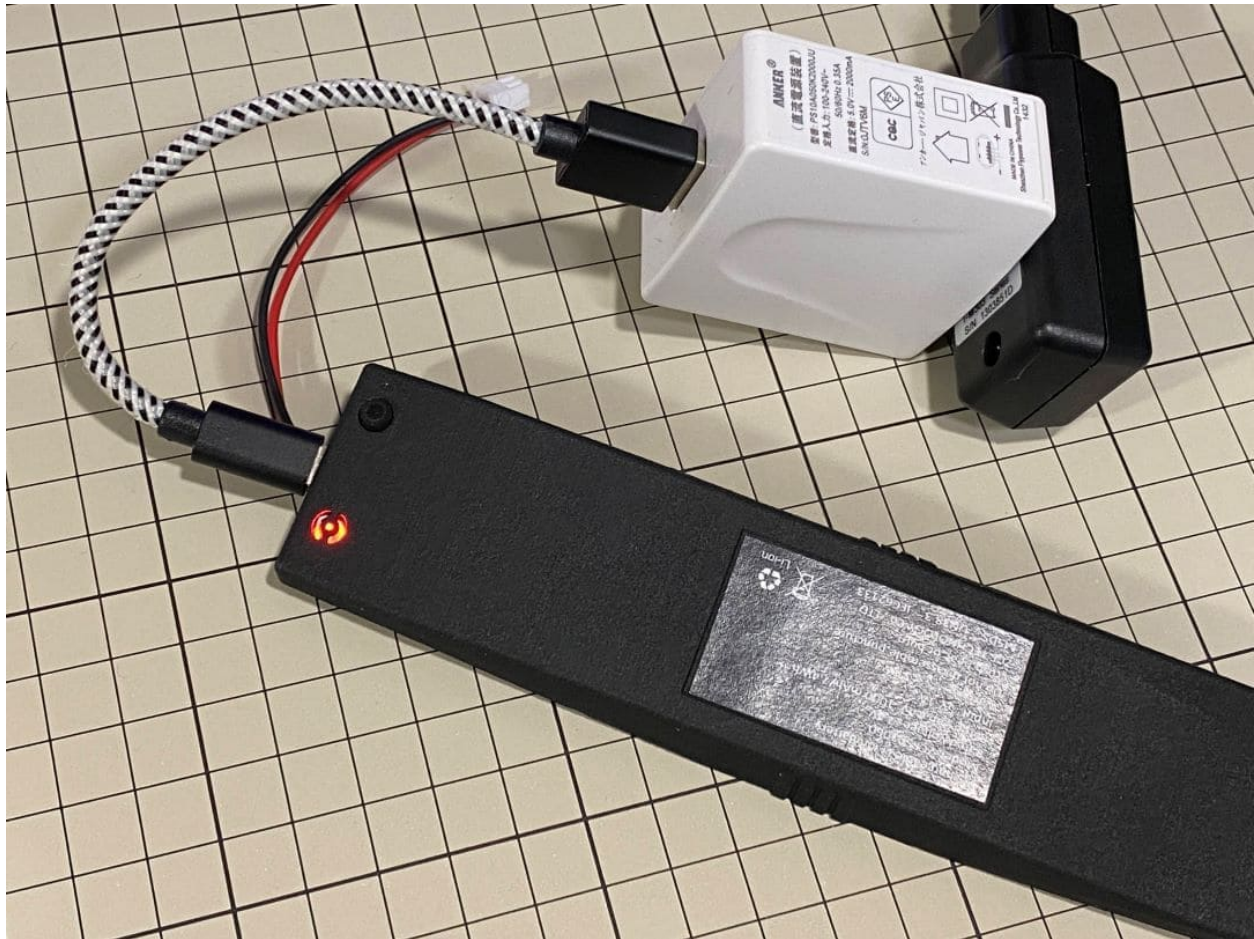
- USB keyboard
- USB mouse
- PC
- microSD card reader
- HDMI Display
- micro HDMI cable
- USB charger

Step 1.1 Charging the battery

- The battery is charged via USB, see picture for USB socket, and can also be charged while attached to the Mini Pupper body.

※ LED light: Green means there is enough power, and Red means you need to charge it.

※ We recommend 5V/1A adapter, if you use 5V/2A adapter, the battery IC will change it to 1A. It needs about 1 hour to charge 80% and the light will become green, and an additional 1 hour to 100%, anyway, you can use it when the light becomes green.



Step 1.2 Download the image

- You can download latest image file via the below folder.

[MiniPupperRelease.from.MangDang](#)

- The below picture is the custom carry board.



* “xxx_MiniPupper_Controller_Ubuntu_22.04.img” means the image is for Ubuntu 22.04 version.

* “xxx.MiniPupper_ROS&OpenCV_Ubuntu20.04.03.img” is the image file for the Ubuntu + ROS + OpenCV version for SLAM & Navigation & AI.

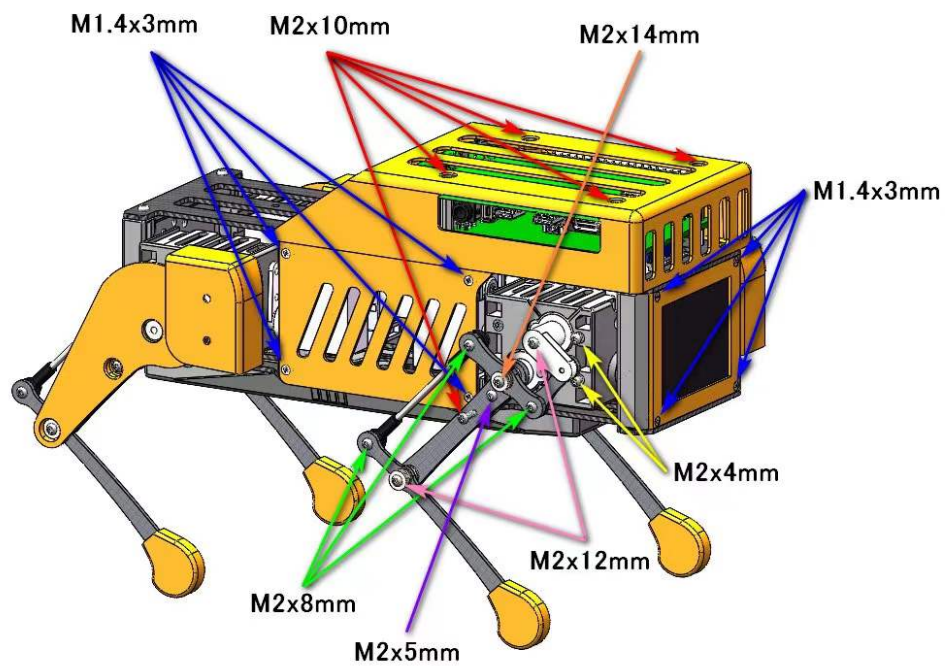
Step 1.3 Write the image into microSD card

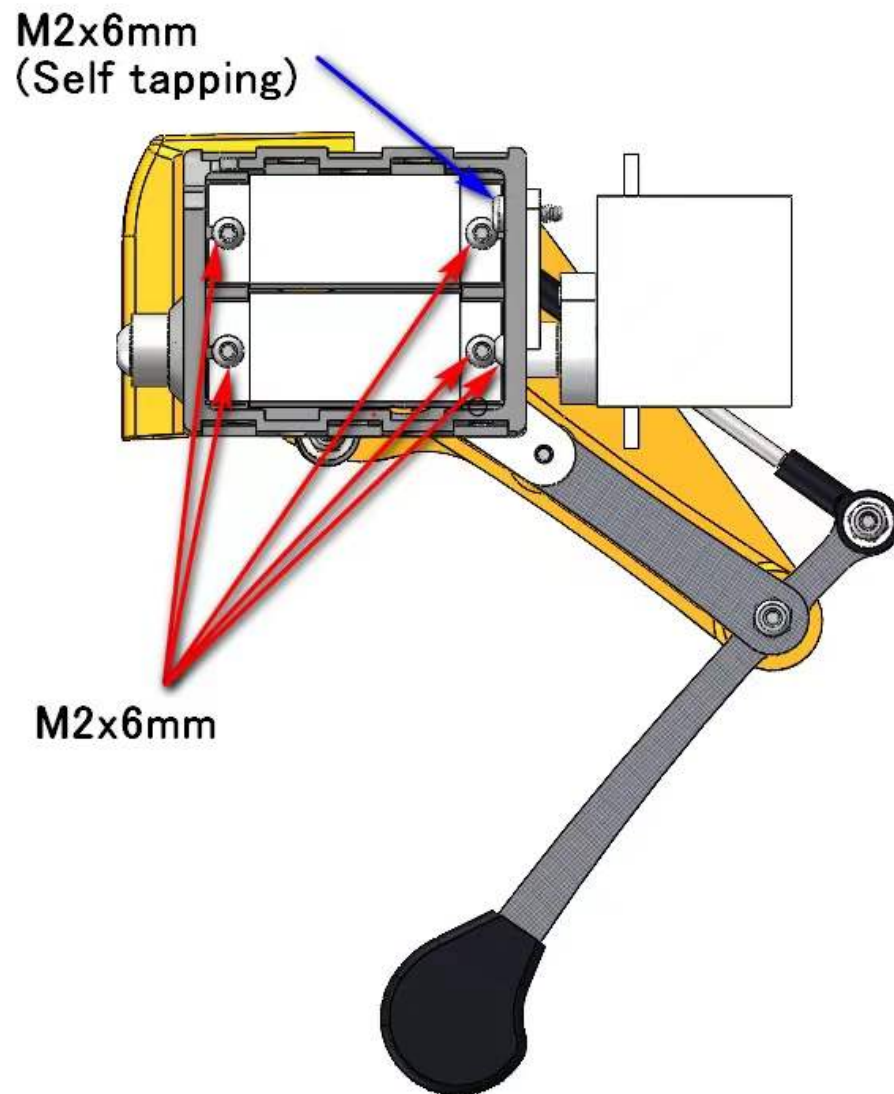
- Insert the microSD card into your PC’s SD card reader and write the image. We recommend the image creation tool balenaEtcher or Win32DiskImager as it is easy and reliable. Please refer to the official manual and below link. It may take a while to complete.
- * Reference Link: [Download Etcher – Flash OS images to USB drives & SD cards](#)
- Remove the SD card from the PC and insert it into the Raspberry pi.

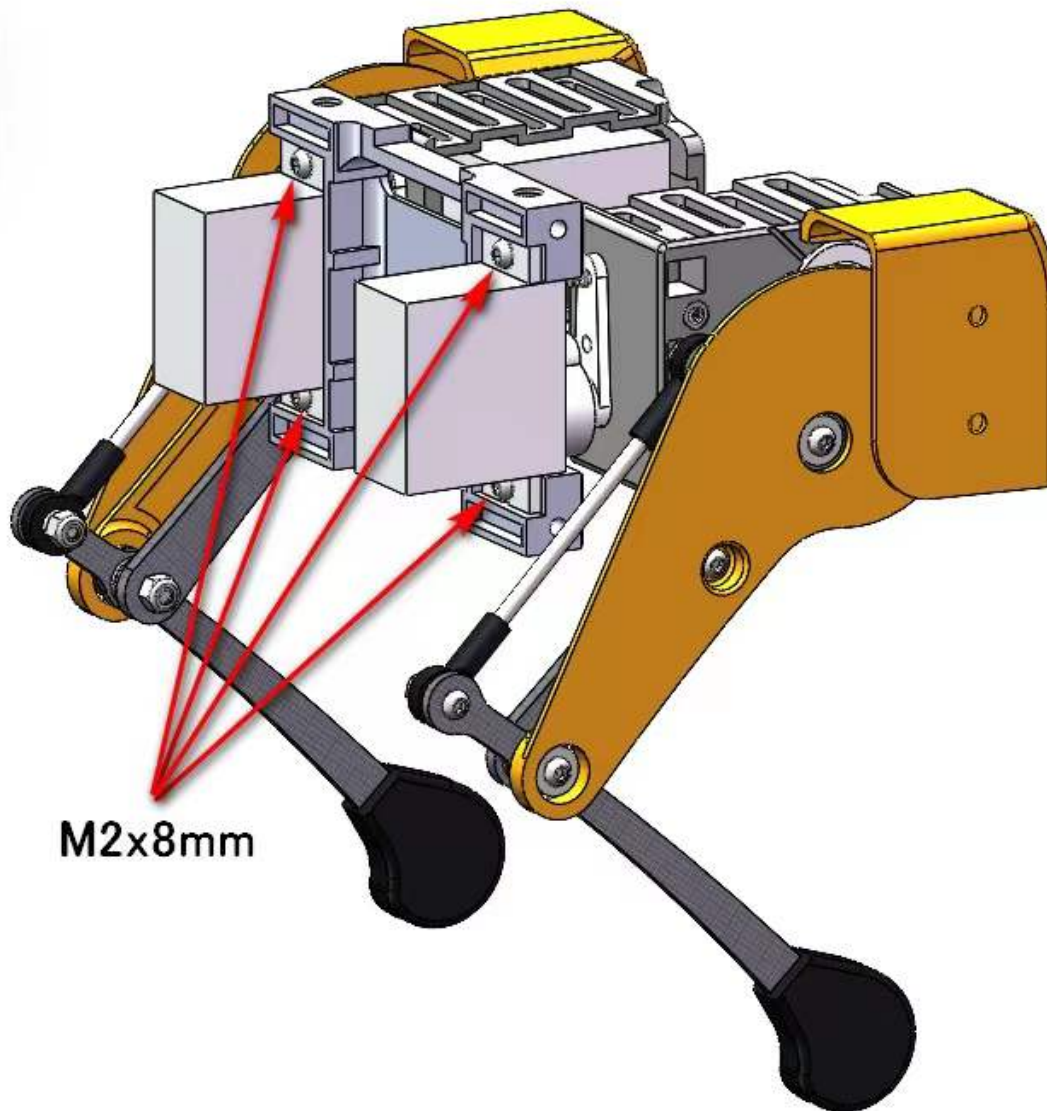


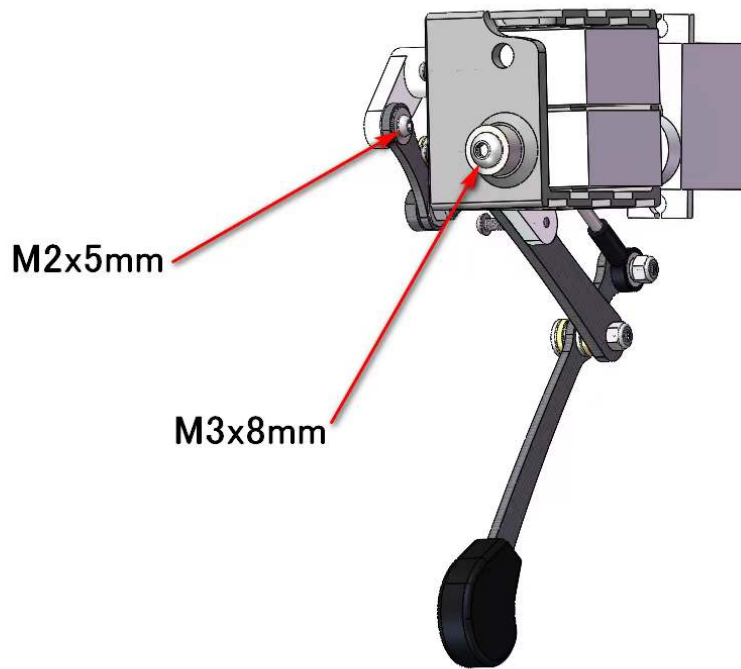
2. Position of the screws

- The pictures show the position of the screws briefly.

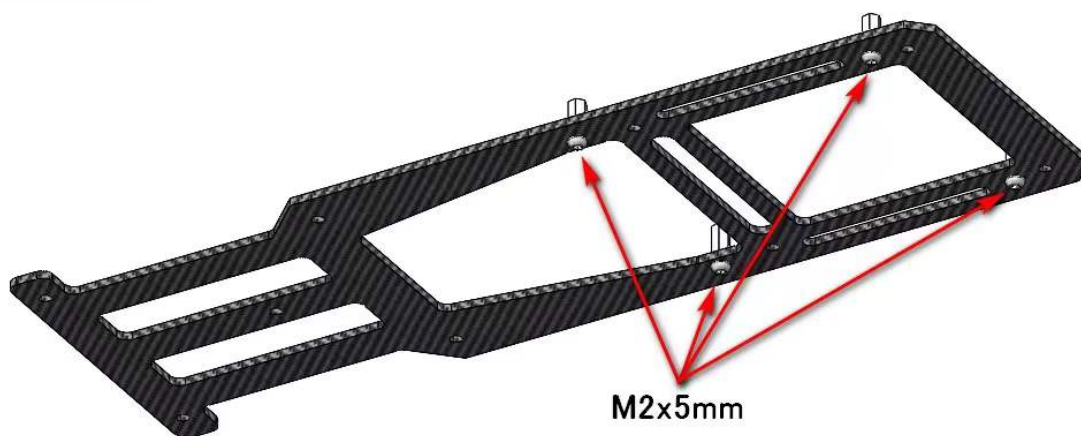
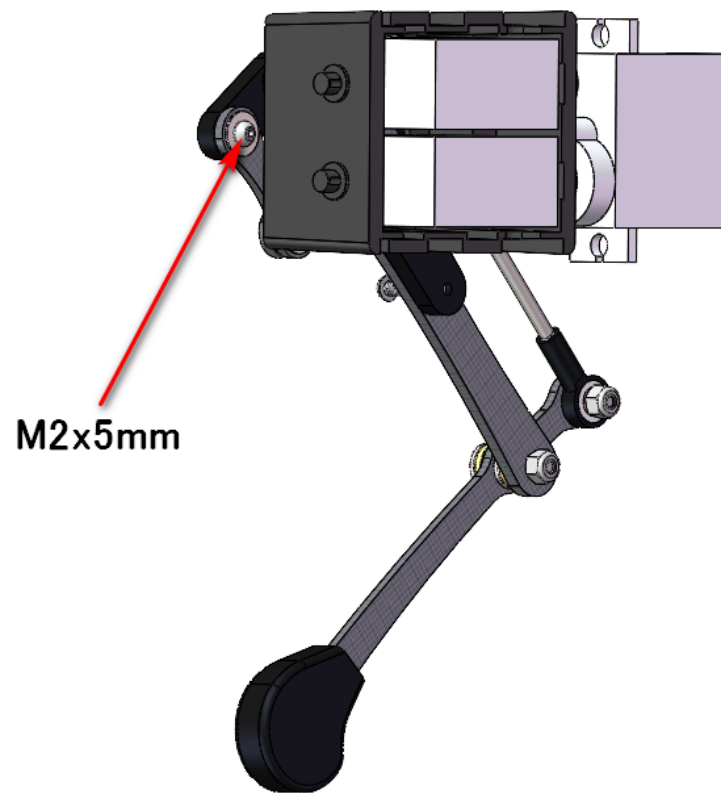


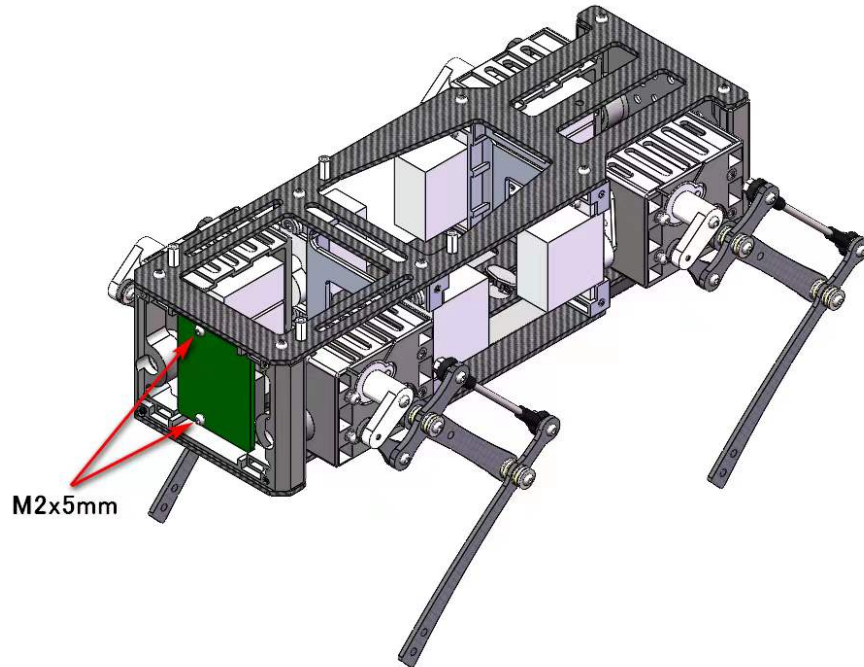




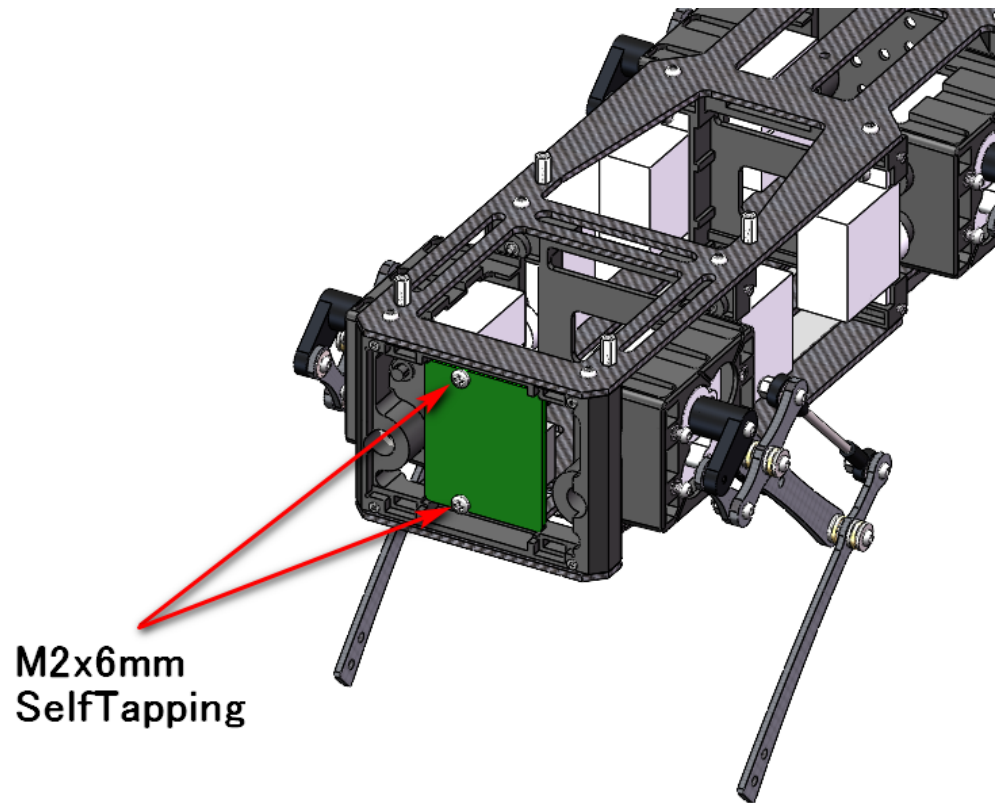


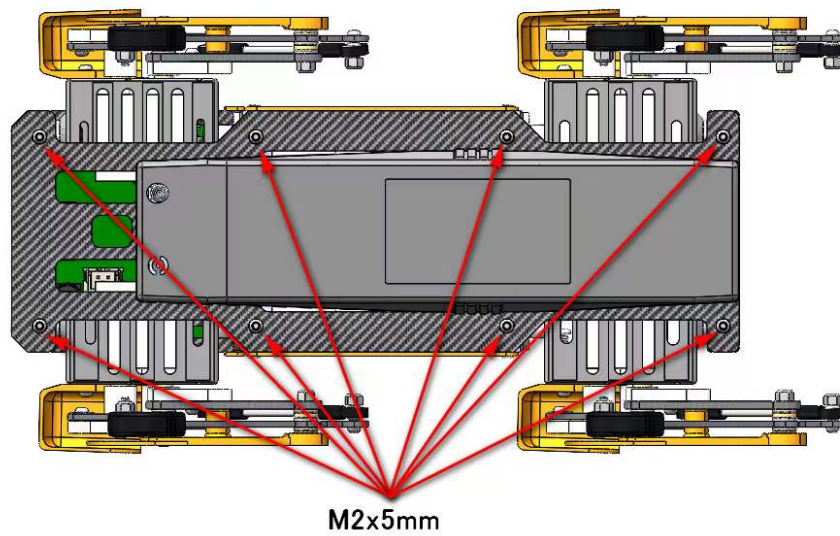
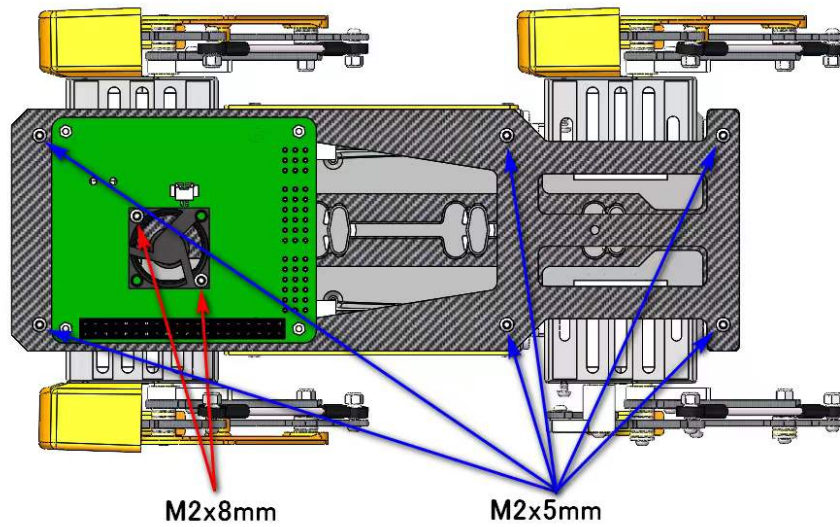
(The up pictures are before April 15 2022 version, the below pictures are after April 15 2022 version)





(The up pictures are before April 15 2022 version, the below pictures are after April 15 2022 version)





3. Legs Assembly

Please refer to the below video clip.

Tools

In addition to the tools included in the kit, the following items are required for assembly.

- Loctite

* We don't recommend new users to use the Loctite at first, you can use it after you have much background.

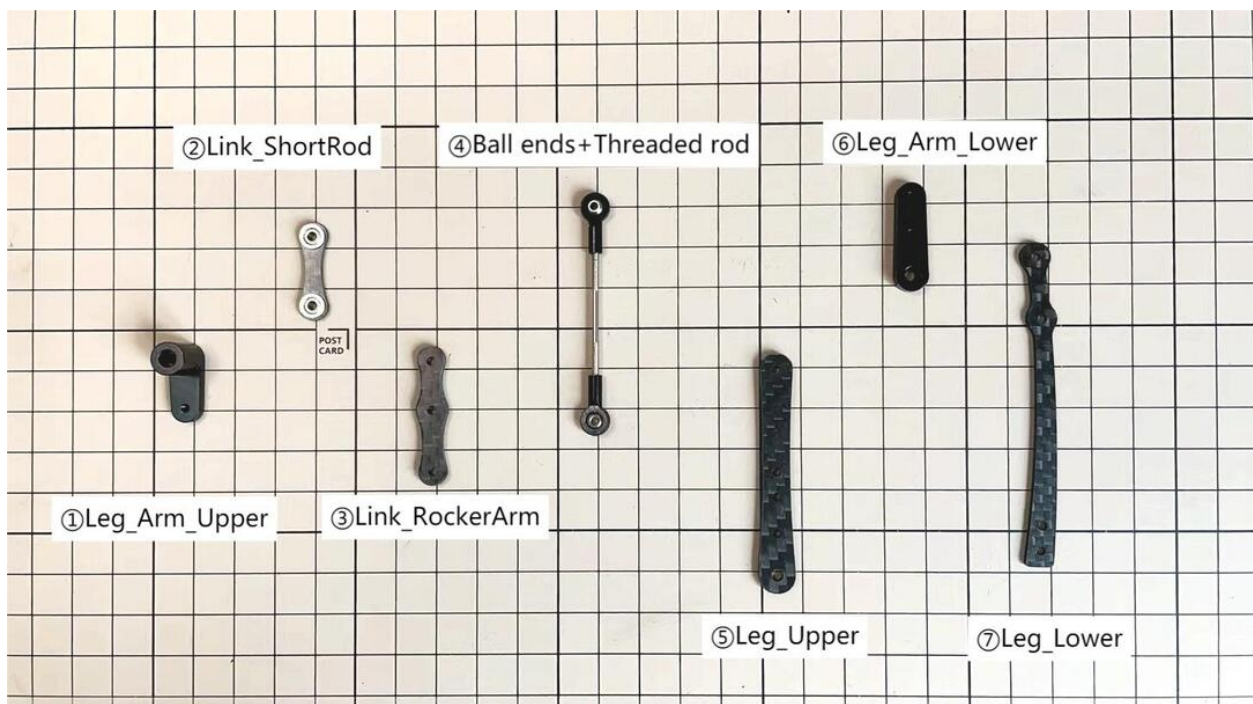
* Loctite prevents the nut from loosening, but it is not essential, as it can be tightened only when looseness is noticed.

Bolt to use

- M2x5mm 2x4=8 +, +
- M2x8mm 3x4=12 +, +, +
- M2x12mm 1x4=4 +
- M2x14mm 1x4=4 +

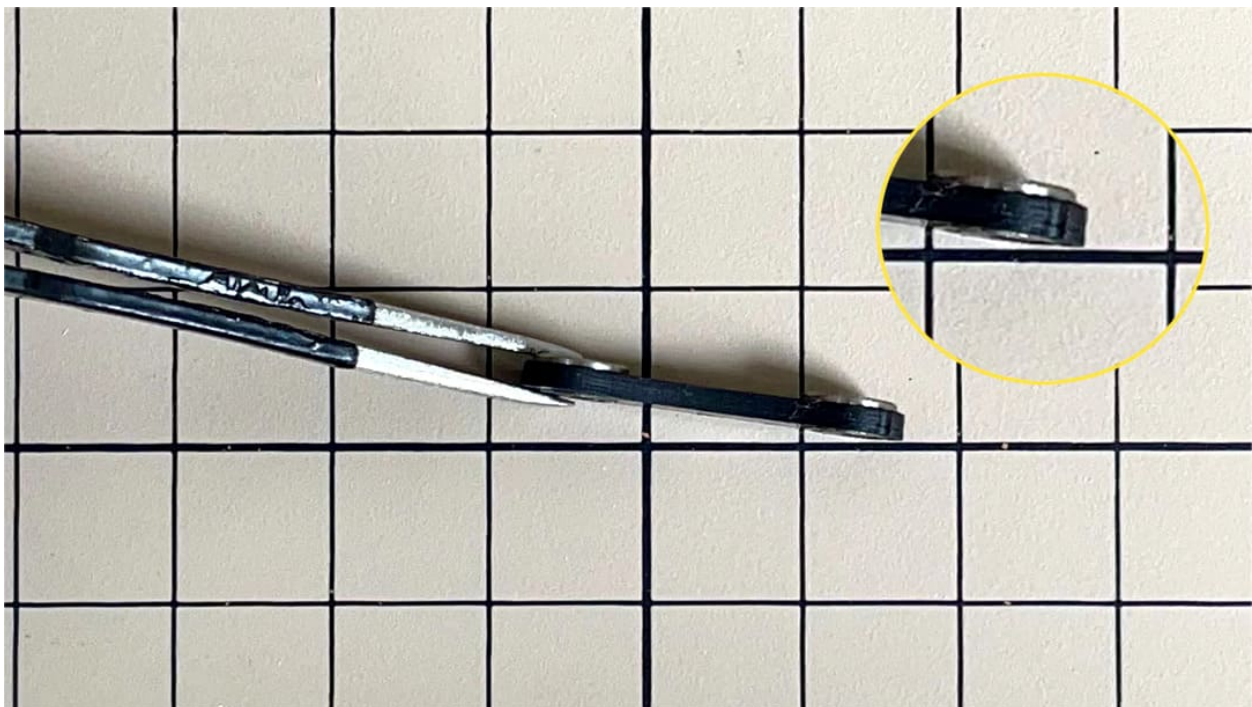
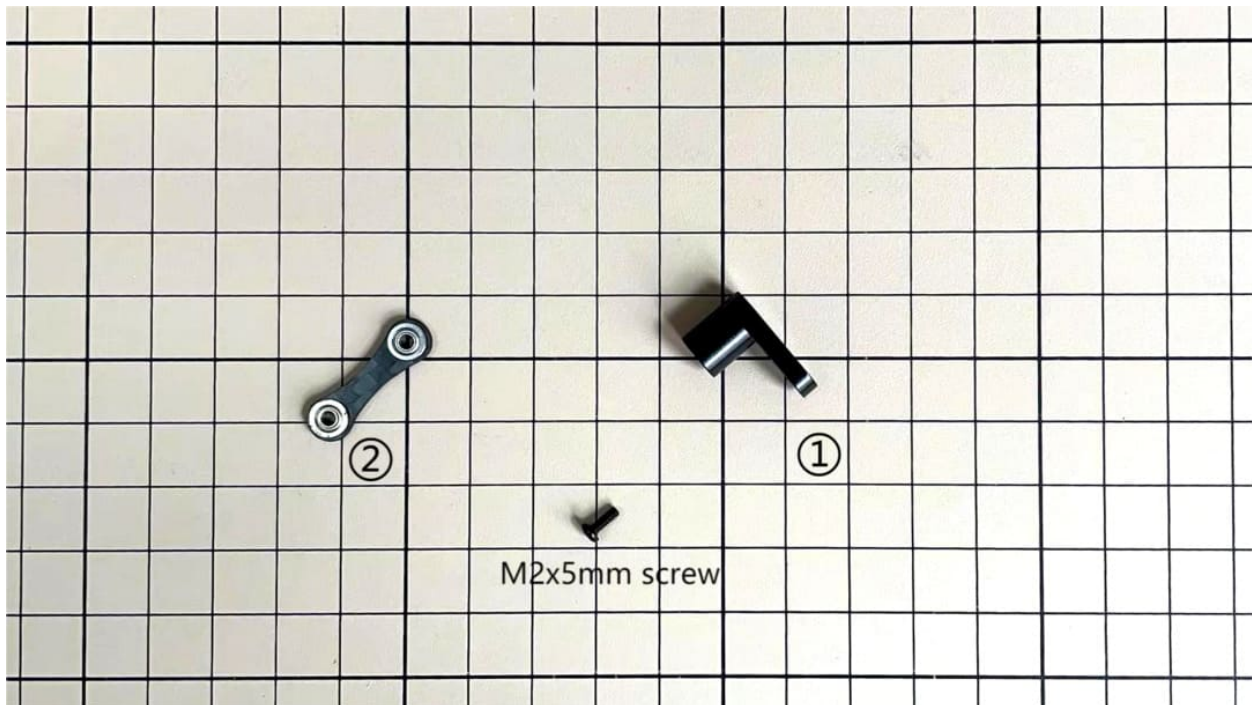
Step 3.1 Single leg

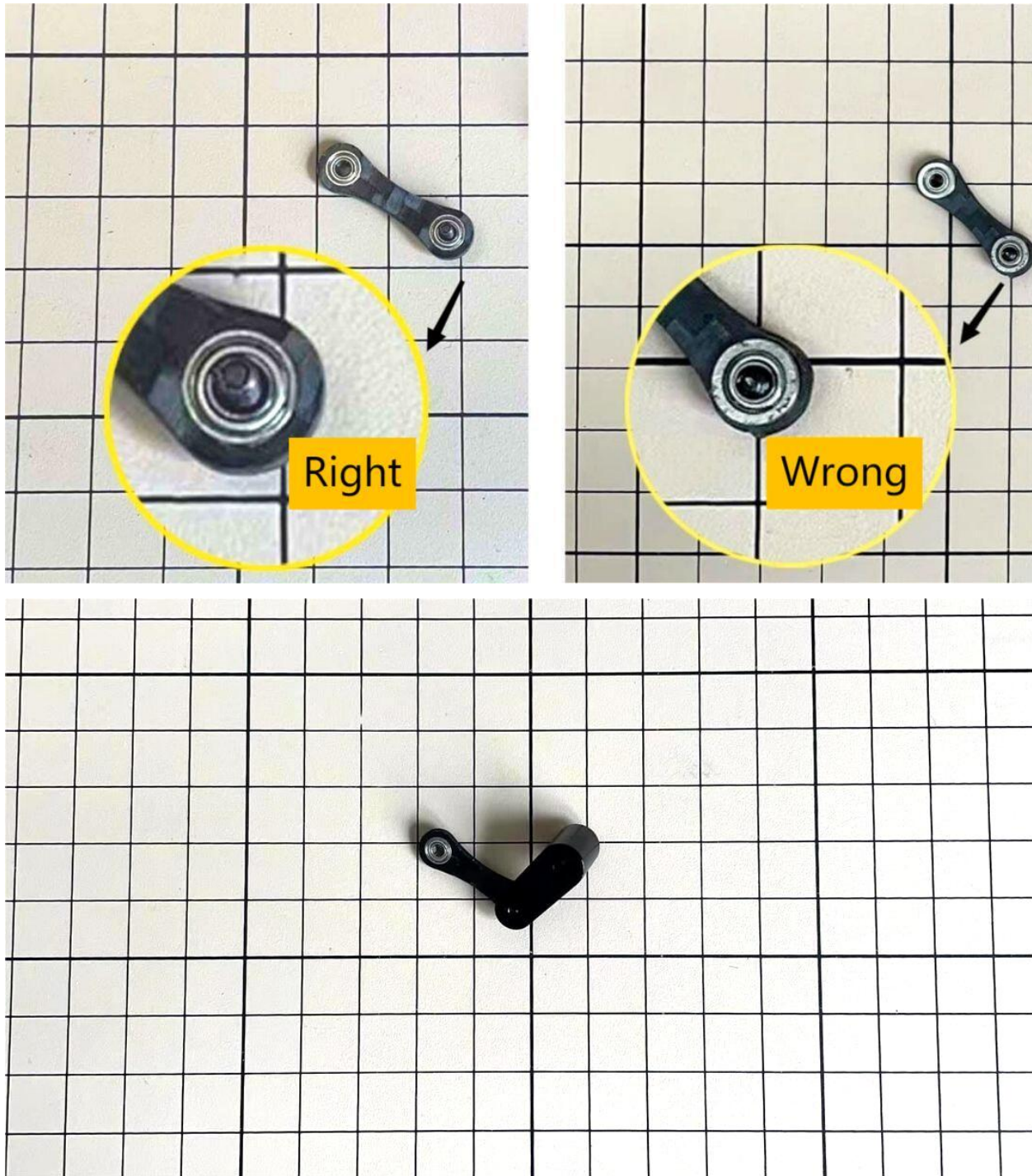
- Assemble the four legs. The front and back of the right side are the same, and so are the front and back of the left side. Show you how to assemble the right side.
- Video Instructions, please refer to the link <https://youtu.be/Ut7UnS3CTZs>
- The parts are numbered as follows to explain.



Assemble and

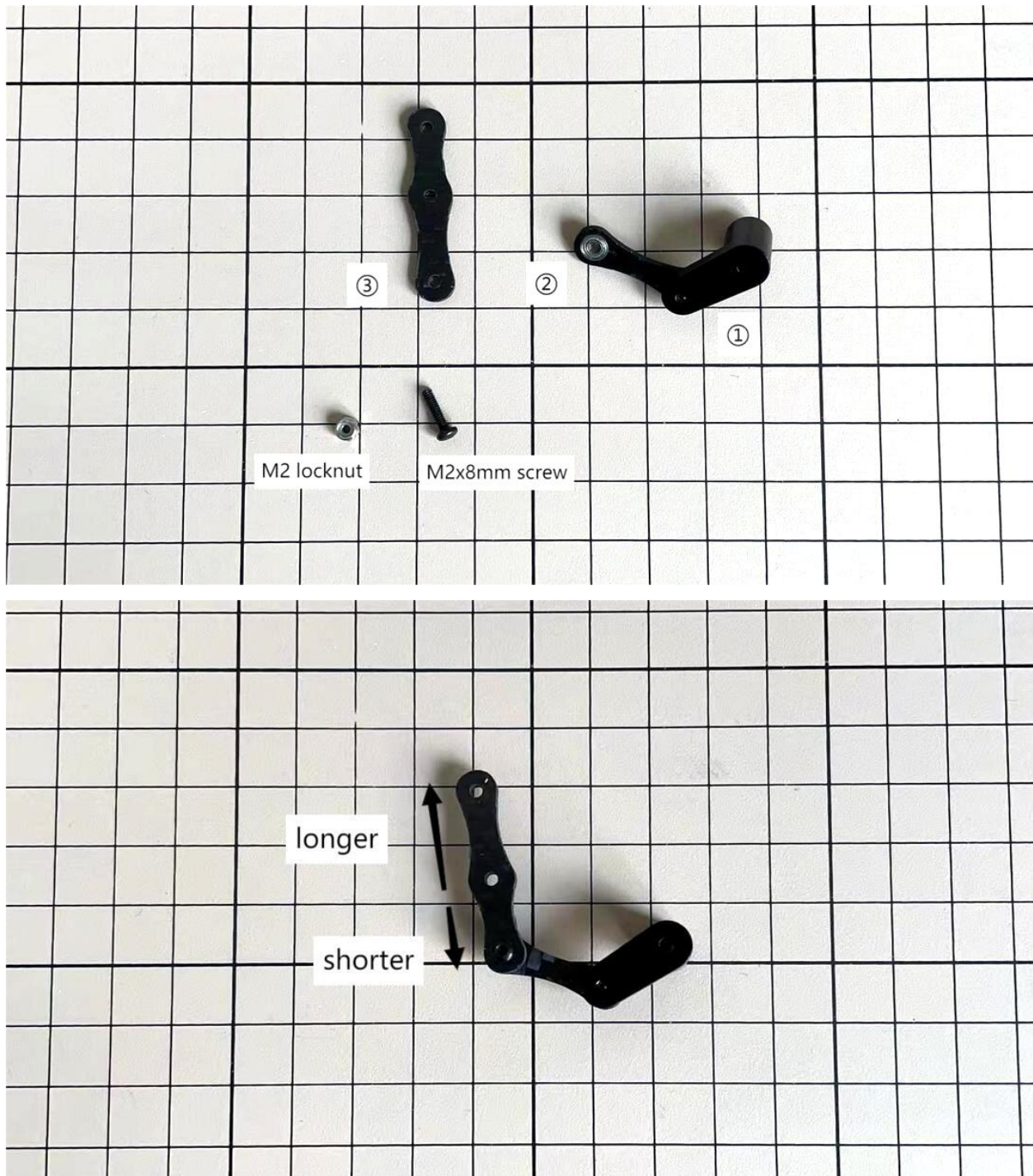
- Use one M2x5mm screw. The screw is inserted from the bottom of upwards and tightened by inserting them into the screw holes in . Be careful about the sides of .
- The two ballbearings in should be inserted all the way in and the end should be slightly visible as shown in the picture below. Tap the ball bearing and press it in without gaps.





Assemble and

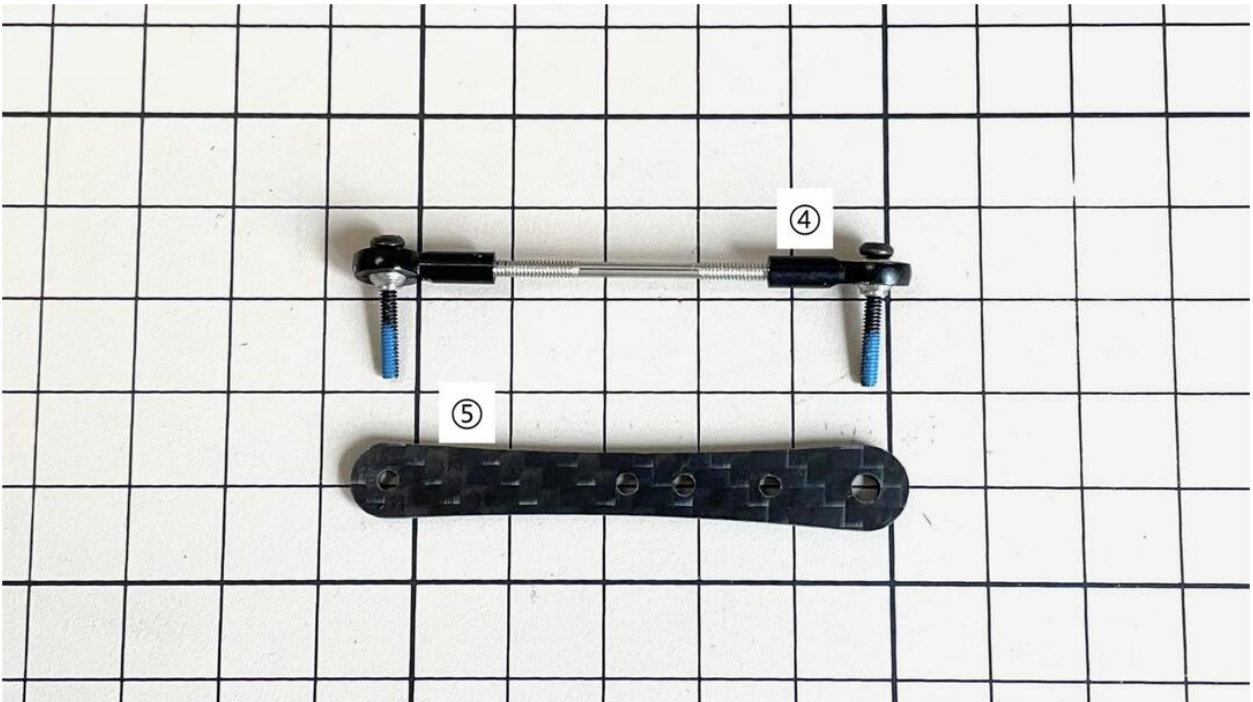
- Use an M2x8mm screw and an M2 locknut. Insert the screw from the bottom to the top of , pass through and tighten with the nut. It is important to pay attention to the orientation of . Look carefully at the position of the hole in the middle.





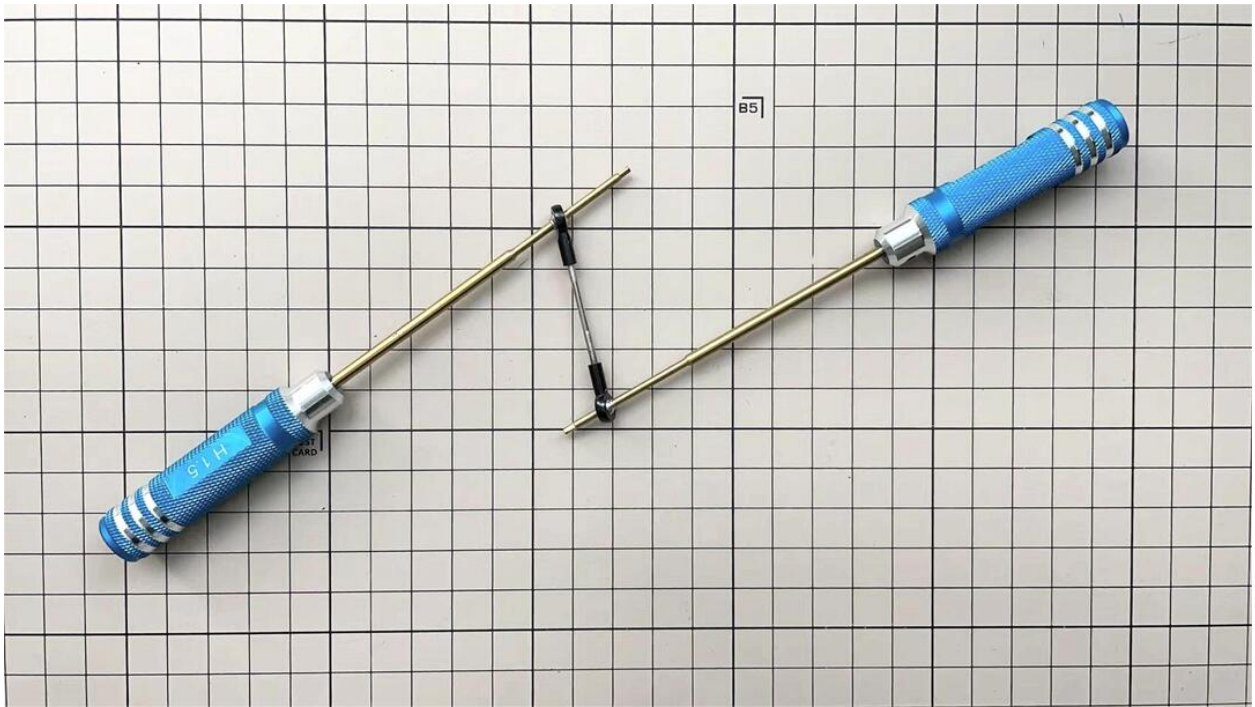
Adjustment of the length of

- The length of must match the length of . When adjusting the length, it is easier to use two long screws to make sure that the lengths have been adjusted, take apart all.



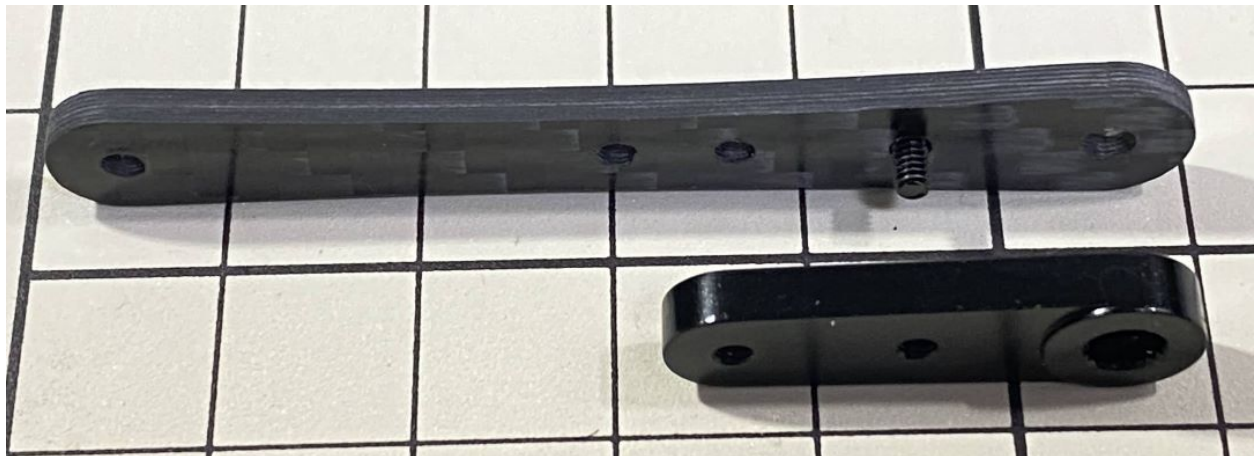
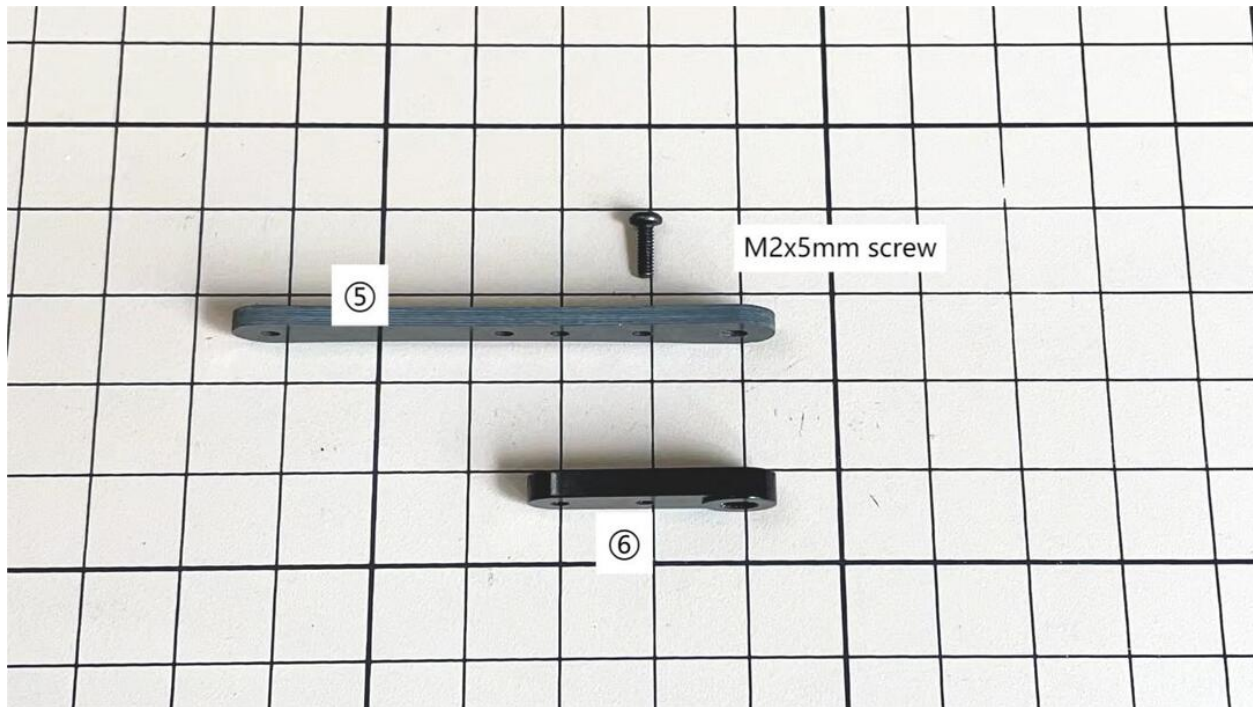


- If it's hard to twist, you can use two screwdrivers to assist.



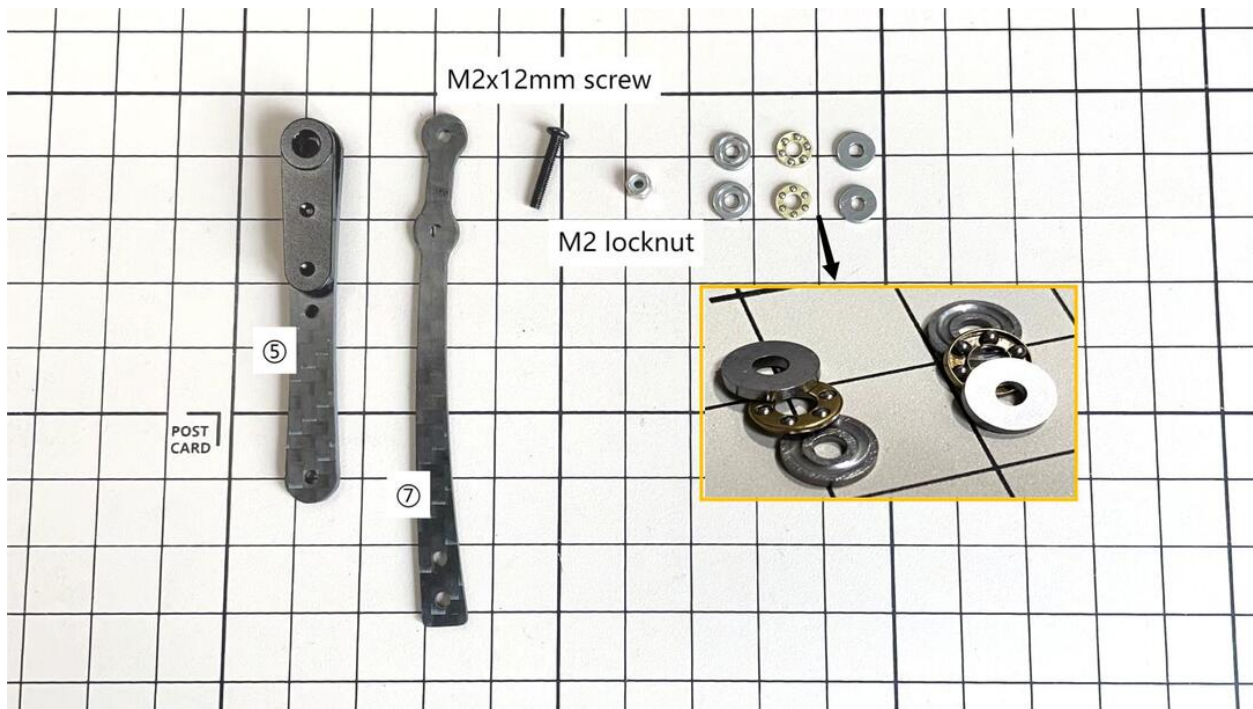
Assemble and

- Use one M2x5mm screw. Insert the screws into first, insert them into the holes of , and tighten them. The large hole in should be facing the surface.

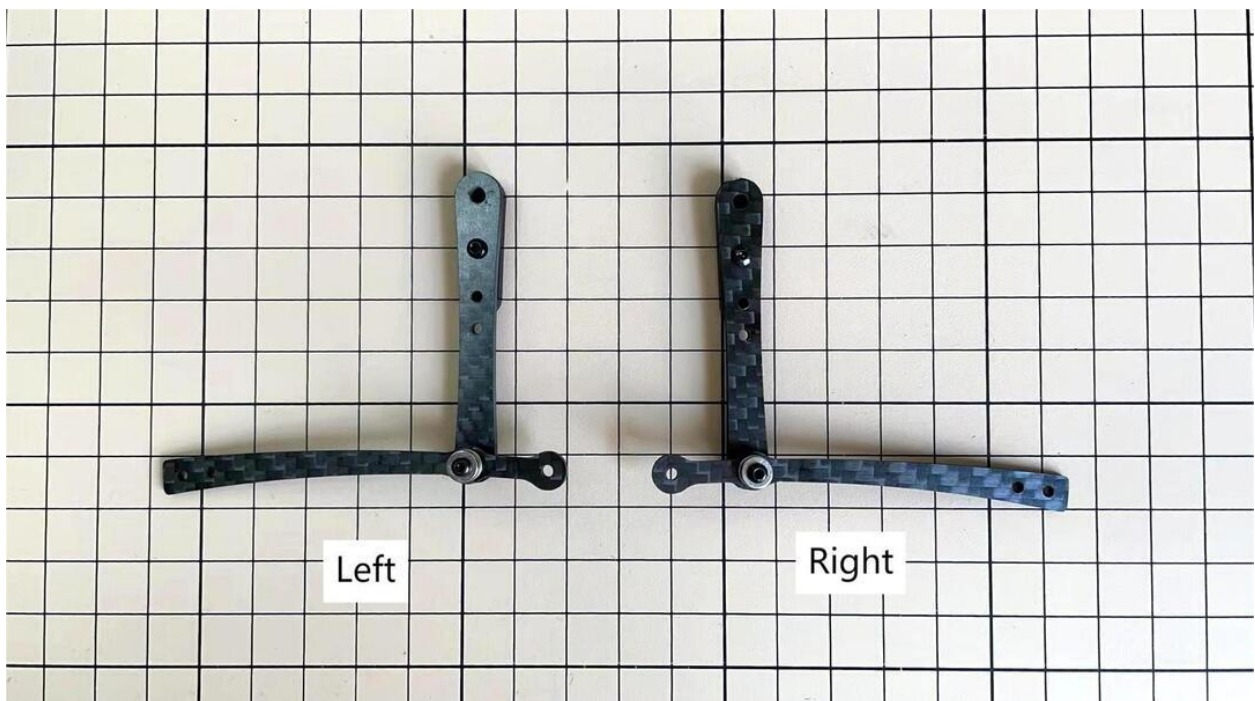
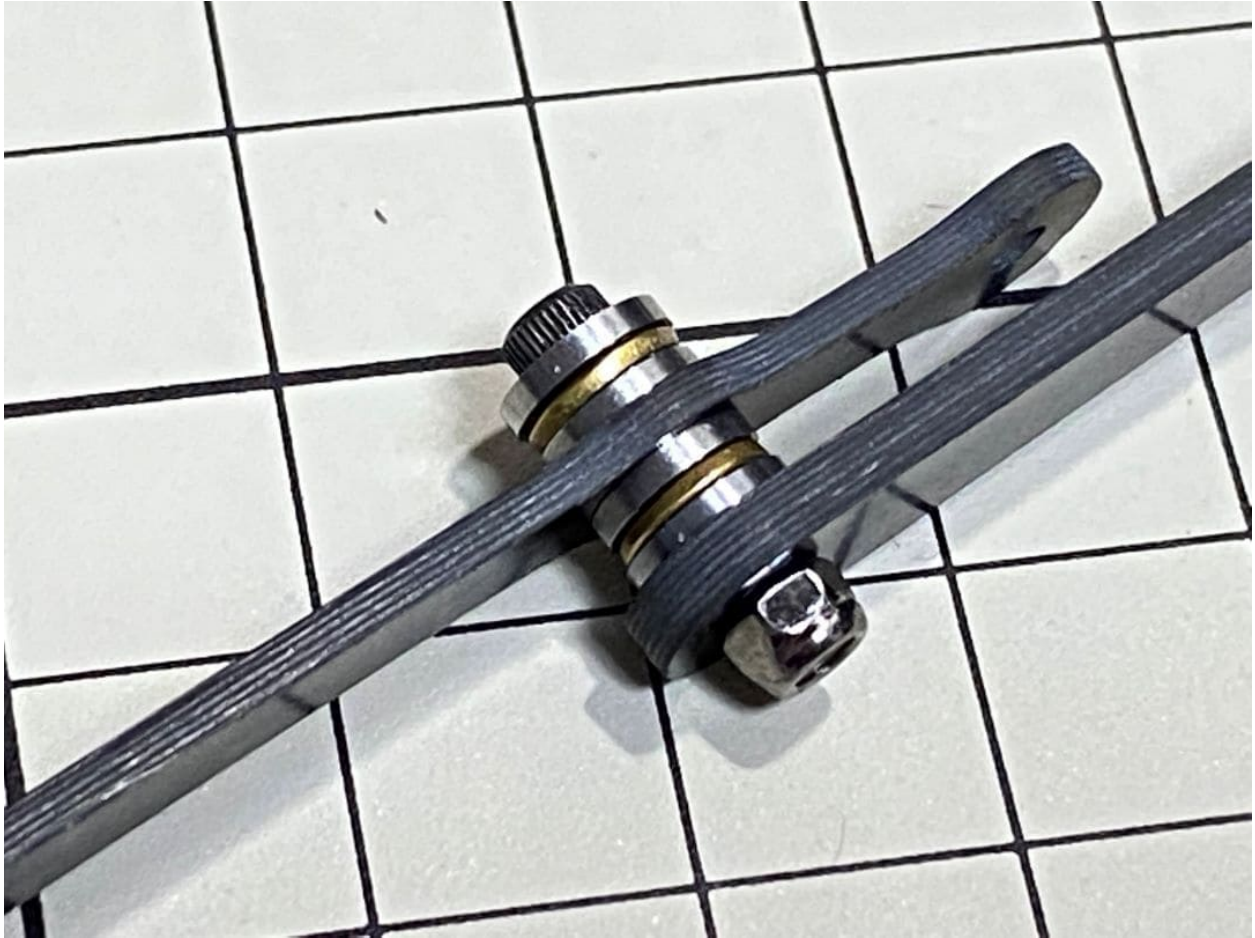


Assemble and

- Use an M2x12mm screw, an M2 locknut and two sets of ball bearings. Each ball bearing is made up of three parts, the top and bottom parts with the grooved side facing inwards. Insert a screw into a set of ball bearing. Then insert the screw into the hole. Taking care to look at the warped side of to make sure it is facing the right way. Now screw in the another set of ball bearing. Finally, insert screw into and tighten it with the nut.



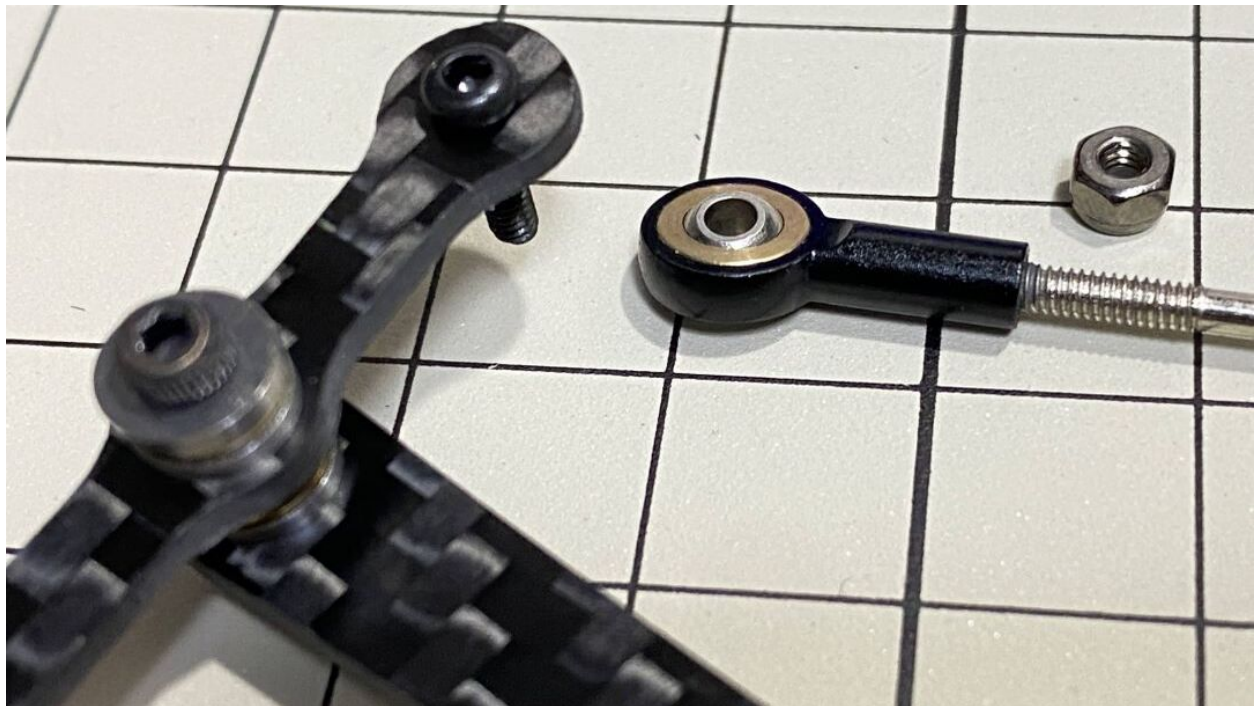
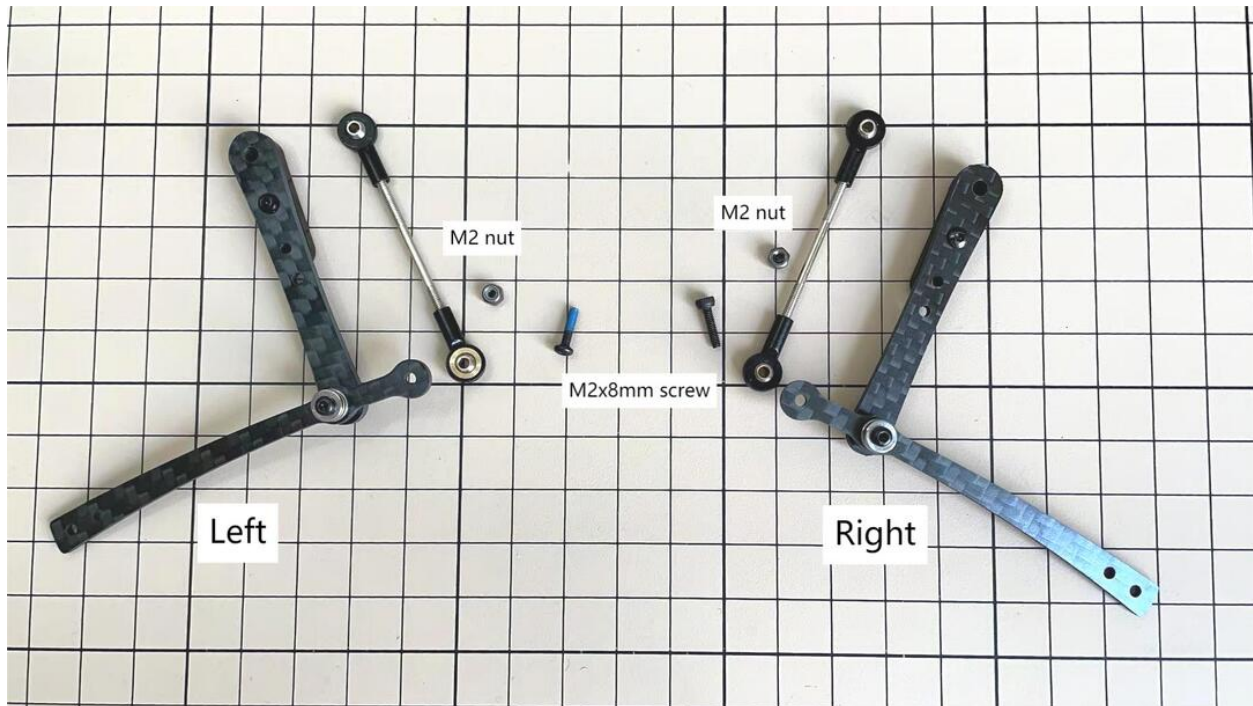


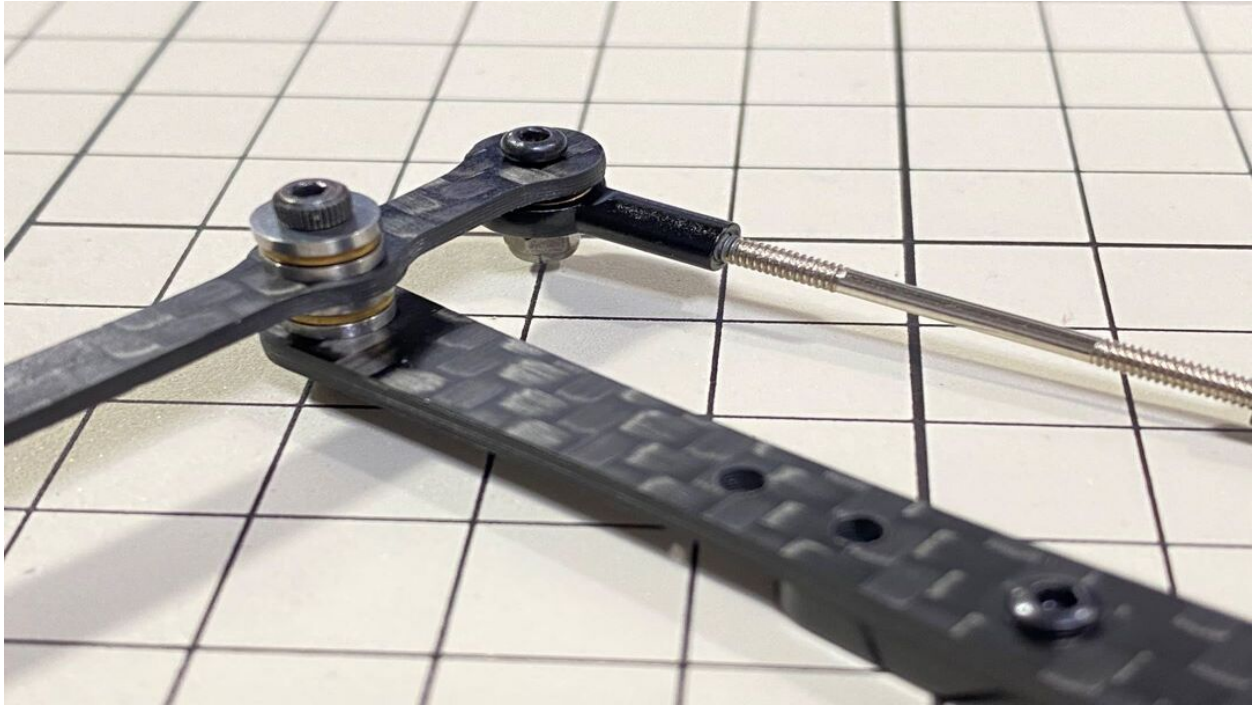


Assemble and

- Use an M2x8mm screw and an M2 nut. Insert the screw into and put through, then tighten it with the nut. The direction of the front and back of can be either.

Left and right leg

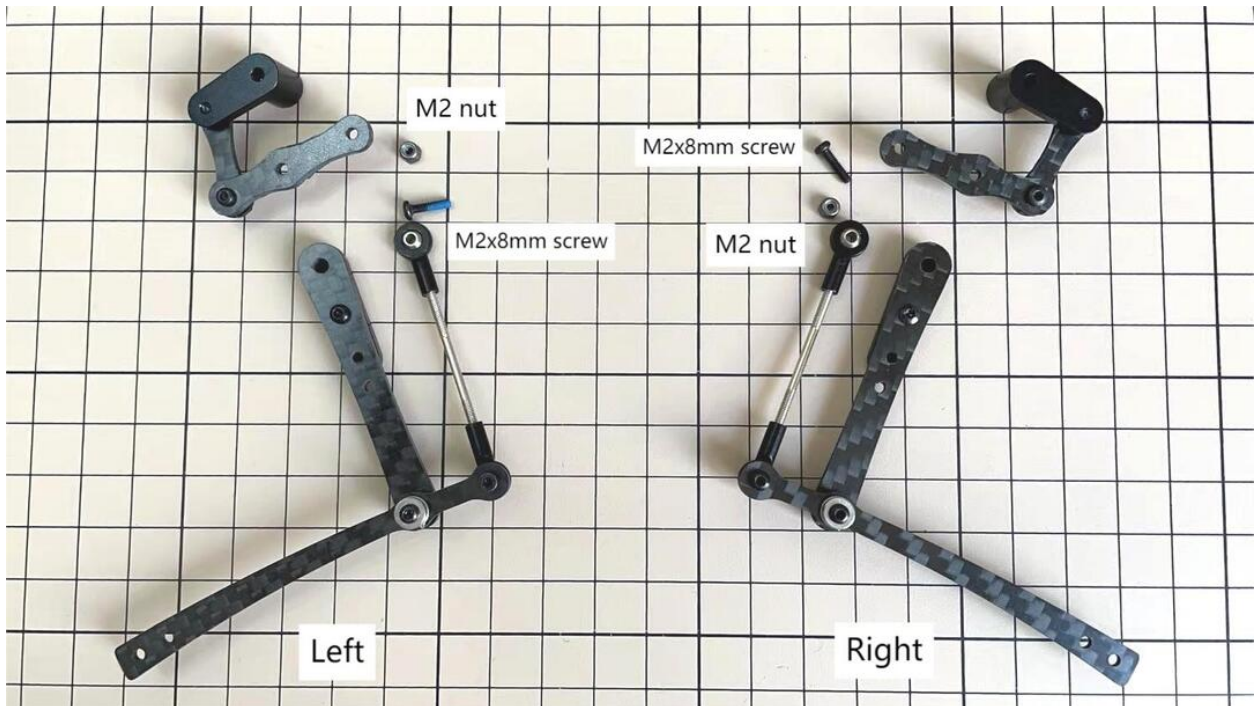




Assemble and

- Use an M2x8mm screw and an M2 nut. Insert the screw into and put through, then tighten it with the nut.

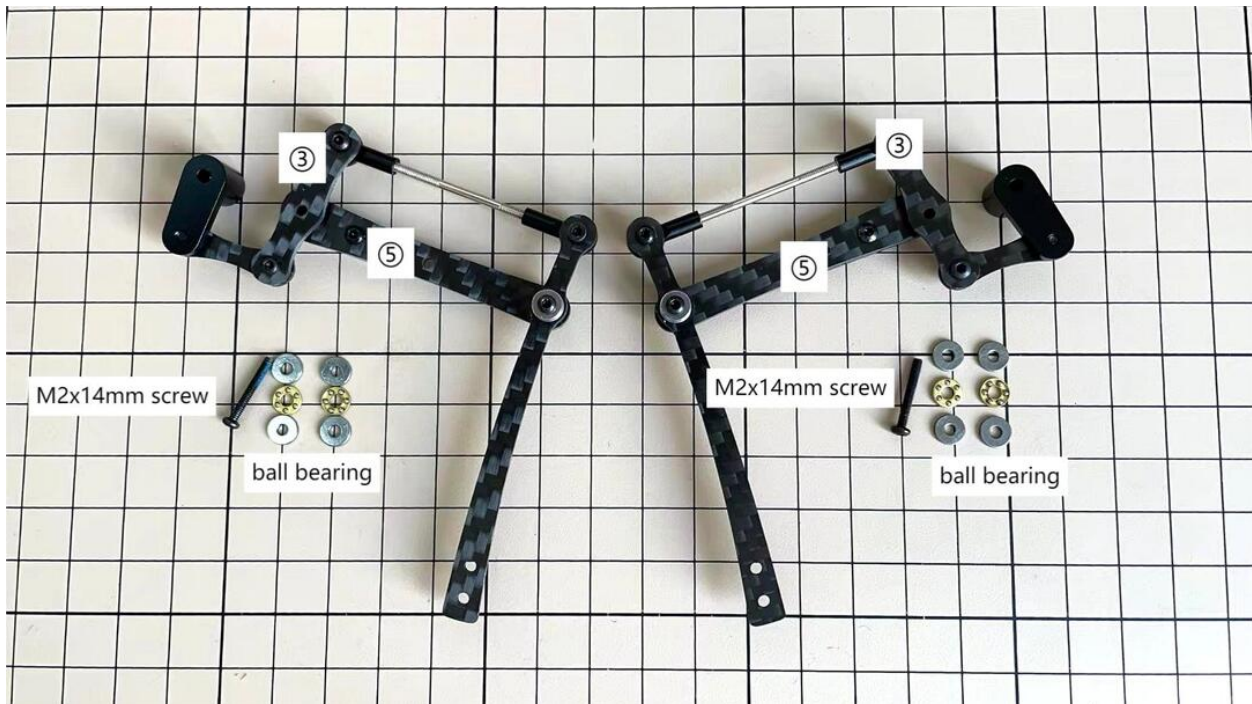
Left and right leg

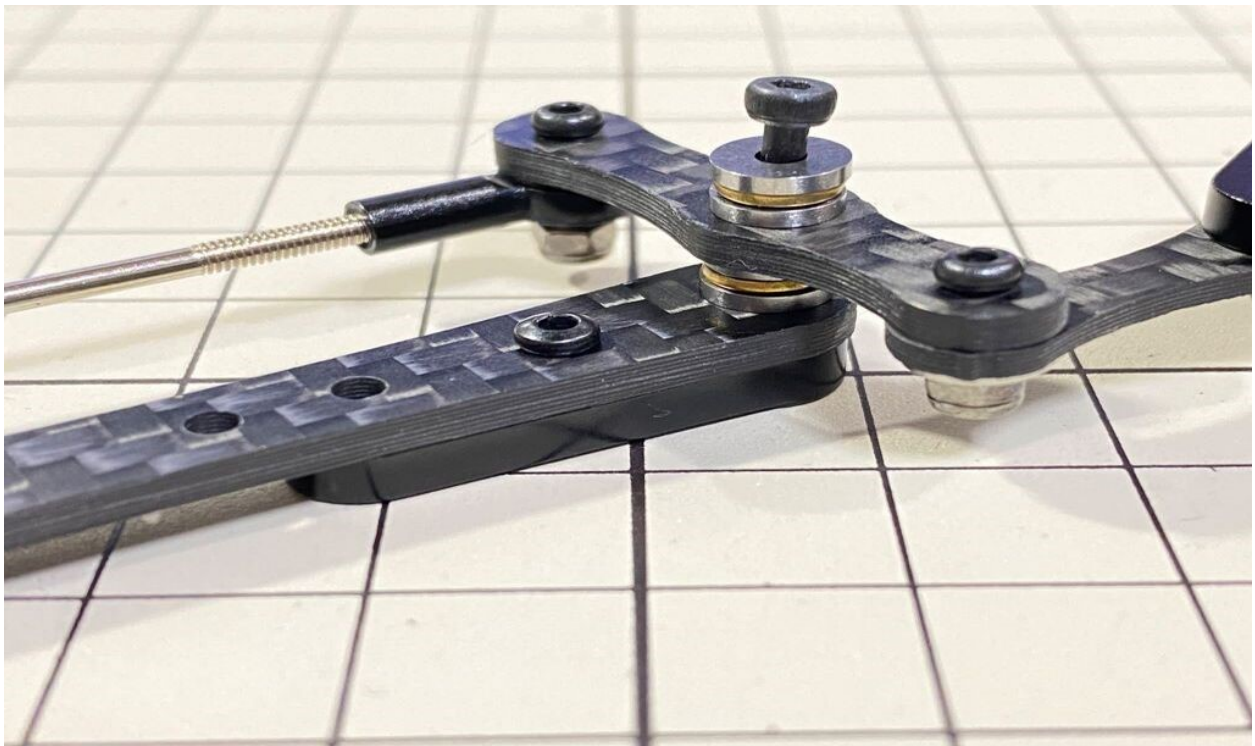
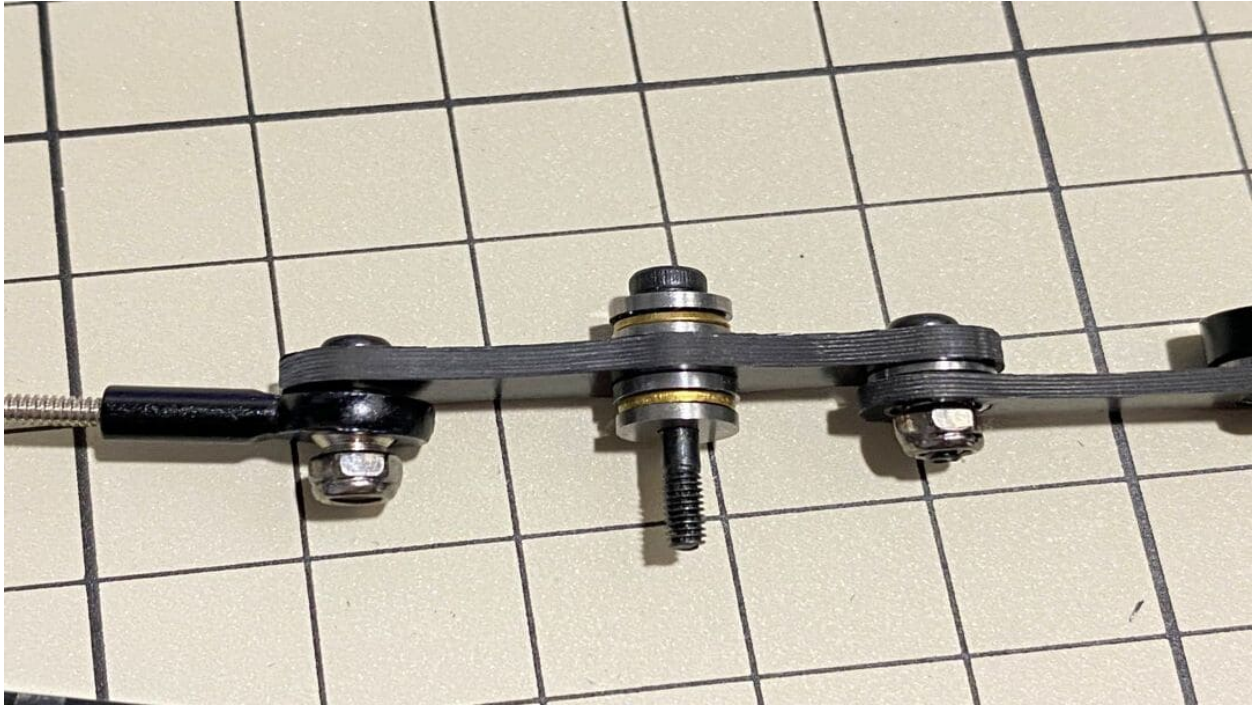




Assemble and

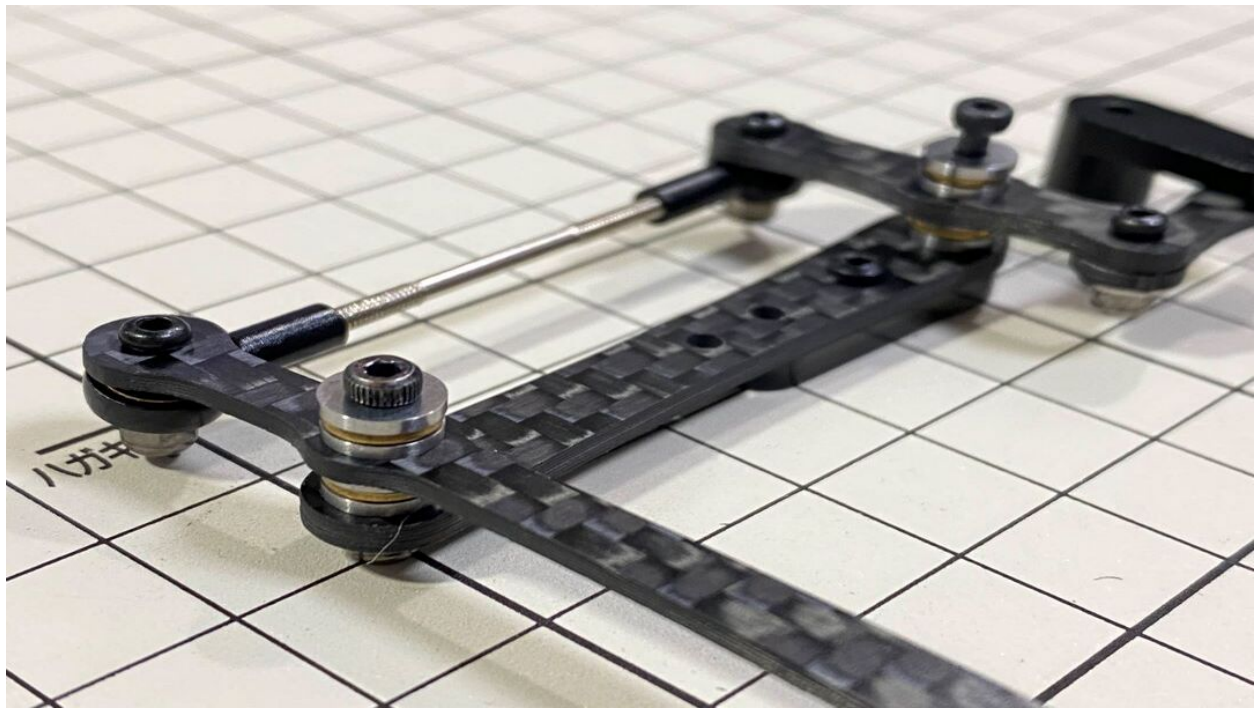
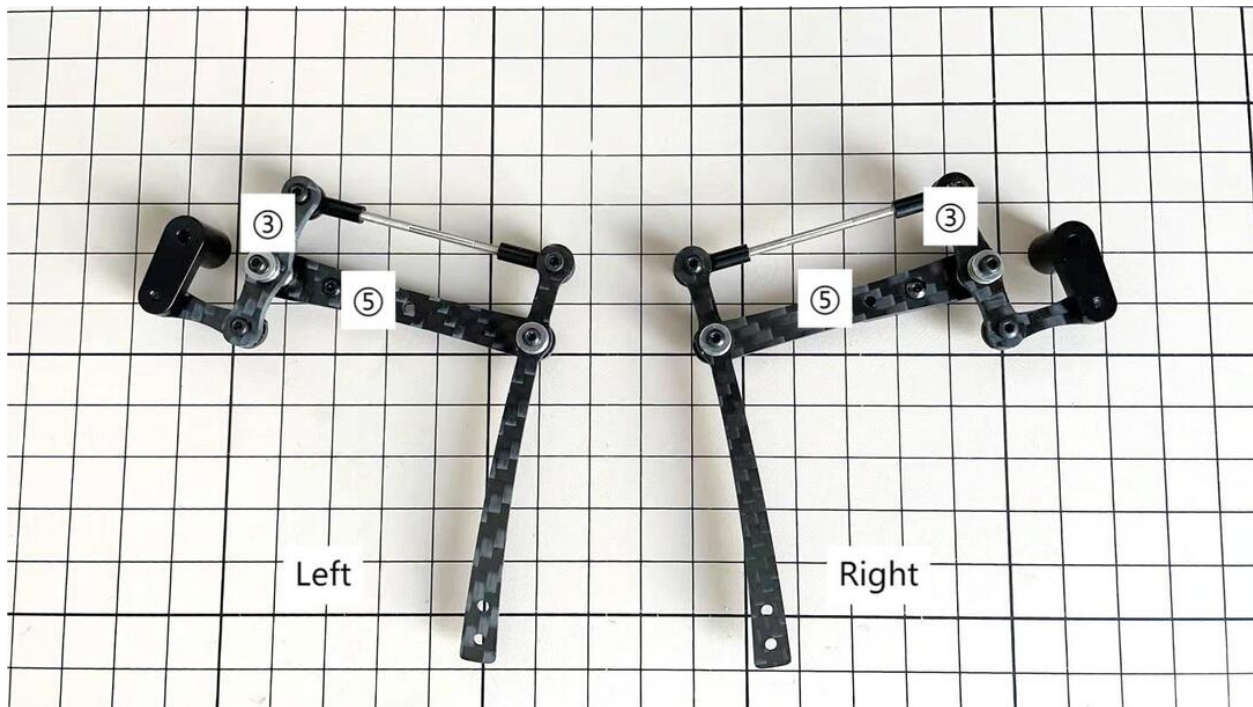
- Use M2x14mm screws and two sets of ball bearings. Thread the screws through the bearings, , bearings, , in that order. The screws are not fixed, but you will tighten them when you mount the servo in the next step.

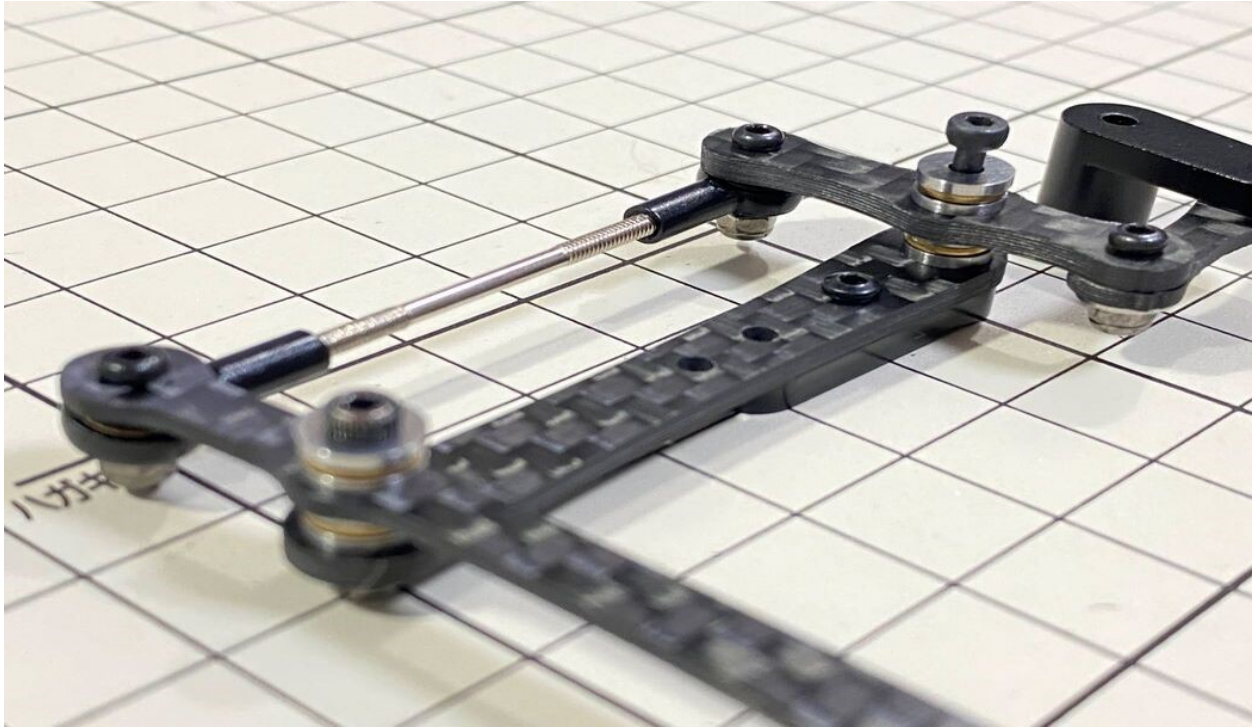




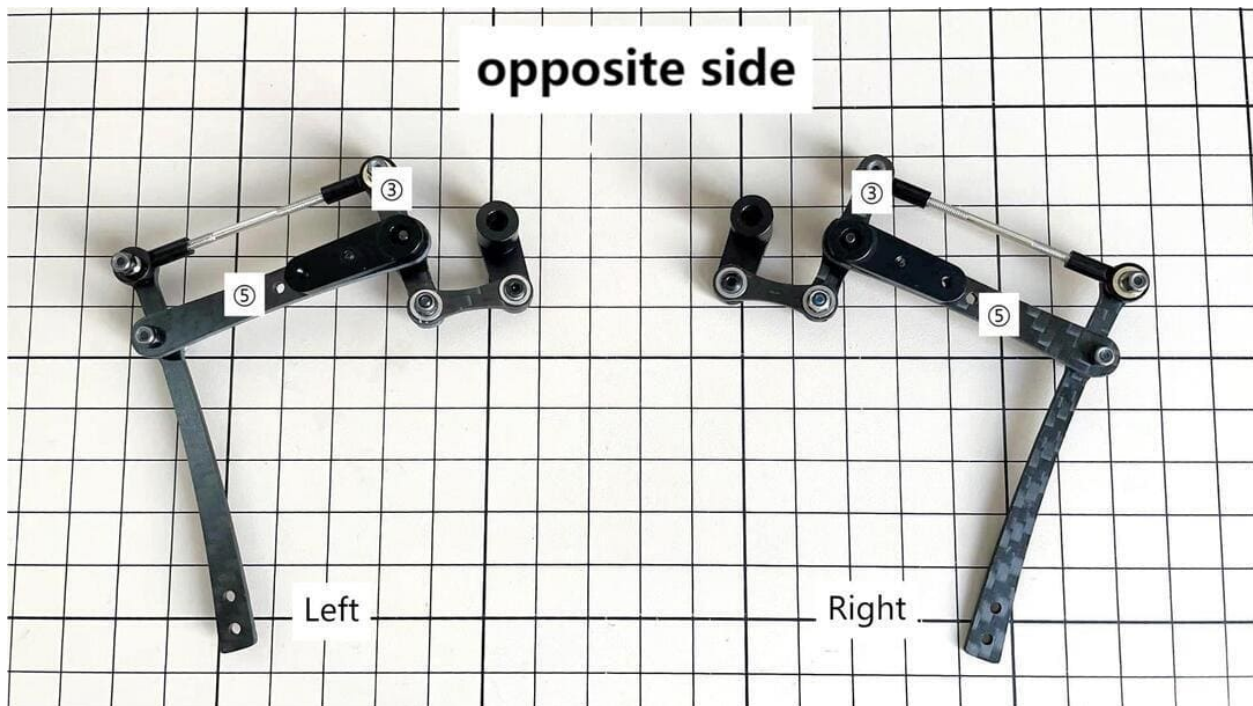
Completion of a right leg

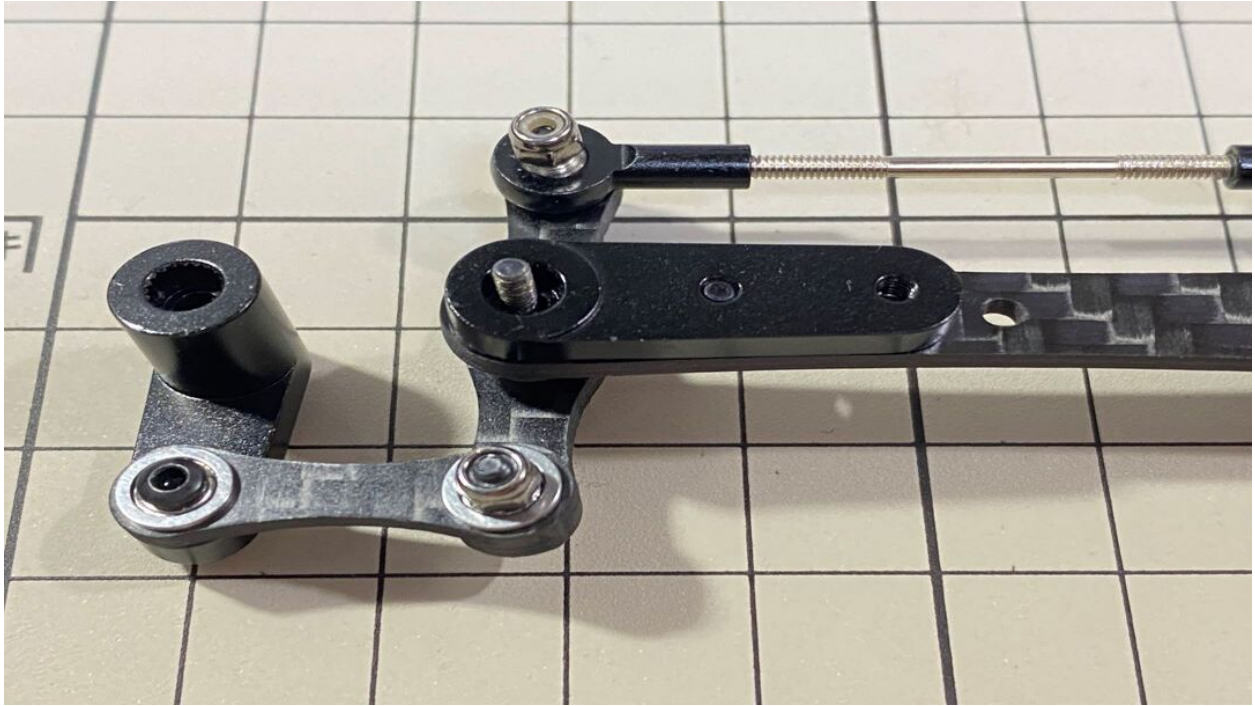
- Now we have one leg on the right side. Here are some pictures so you can see it from different angles. The left leg should be symmetrical with the right one.



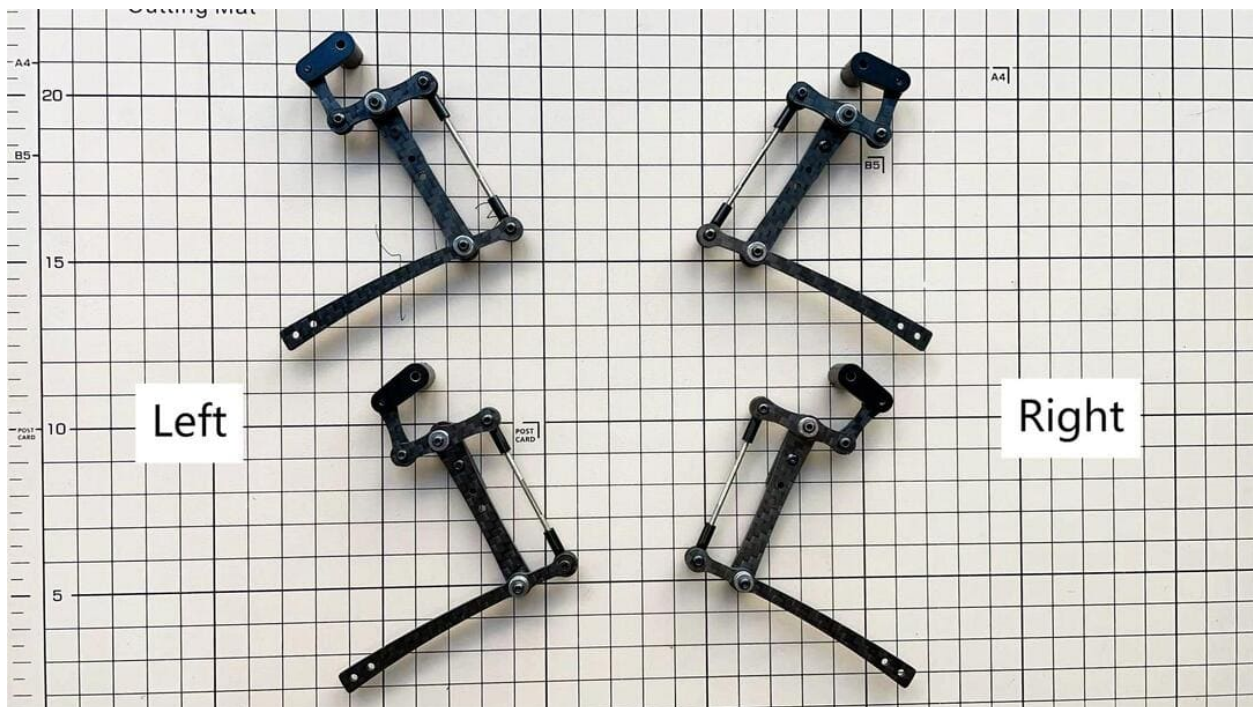


opposite side





Step 3.2 Four legs



Step 3.3 Loctite

- As the nut is on a moving joint, it will loosen quickly if tightened too tightly. They should be secured with Loctite. It is possible to dismantle the nut later, as it can be loosened by a strong force.



- Some screws are also secured with glue as the below picture shows.



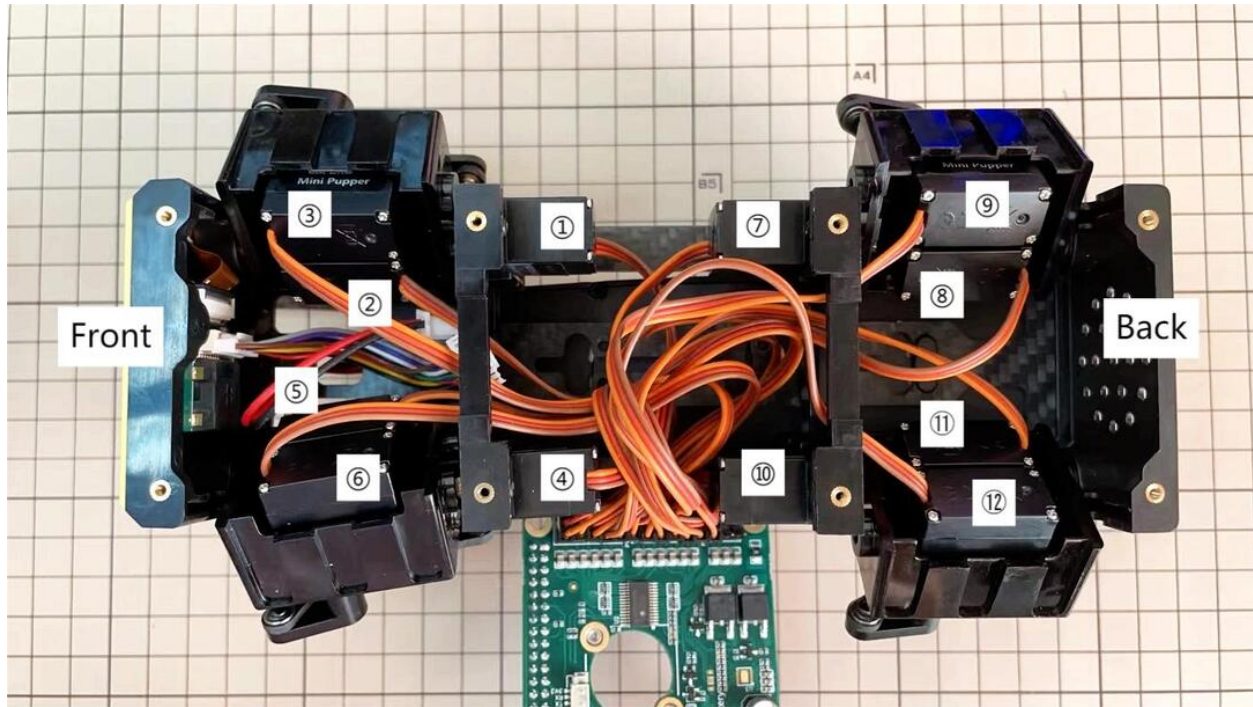
4. Hips Assembly

Step 4.1 Hip

Please refer to the below video clip.

There are two kinds of servo cables, No.1,4,7,10 cables length is 9cm, other cables length is 15cm.

- For the position of each servos, please refer to the below picture.

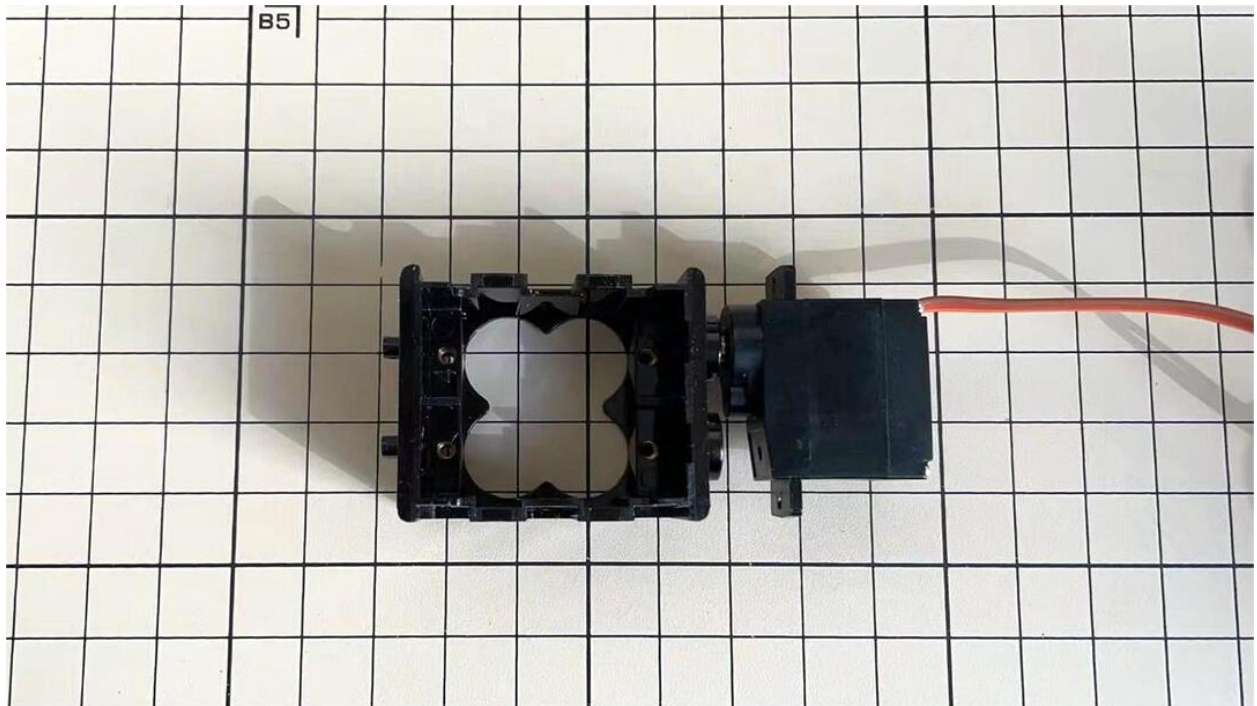
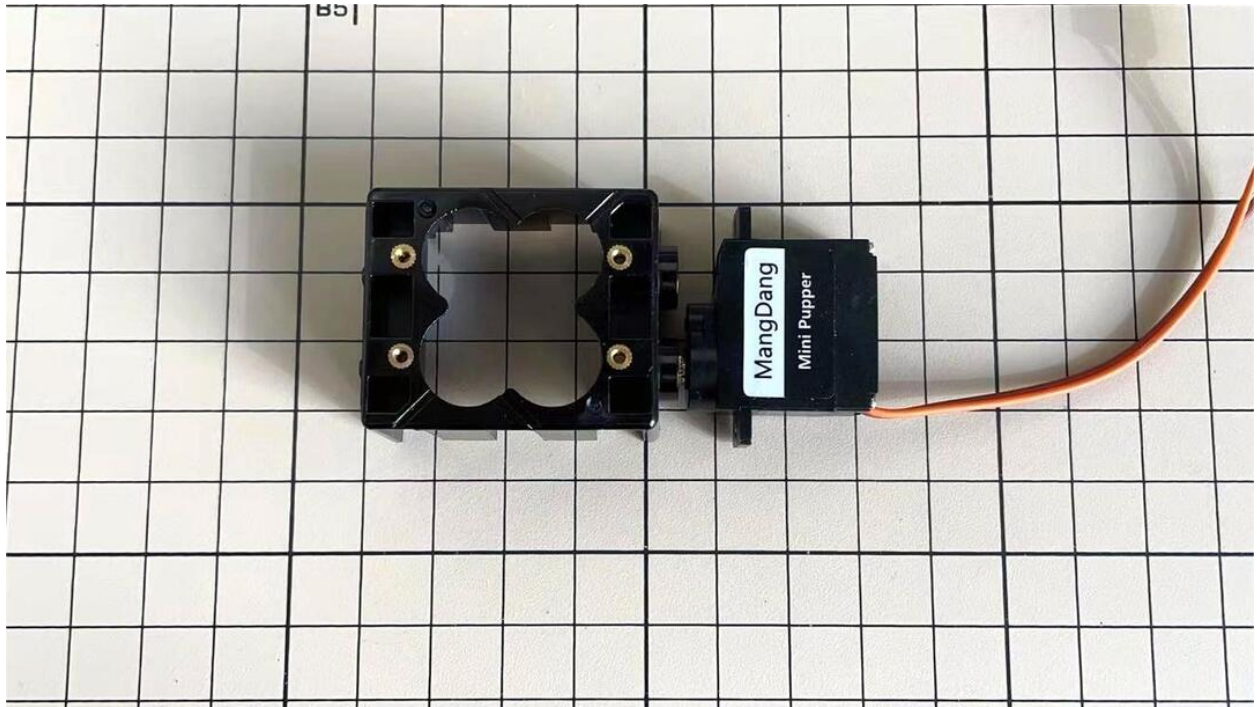


- Here shows how to assemble the rear right hip.

Confirm whether the servo shaft is at the right position. The middle position marker is added on the output shaft, the output shaft is at its middle position by fault as the left picture shows. The shaft position may be changed during assembly as the middle picture shows, if you find it, you can use the servo horn to move the output shaft to the right position, and then finally make the servo horn at the place as the right picture shows.

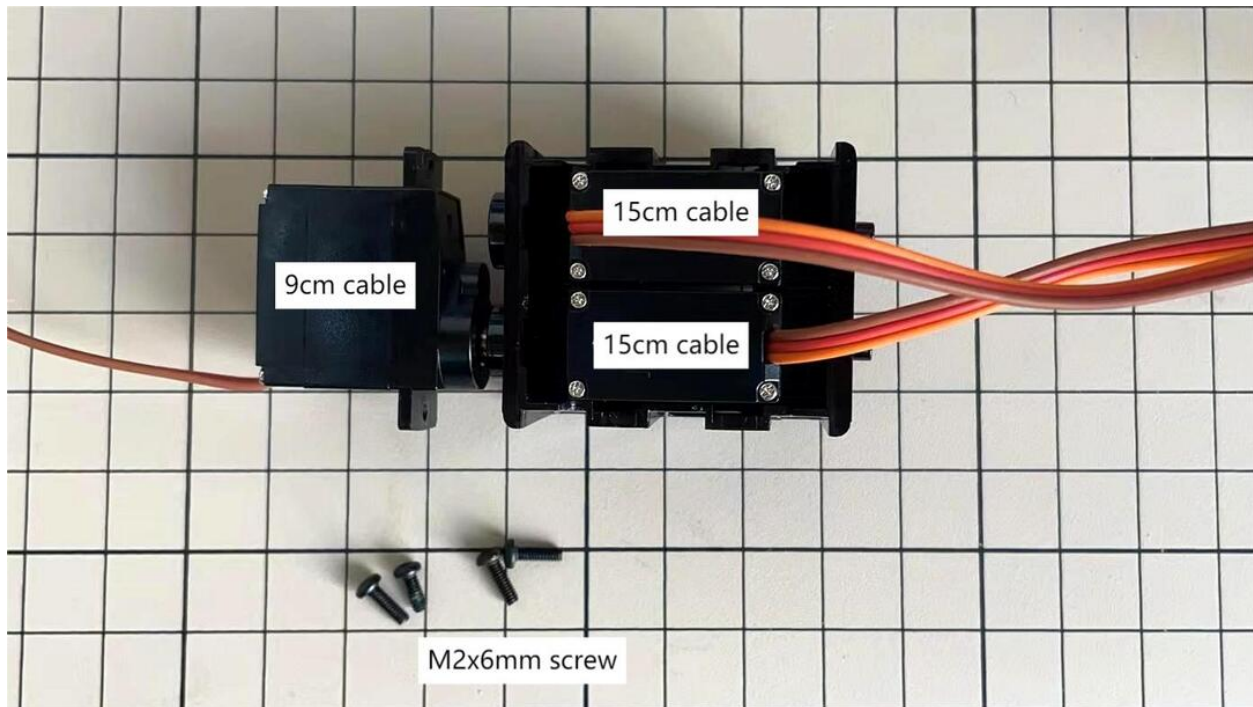


Connect the servo and hip part.

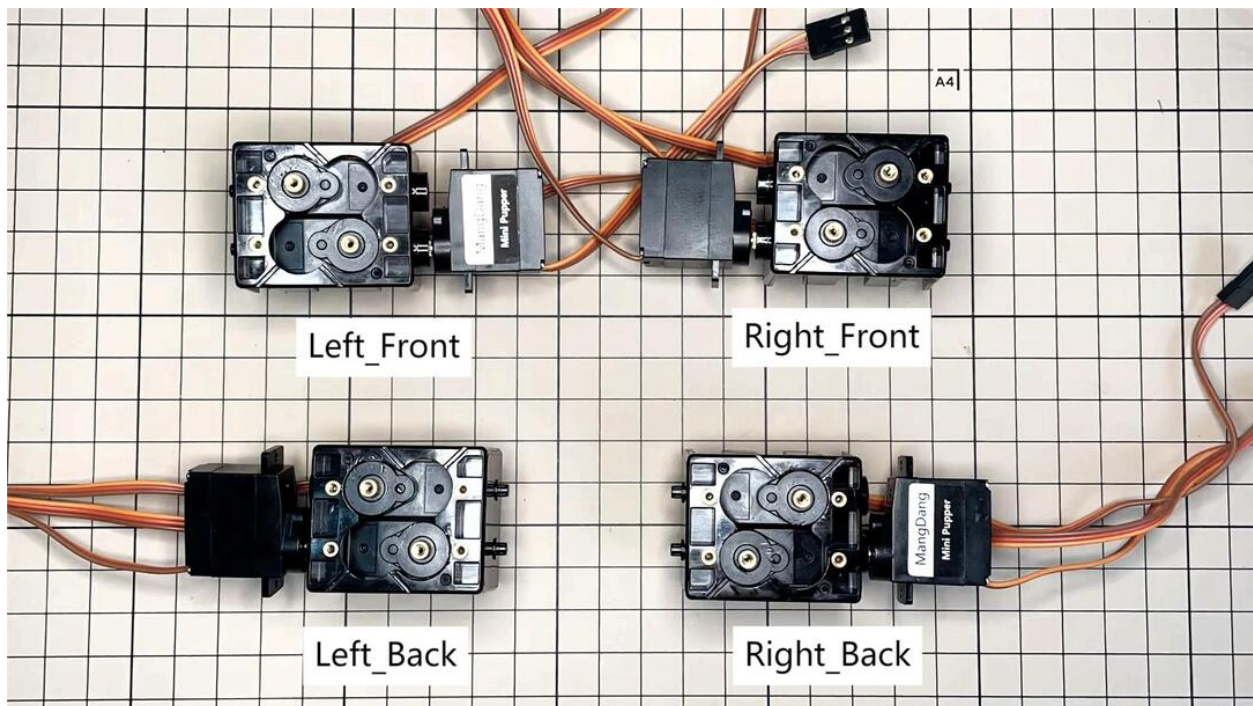


Put two servos into hip parts

- Insert two servos into the box and fix them with M2x6mm screws.

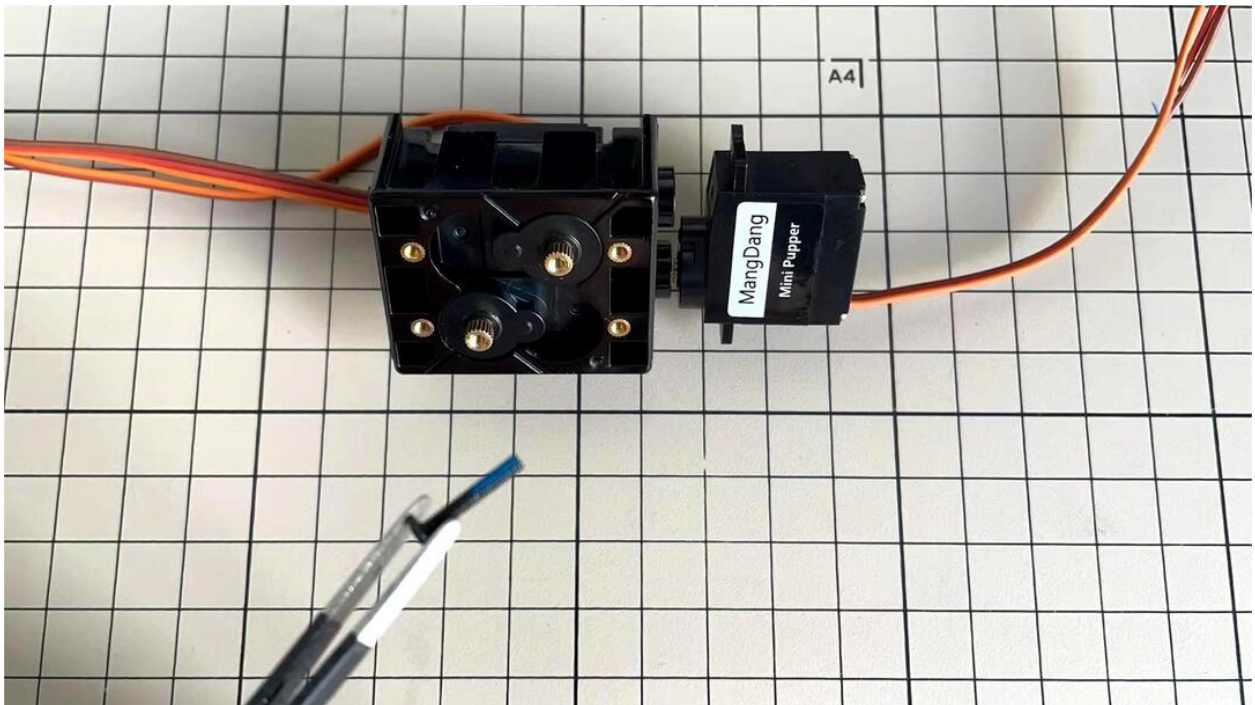
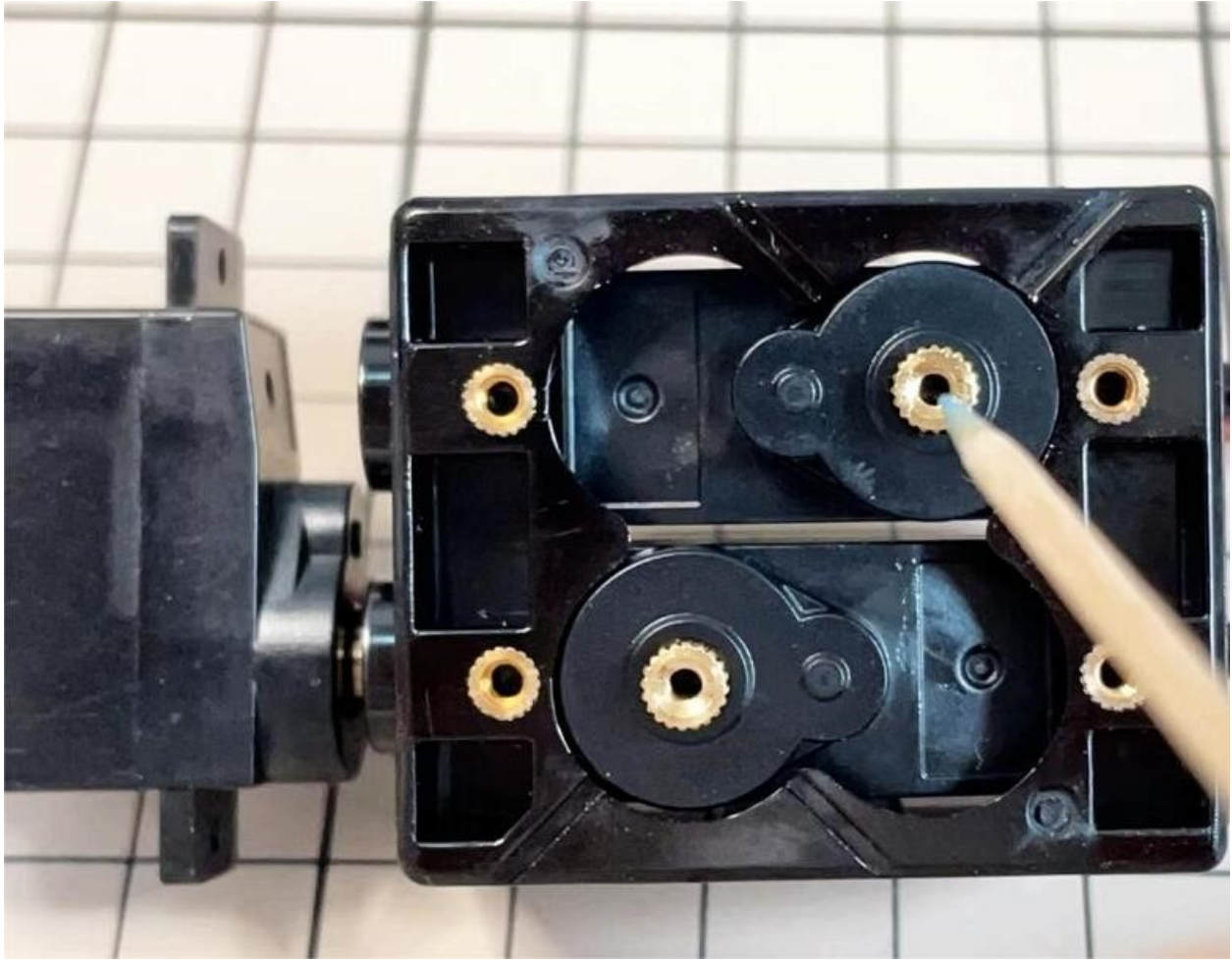


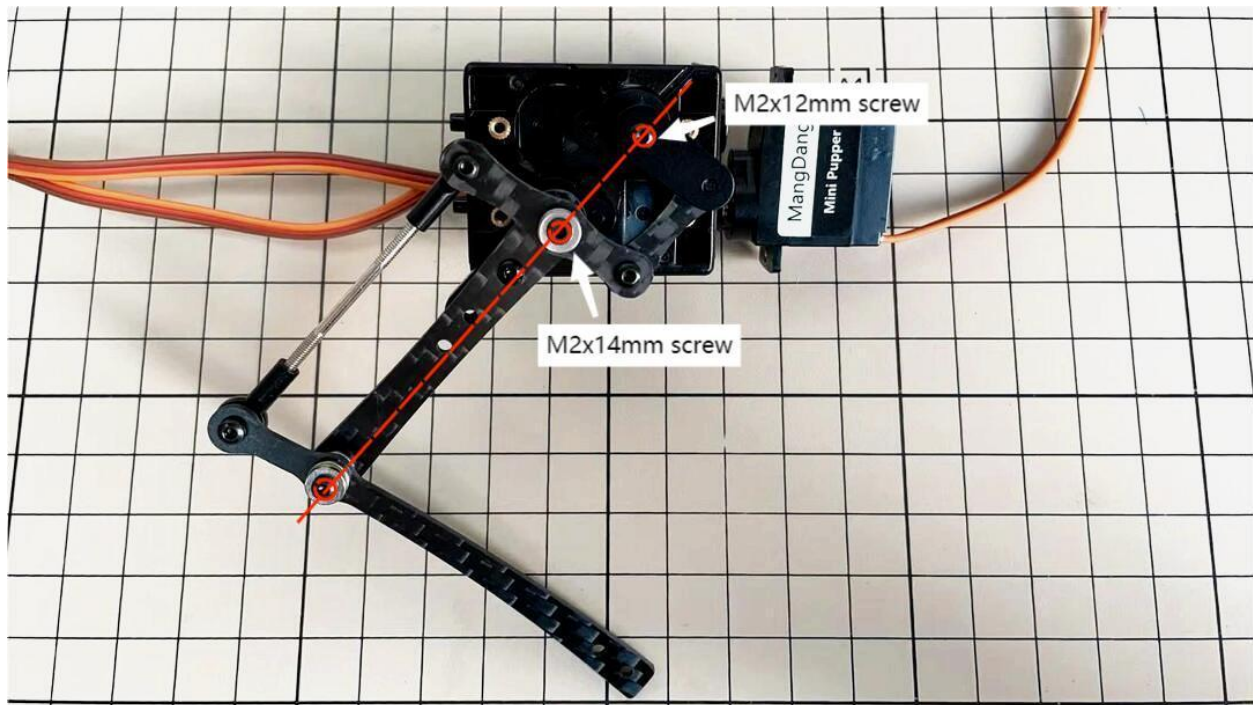
Four hip parts, please refer to the servo positions.



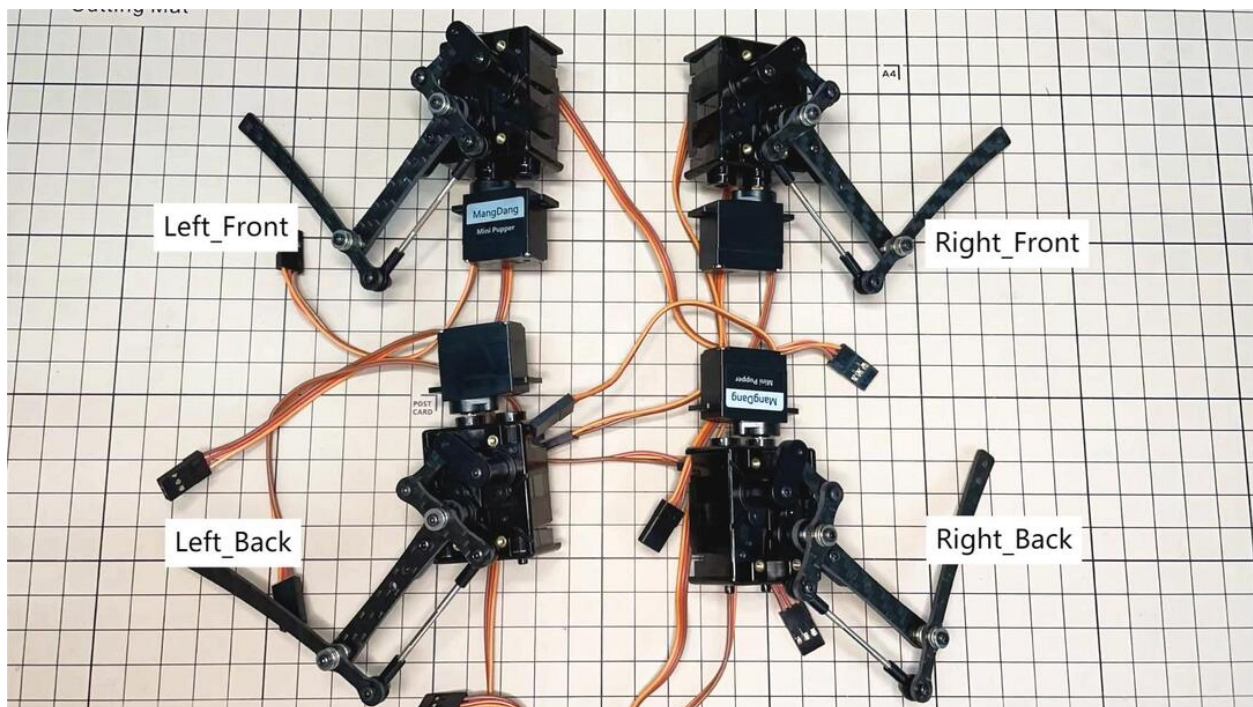
Assemble leg and hip

- * If you have no technology background, it's easier to attach the leg to the hip during the calibration step.
- * If you are the first time to assemble quadruped robot, we don't recommend you use the Loctite.
 - Attach the leg to the hip using the M2x12mm screws. Leg is tilted at approximately 45°, as shown in the manual.

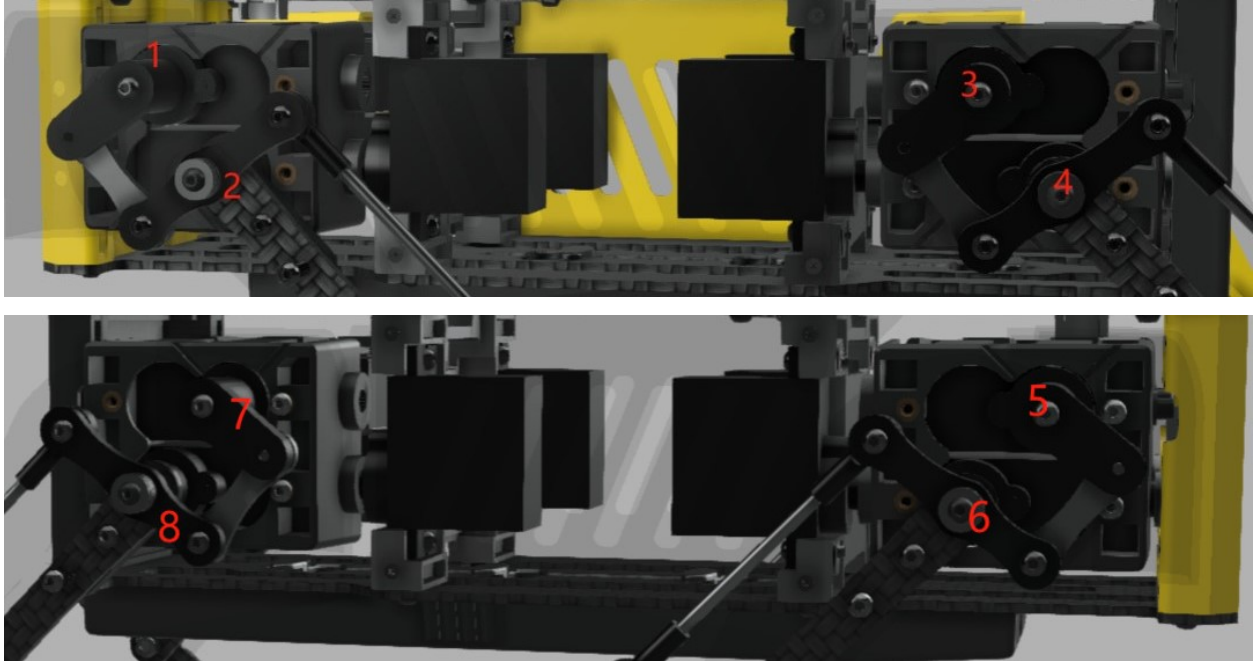




Step 4.2 Four Hips



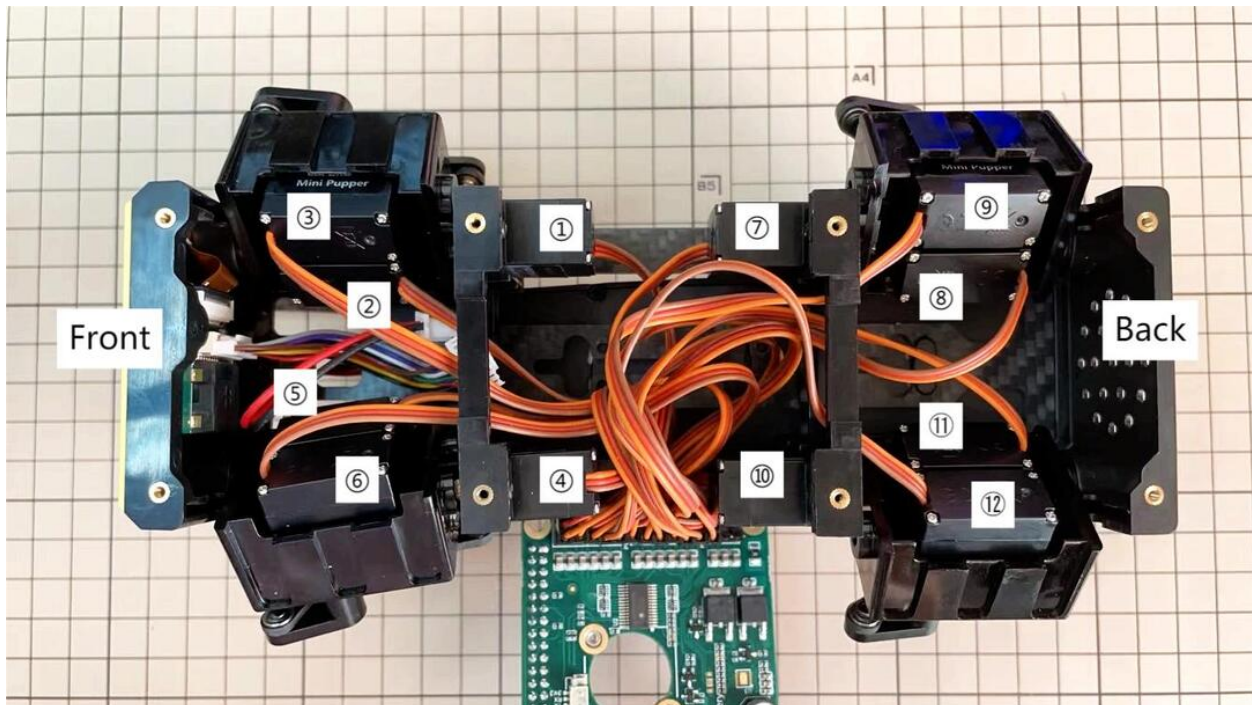
※ Please pay attention to the positions of the servo gear output shaft



5. Body Frame Assembly

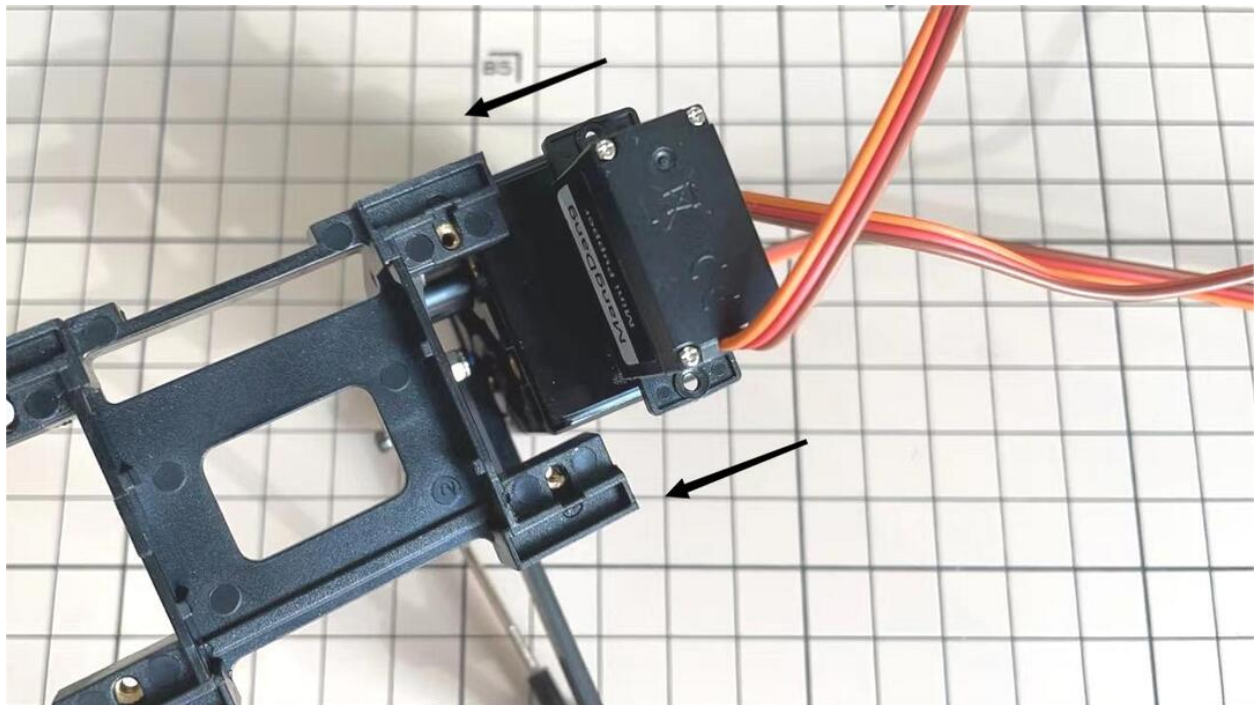
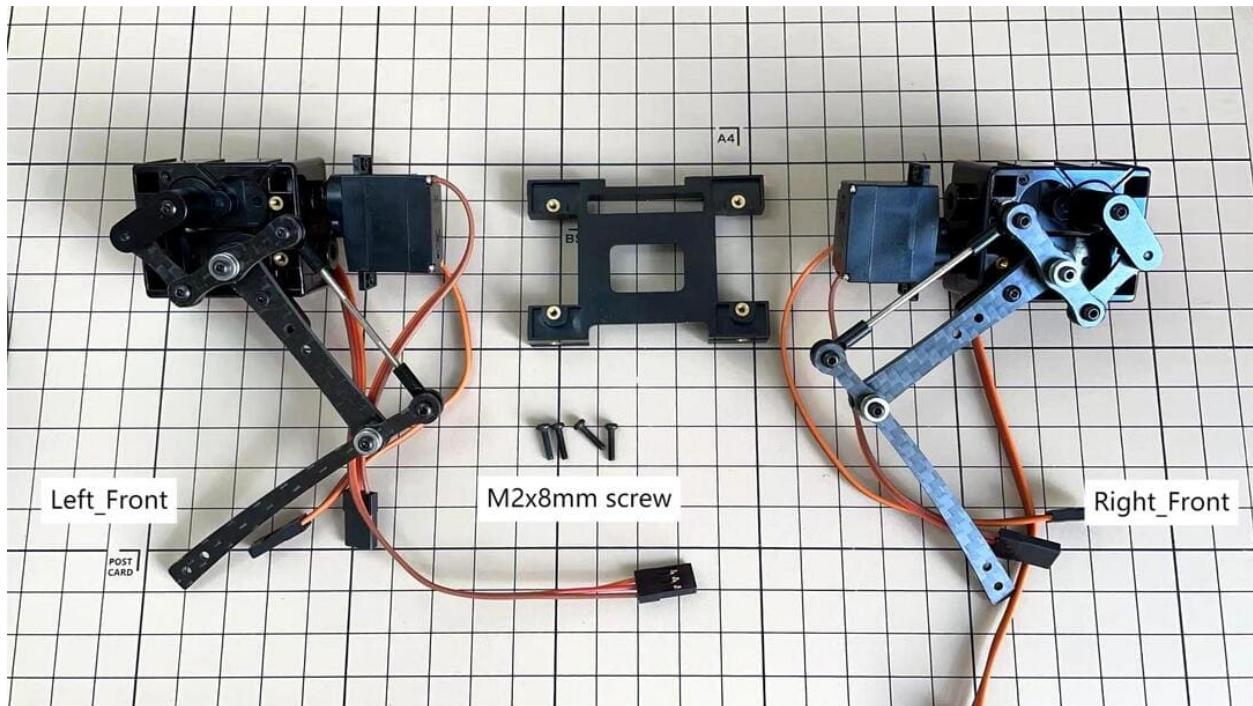
Step 5.1 Center parts

- The position of each servos are shown as below.



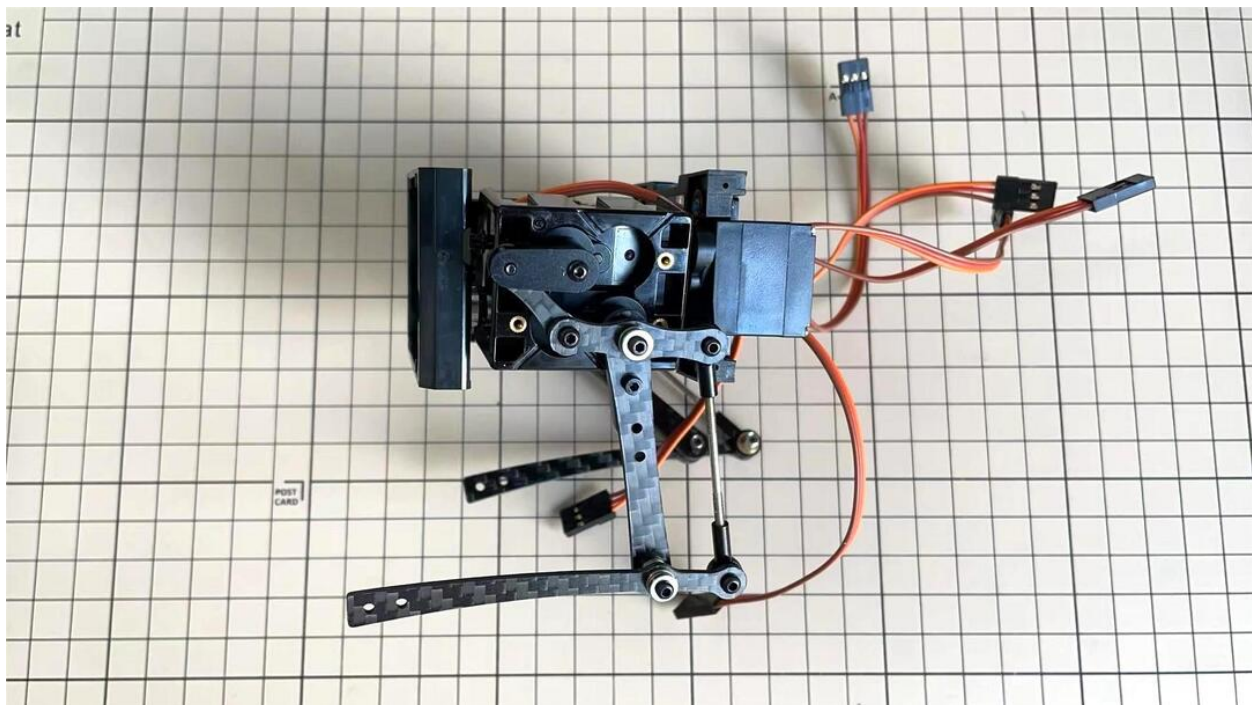
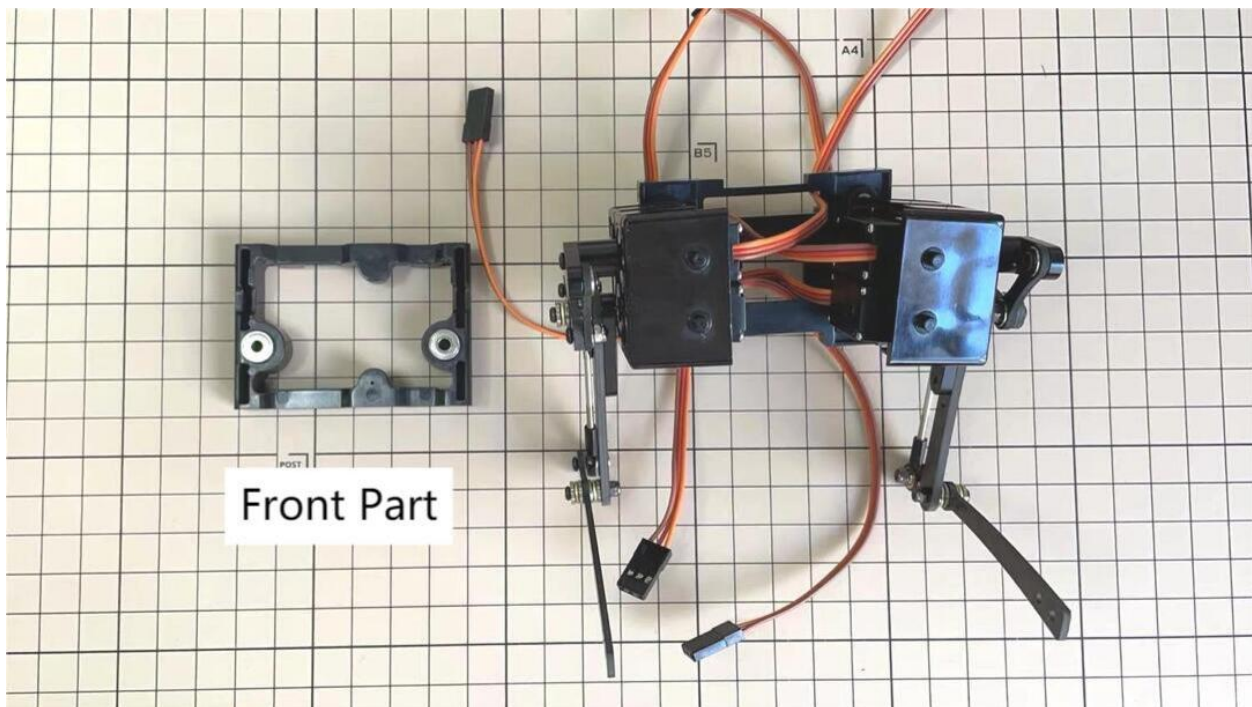
* There are two kinds of servo cables, No.1,4,7,10 cables length is 9cm, other cables length is 15cm.

- It is useful to put masking tape on the cables and write the number of servos during this process to make it easier later.



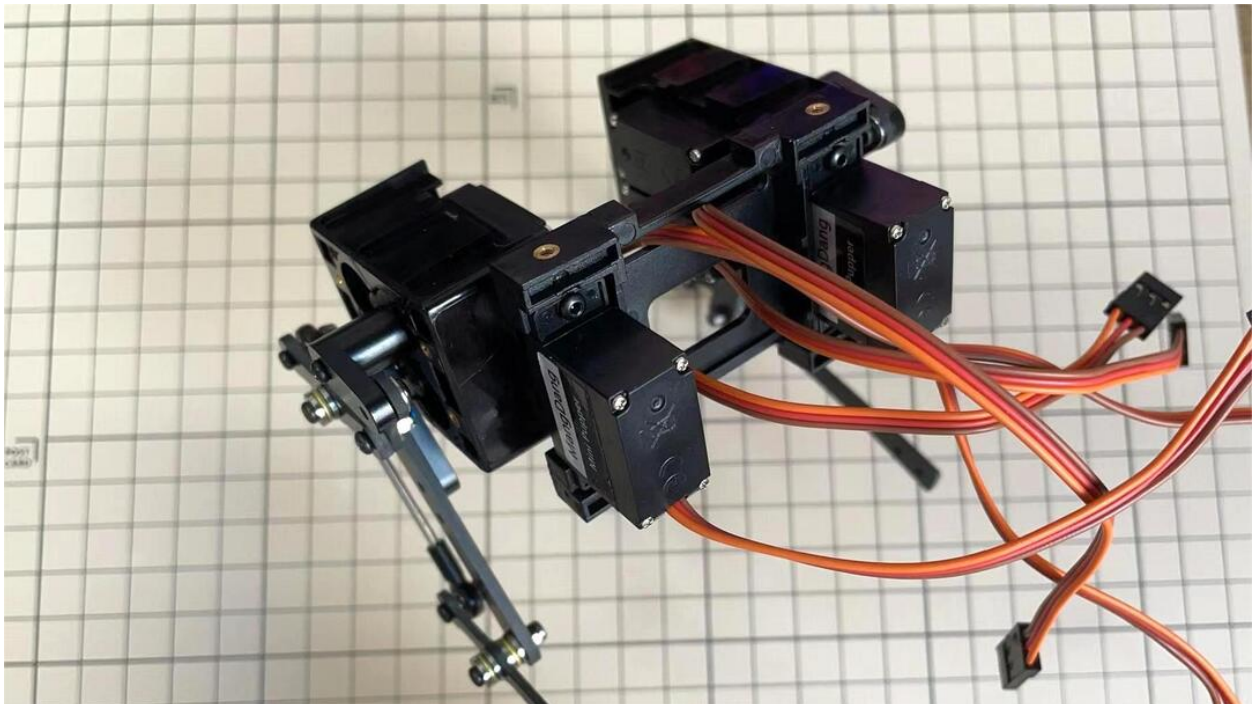
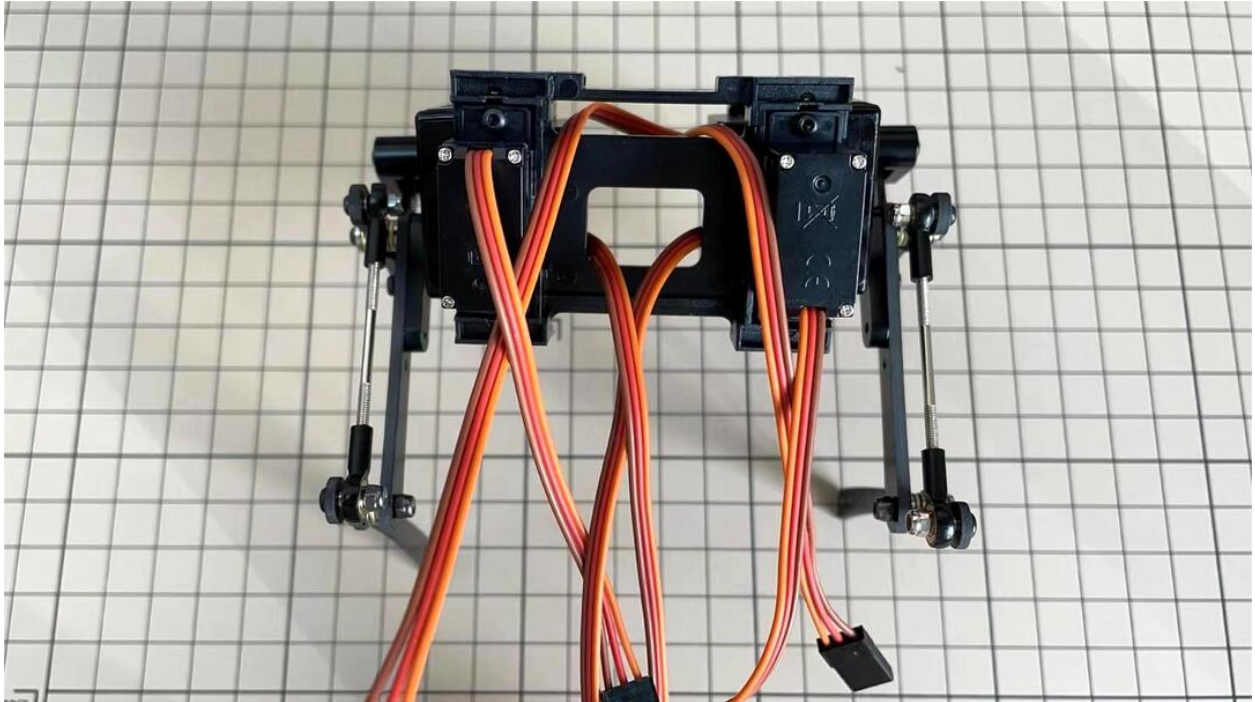
Step 5.2 Front parts

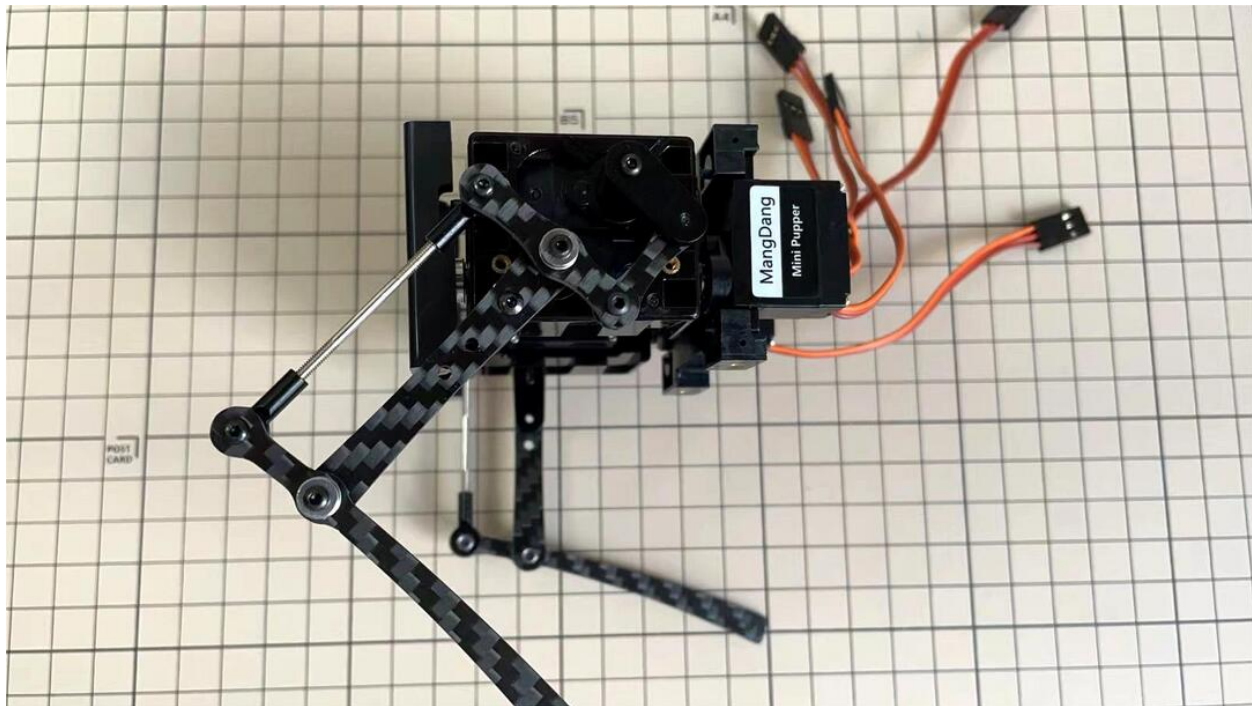
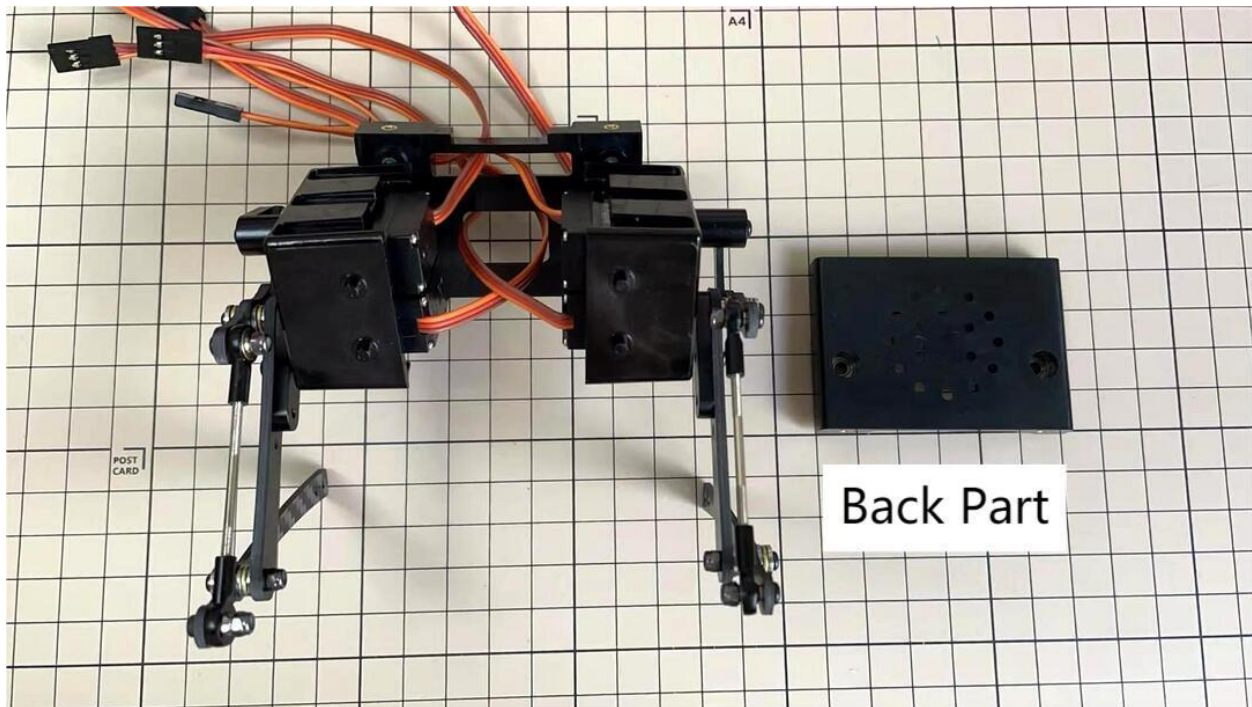
*The front part is designed to hold the LCD screen. Make sure you don't mistake it for the rear part.

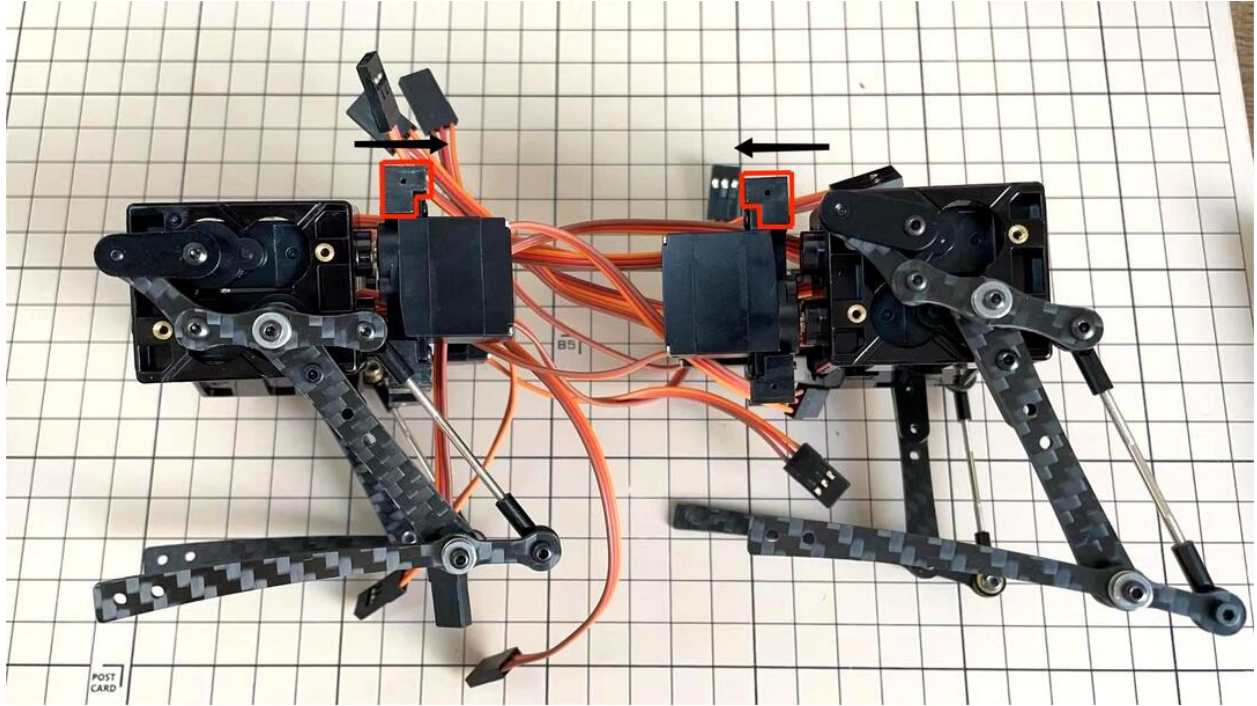


Step 5.3 Rear side

- The same procedure as for the front part.

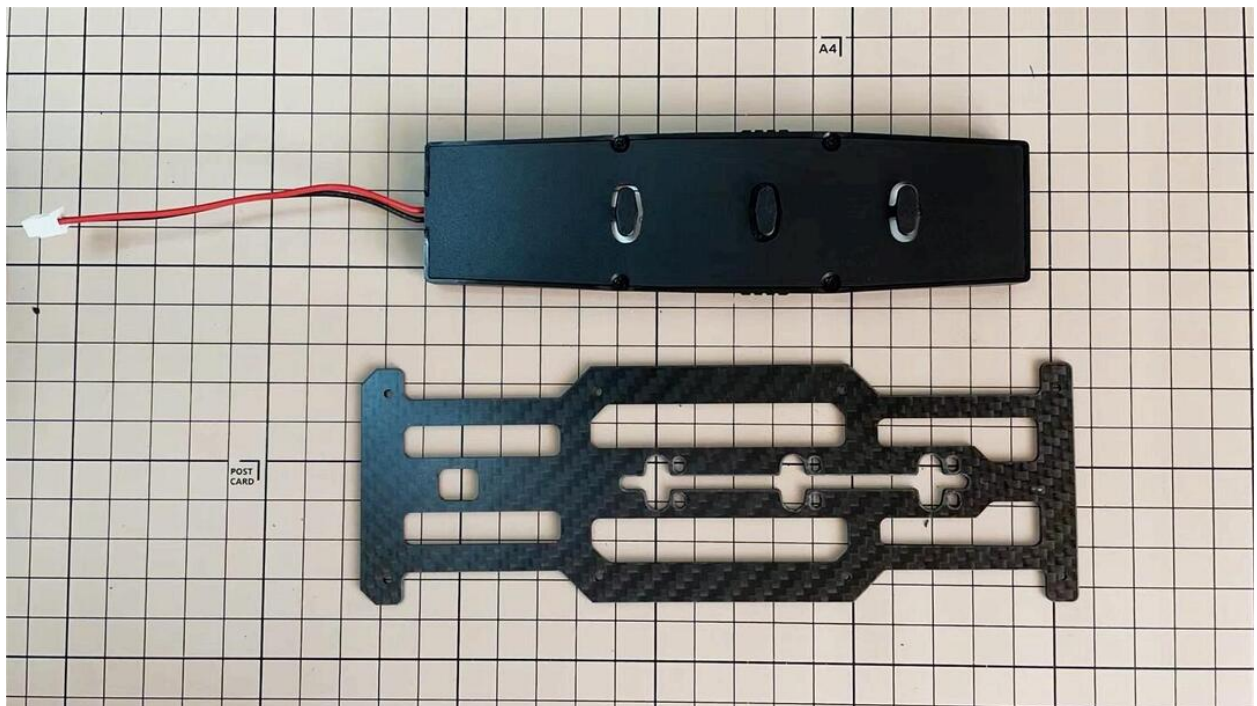




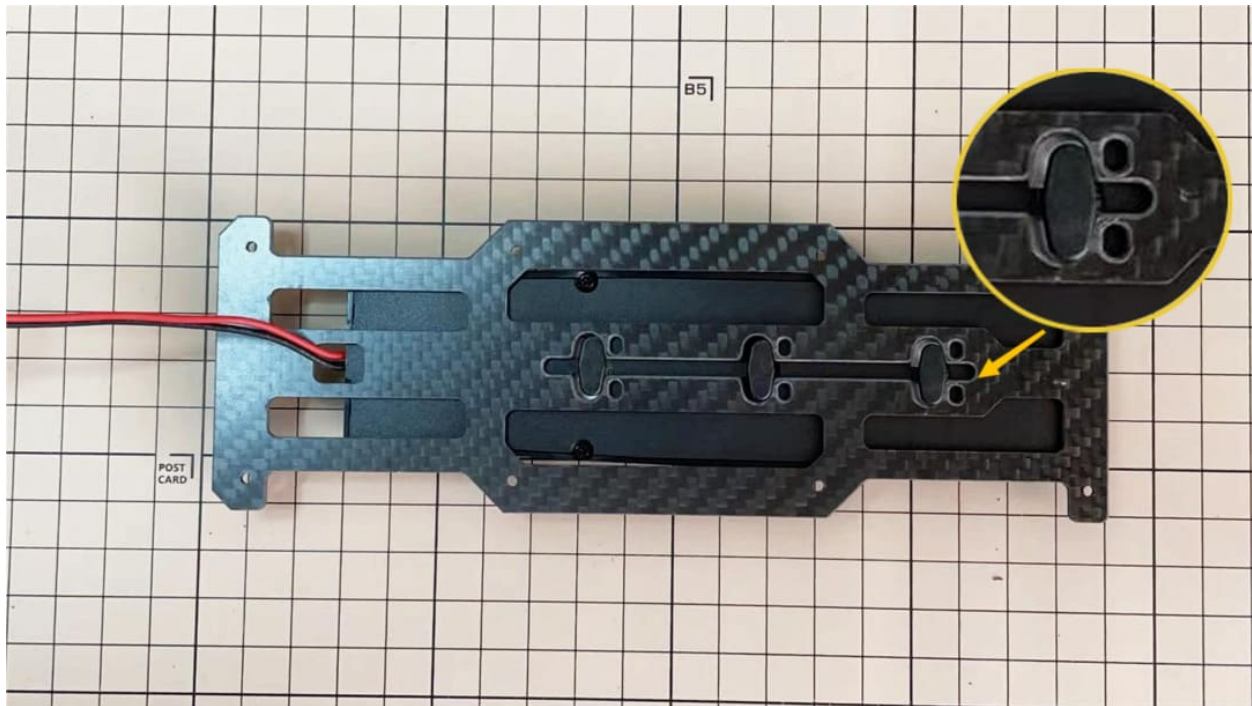


Step 5.4 Battery

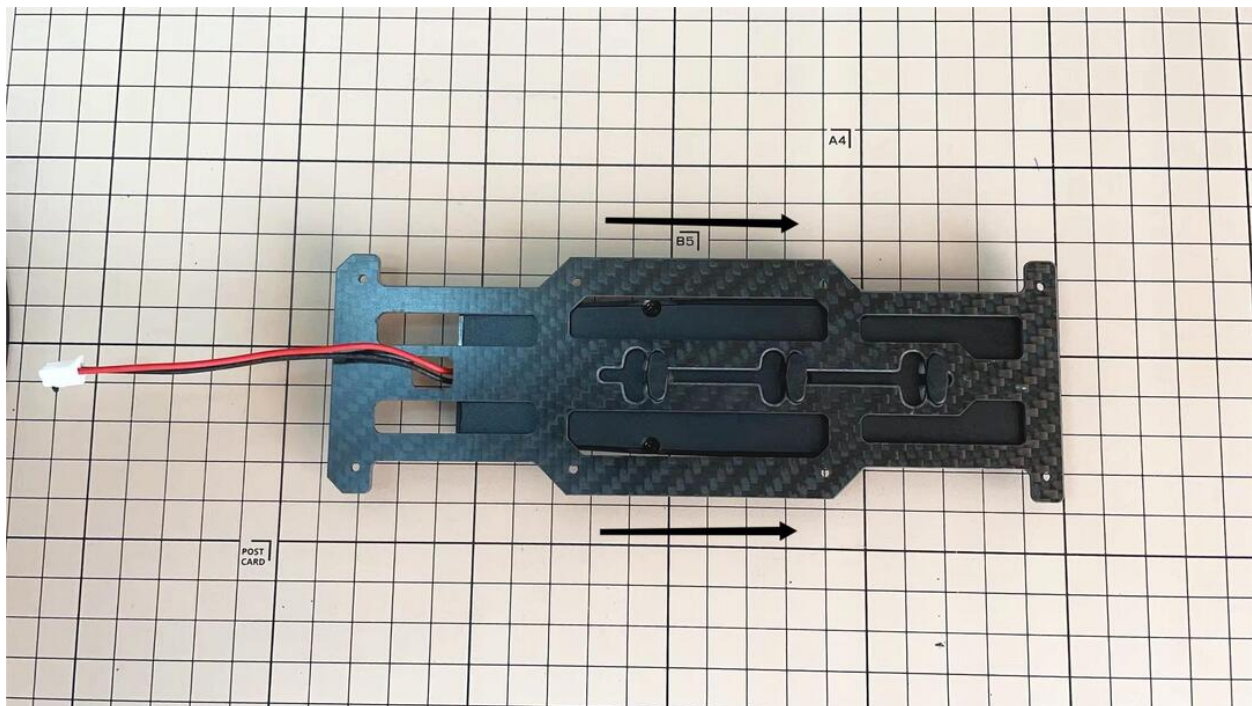
- If you DIY the battery, please ensure our battery spec at first, especially the Voltage should be less than 7.4V, you can also refer to other backers work <https://www.facebook.com/groups/716473723088464/posts/777616293640873/>
- Install the battery pack.



- Be careful of the carbon fiber front and rear orientation.

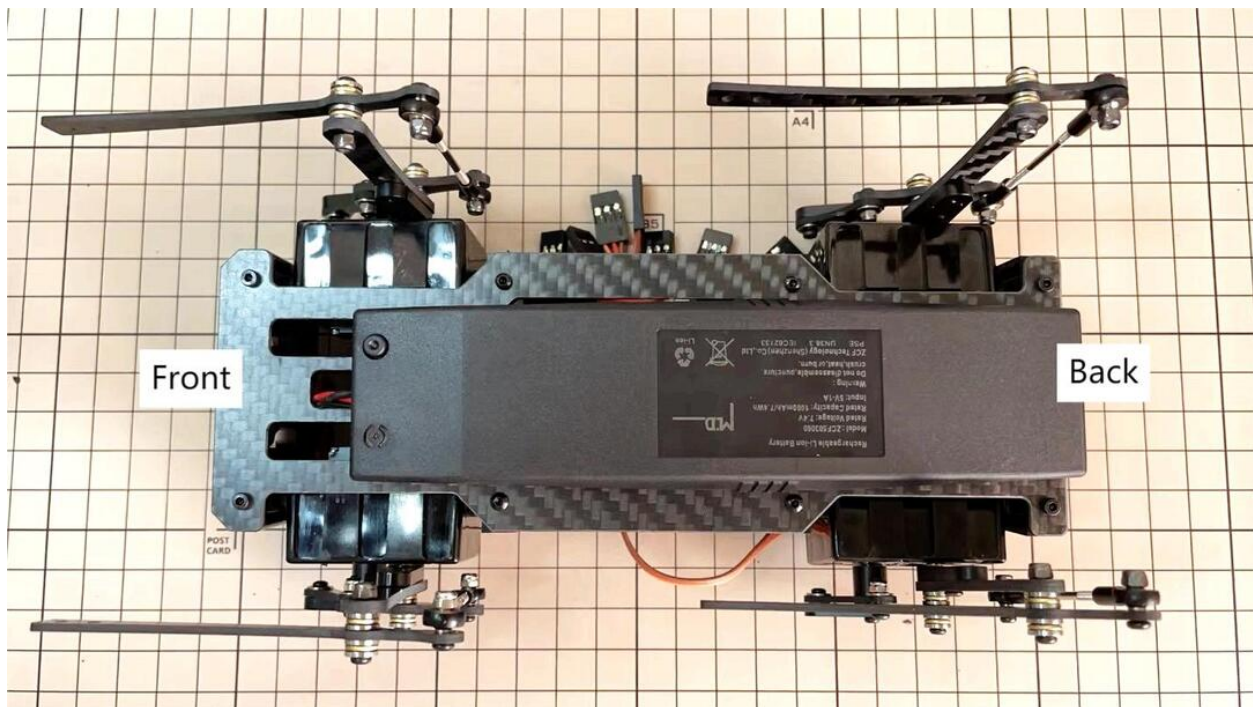


- Slide the battery backwards and secure it. Pass the cable through the hole in the bottom plate and bring it up to the top.

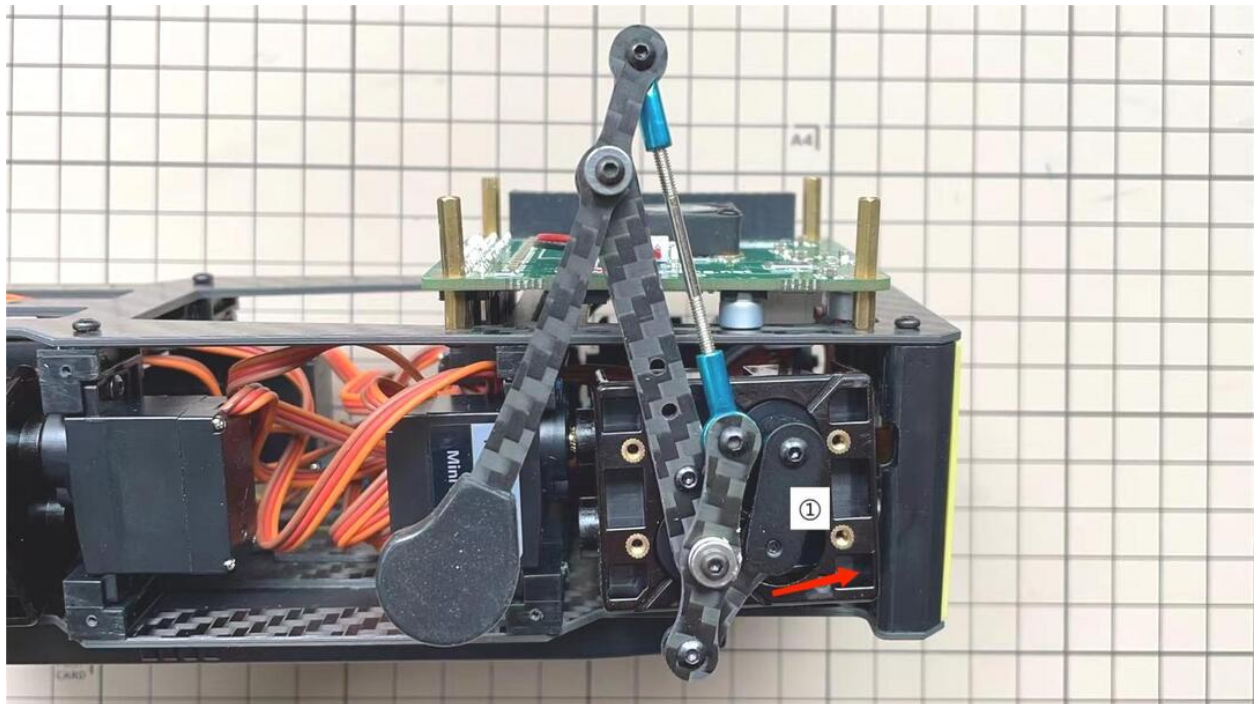


Step 5.5 Bottom plate

- The orientation of the plate must be such that the hole is at the front.

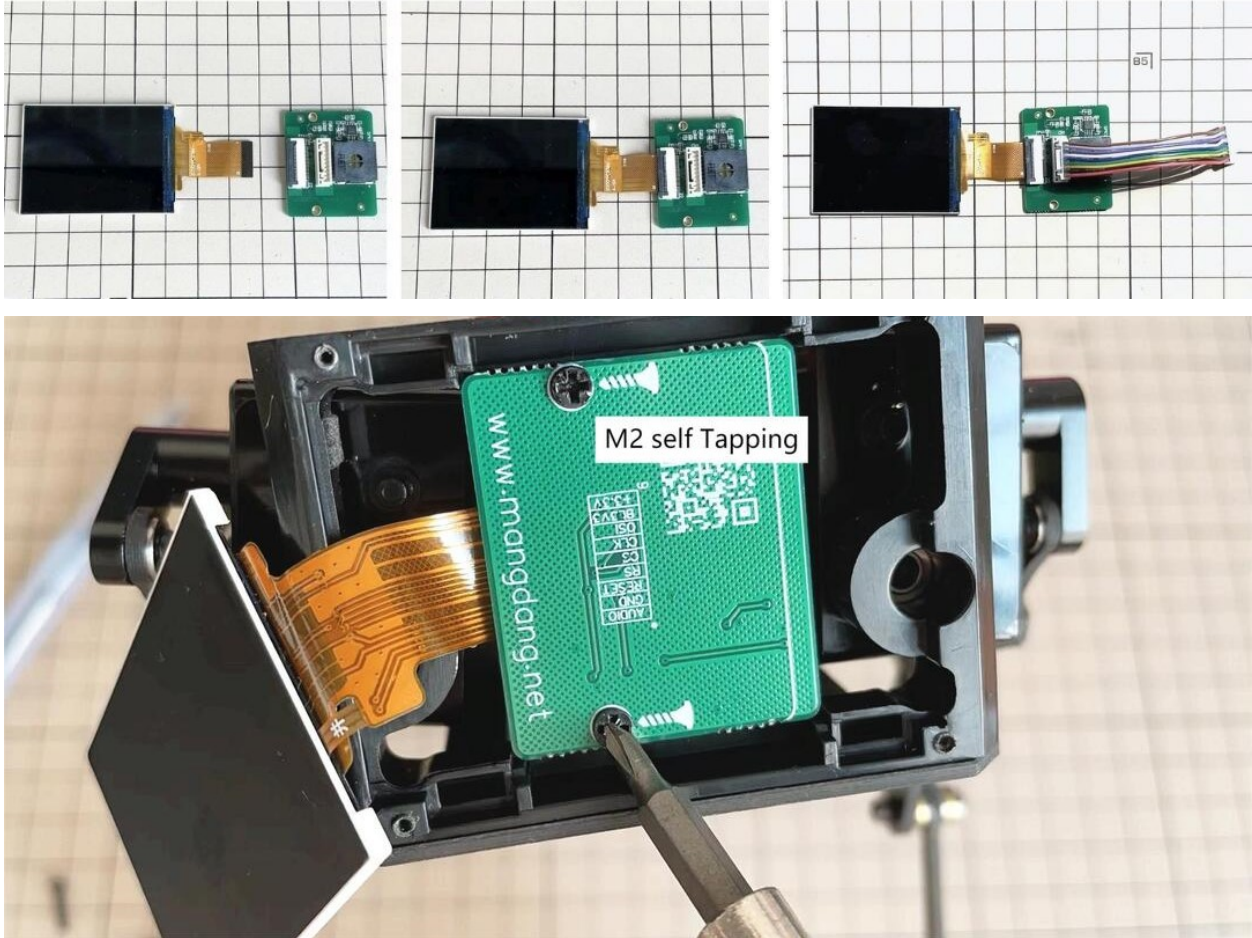


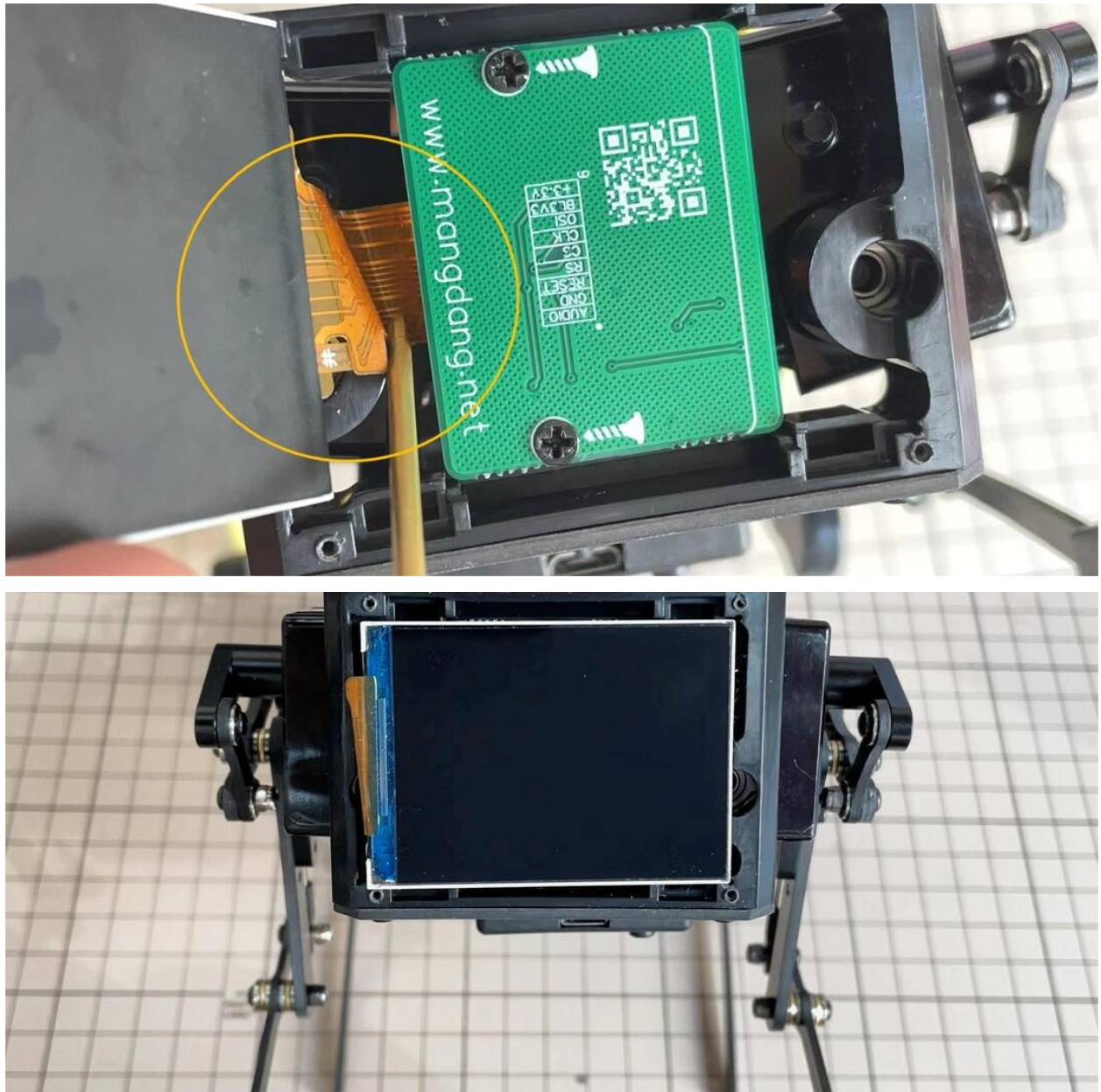
- If the leg is stuck, turn the part

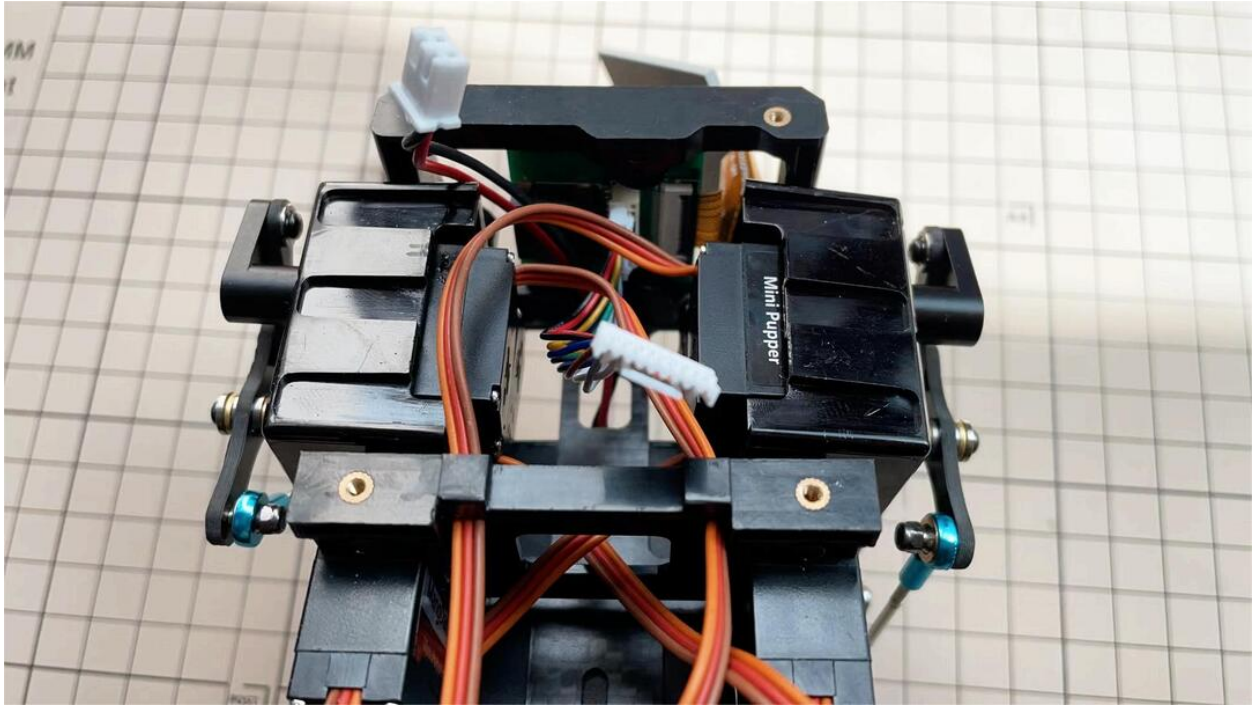


Step 5.6 Display and Frame of face

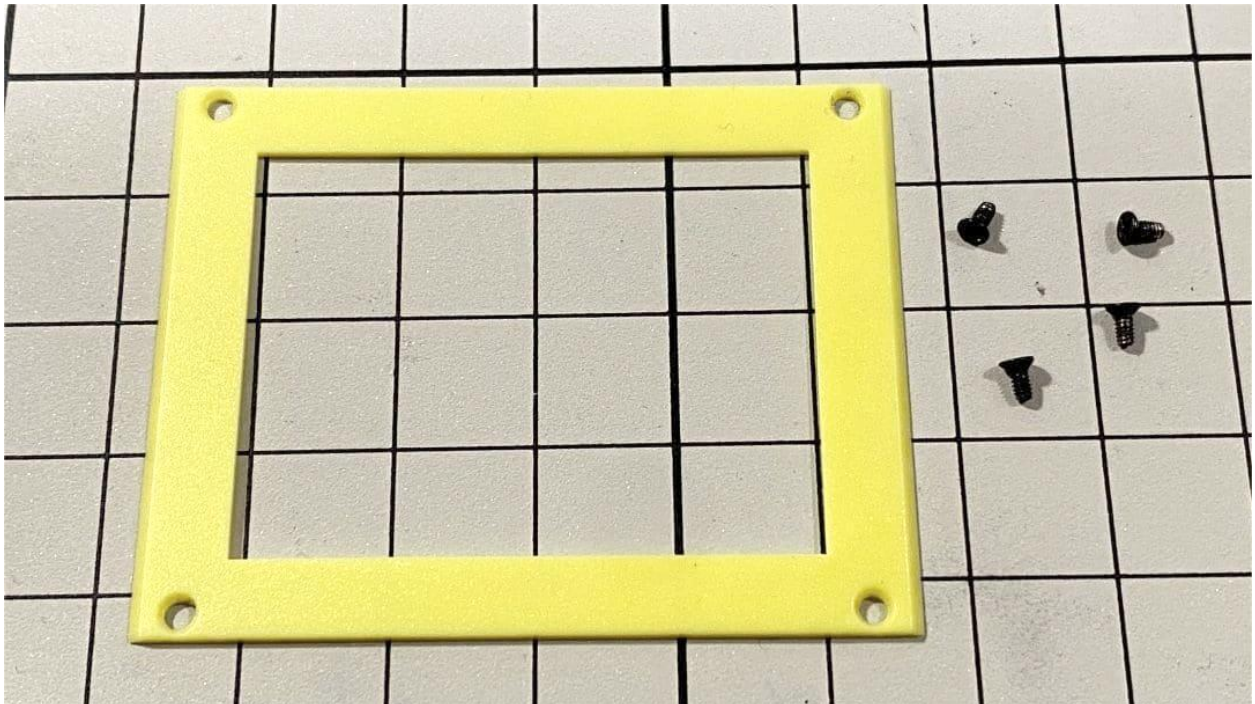
- Remove the protective sheet for the display. Fold the thin flexible cable at the edge of the display. Attach the board and the display to the main unit. When attaching the display, you can use a stick to gently push the flexible cable, so that it goes as far back as possible.

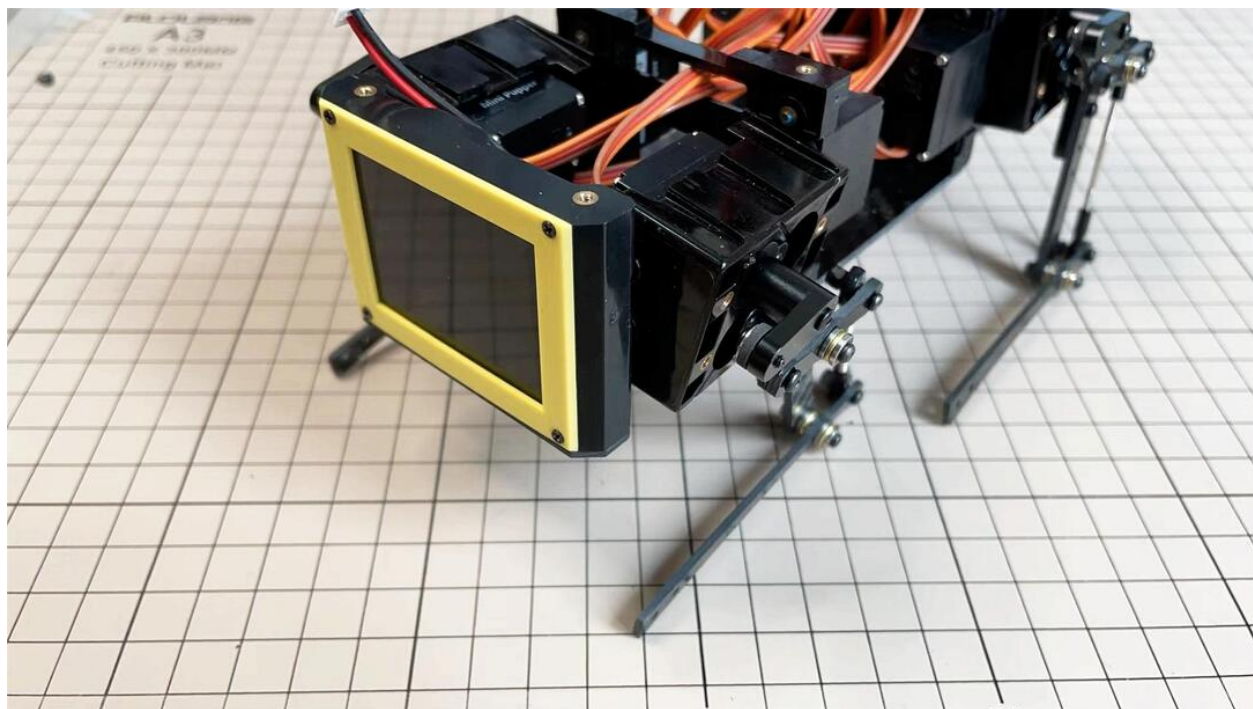
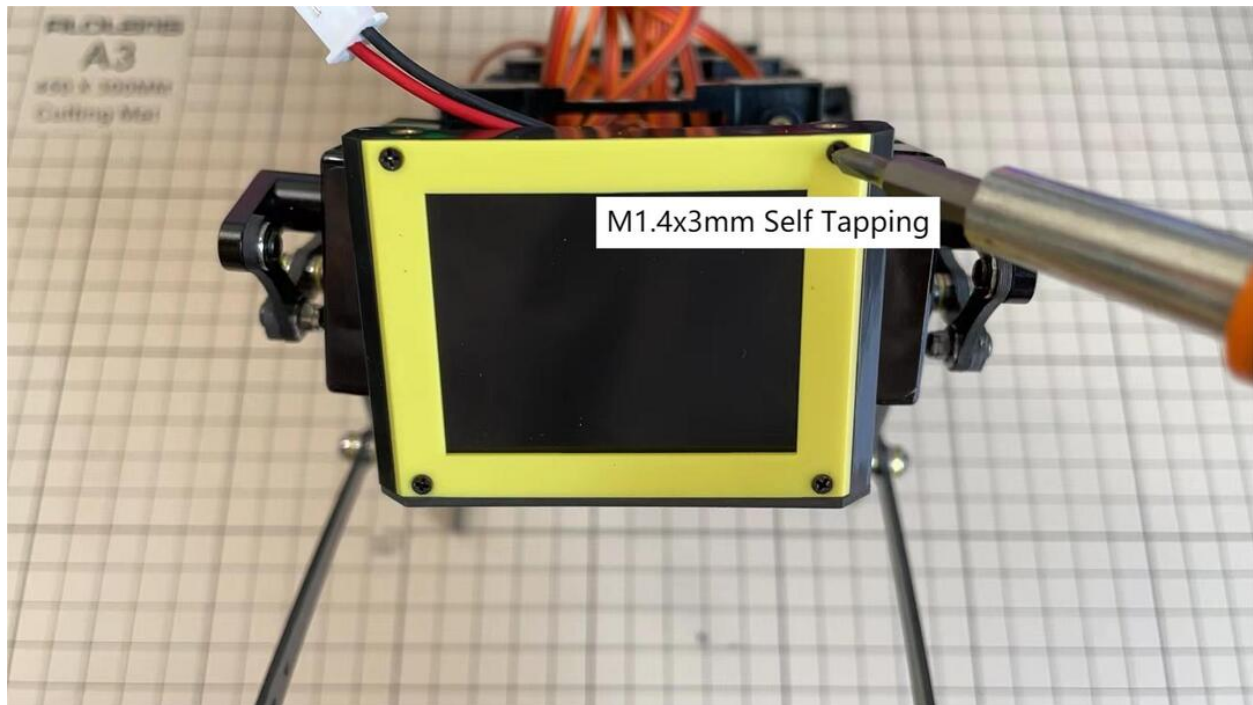






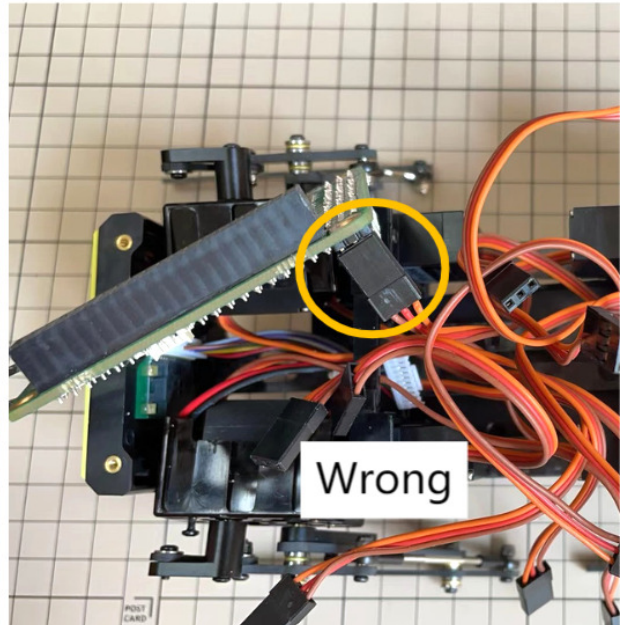
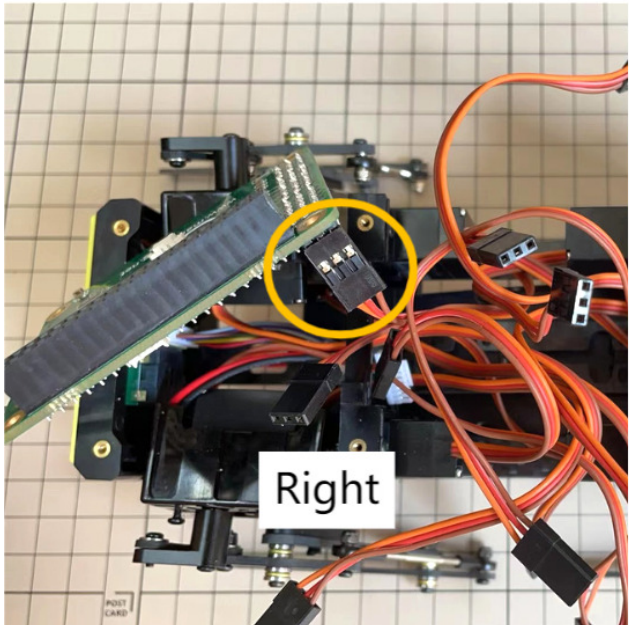
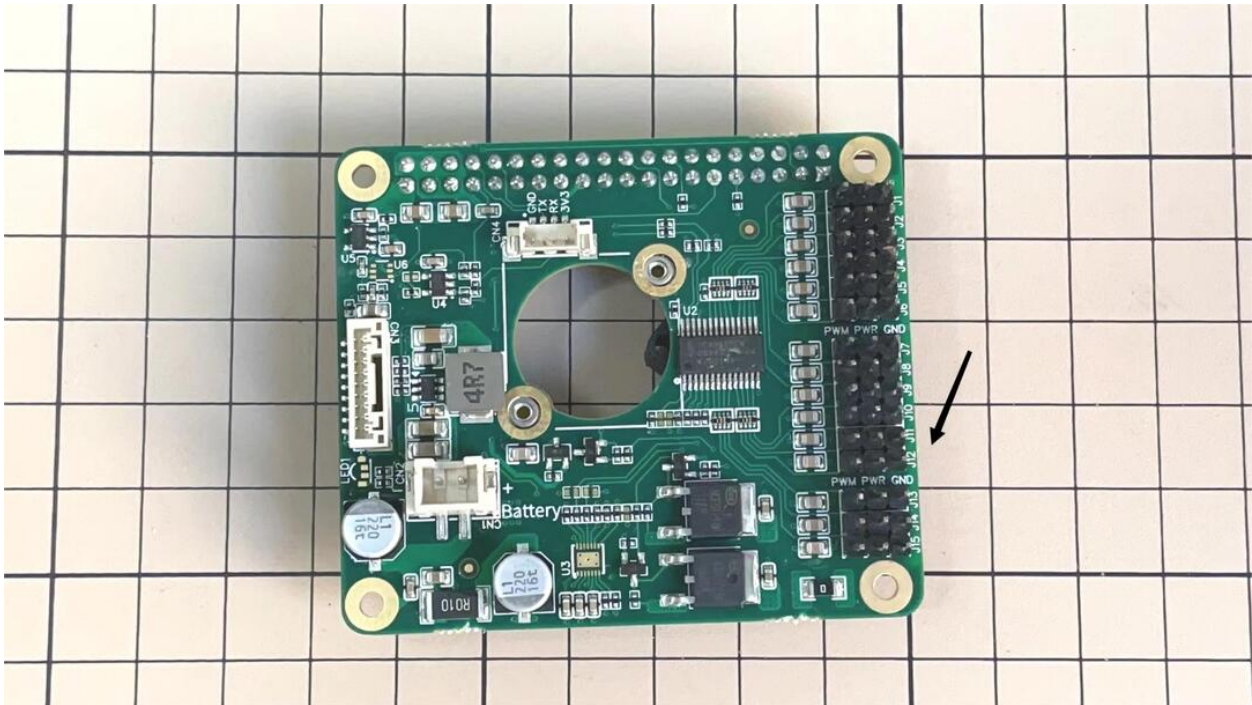
- Be careful with the yellow parts as it has a front and back.



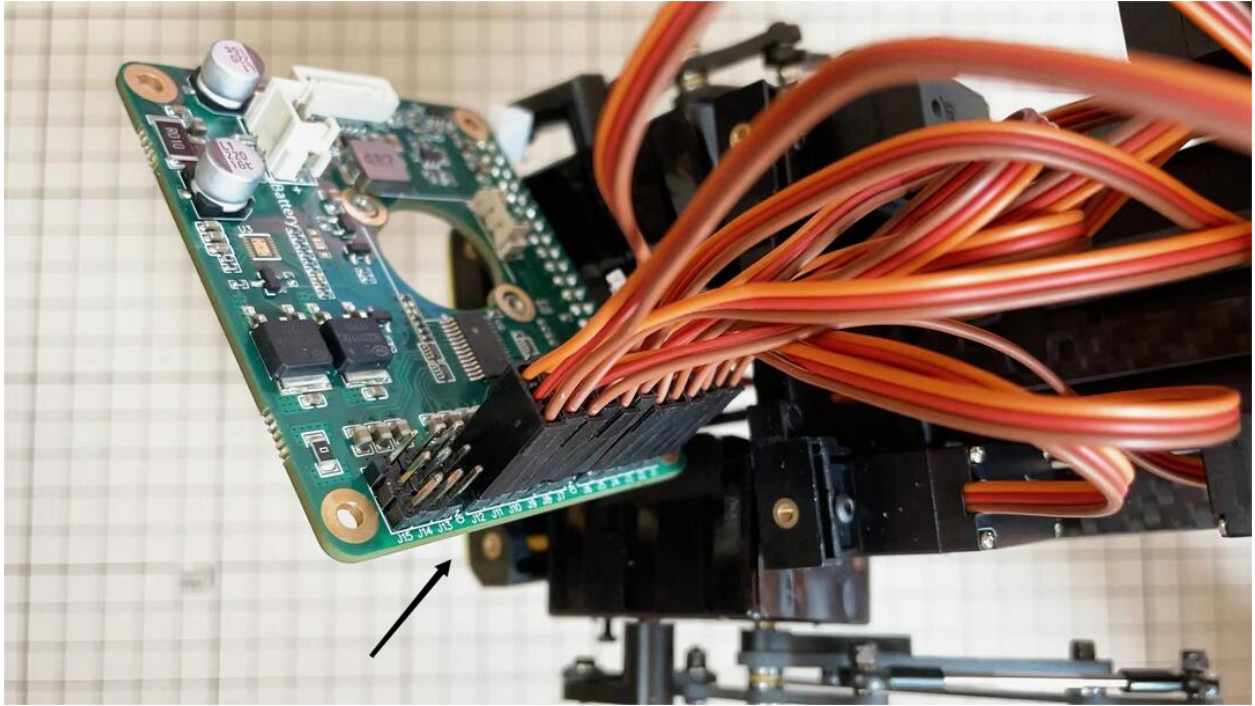


Step 5.7 Custom circuit board

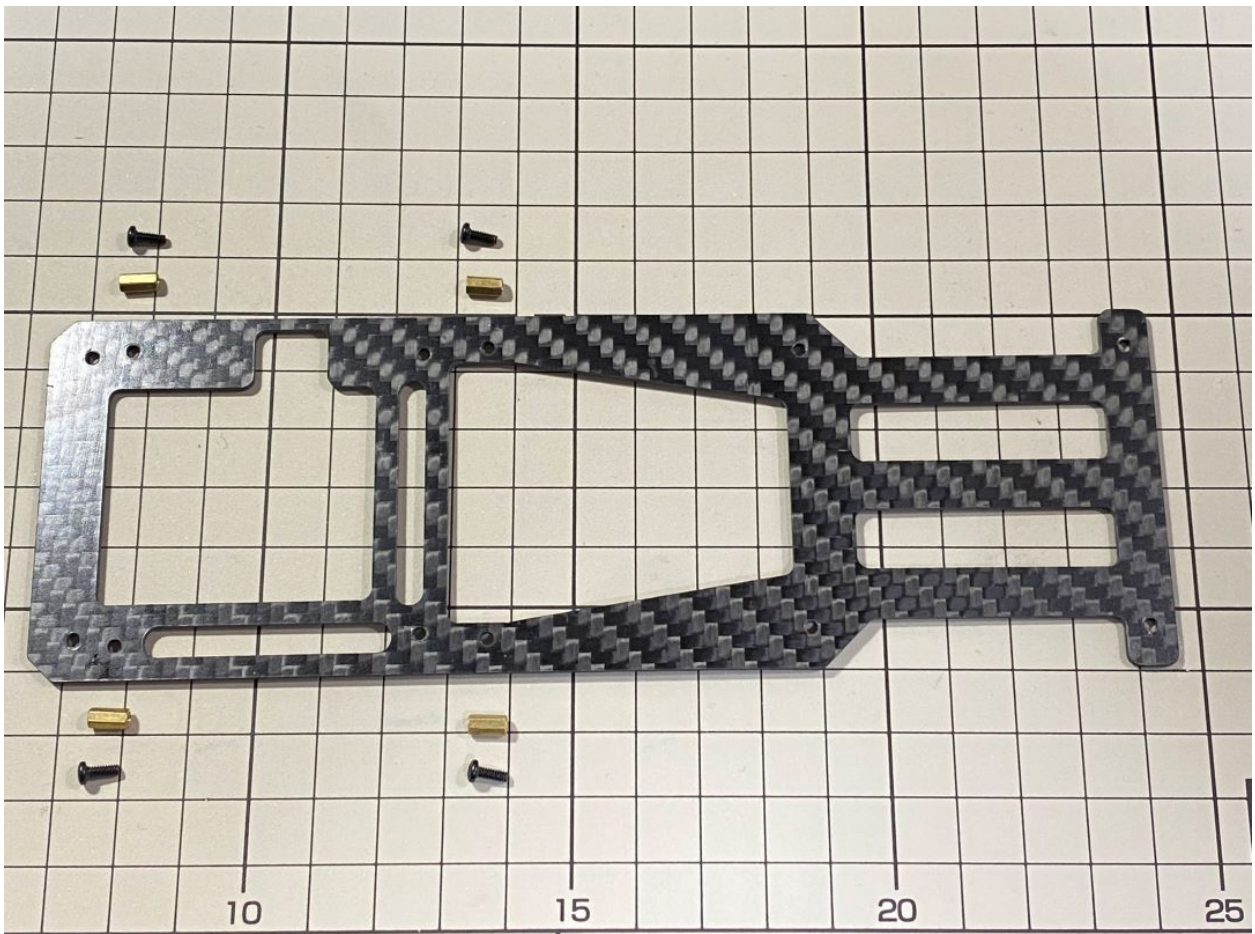
- Plug the display cable into the custom circuit board.

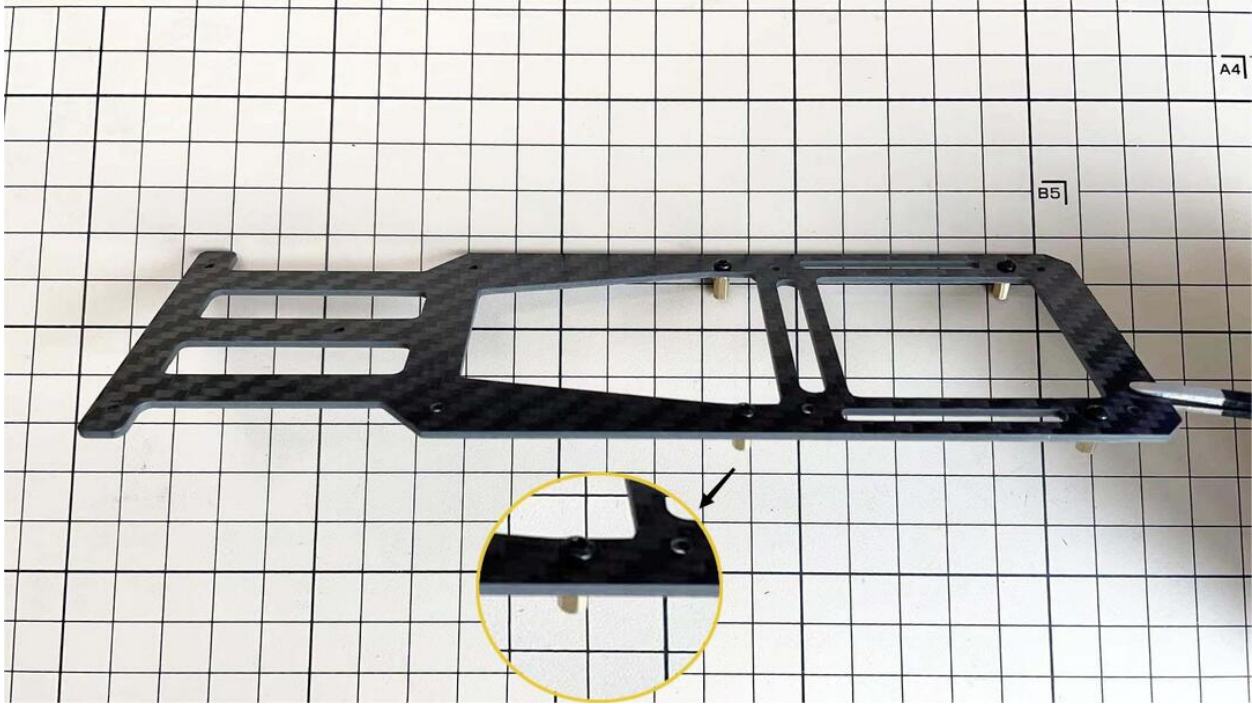


- Insert the 12 servo cables. In the picture, you can see: J1,J2,J3.... J12.

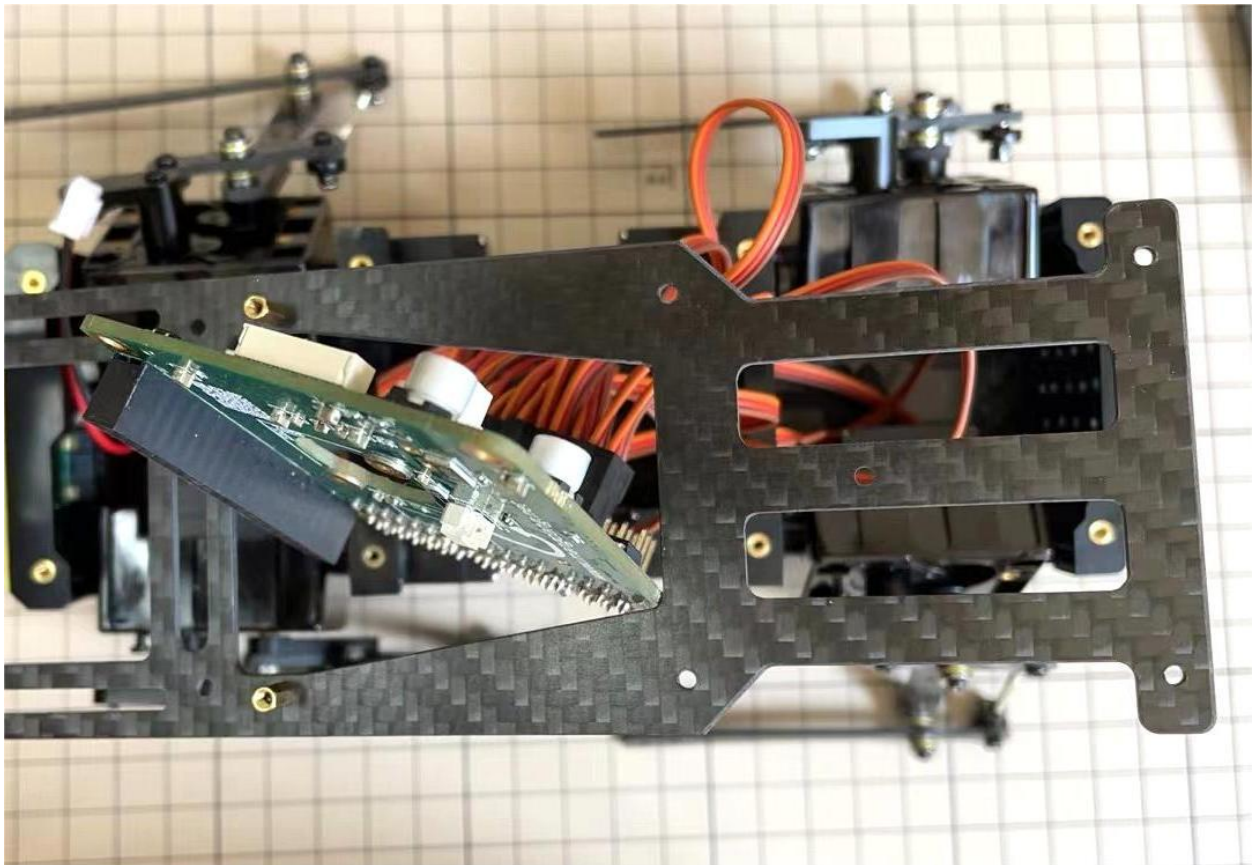


- Use four M2x5mm screws and four short supports.

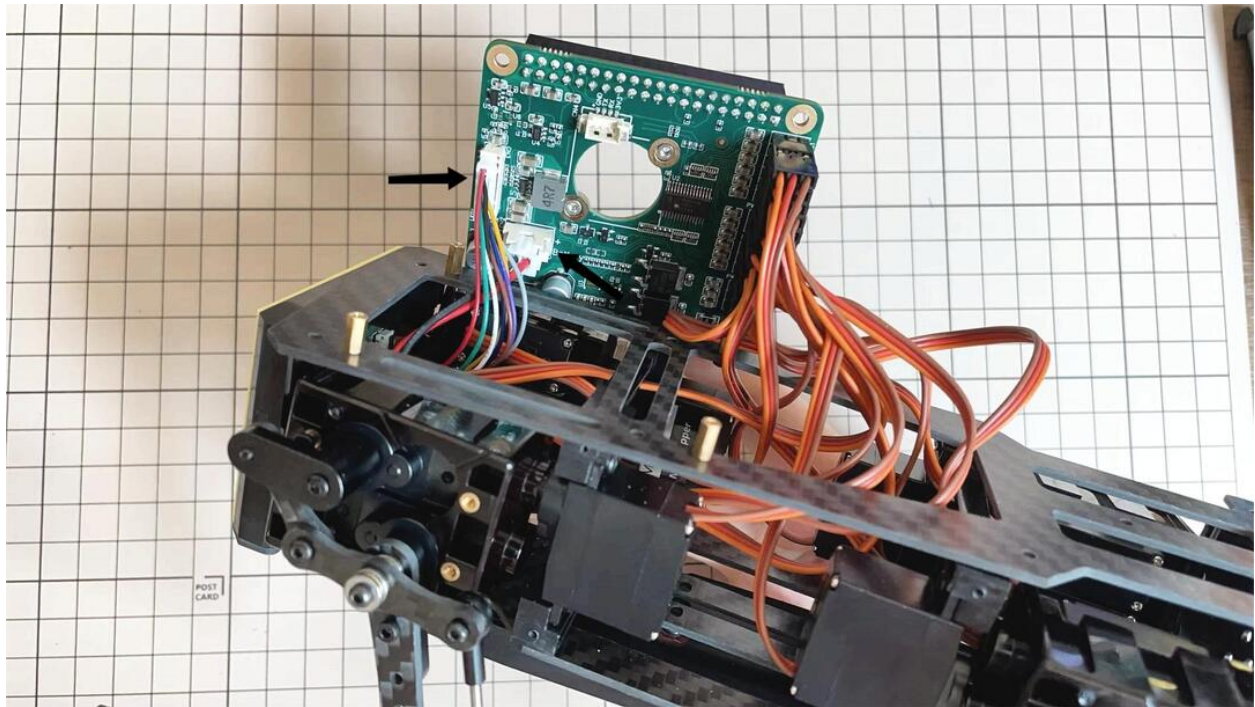




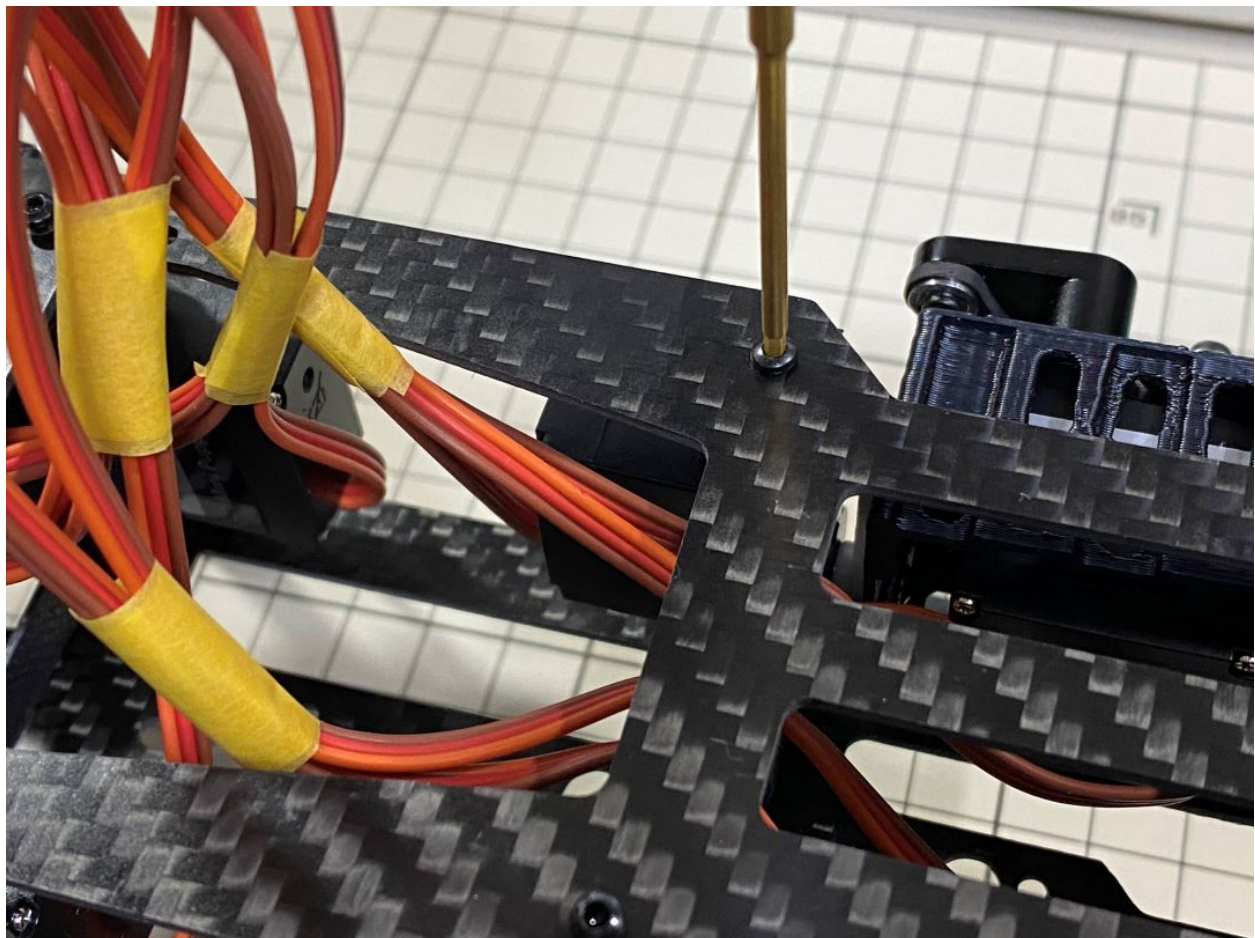
- put on the carbon fiber board



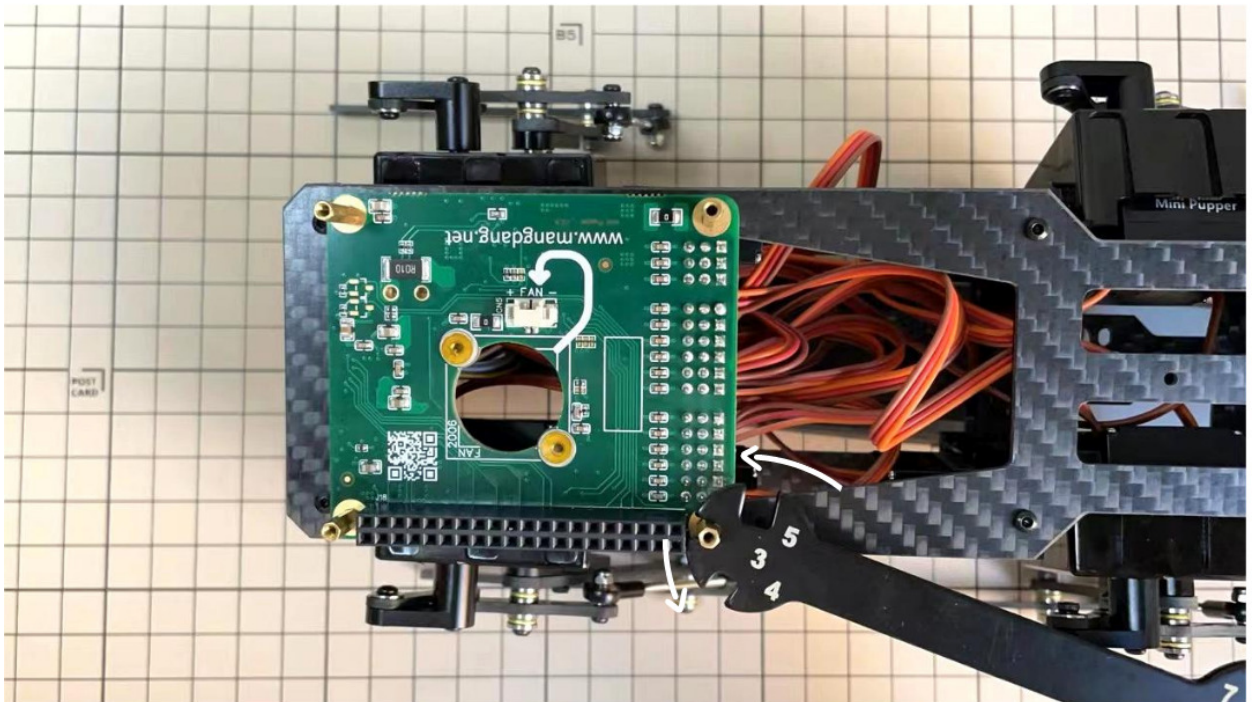
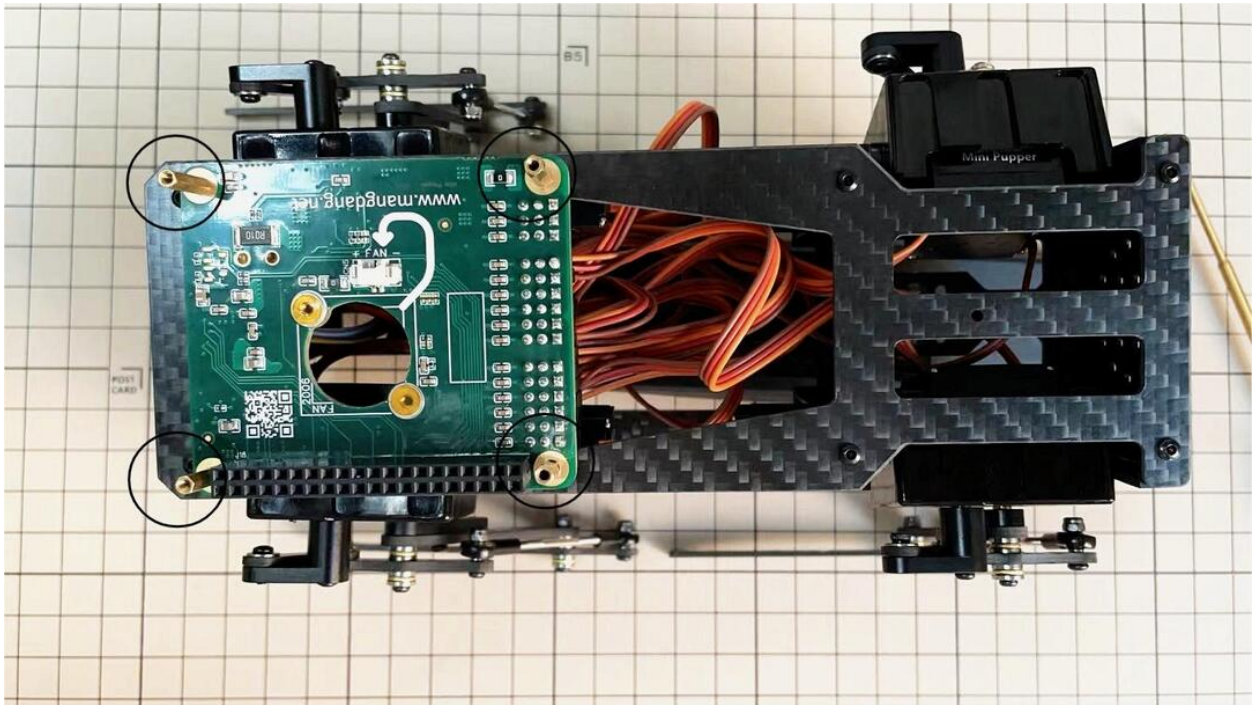
- plug in the battery cable. This connector may interfere with the hips parts, so you have to slide it through a hole in the middle of the board.

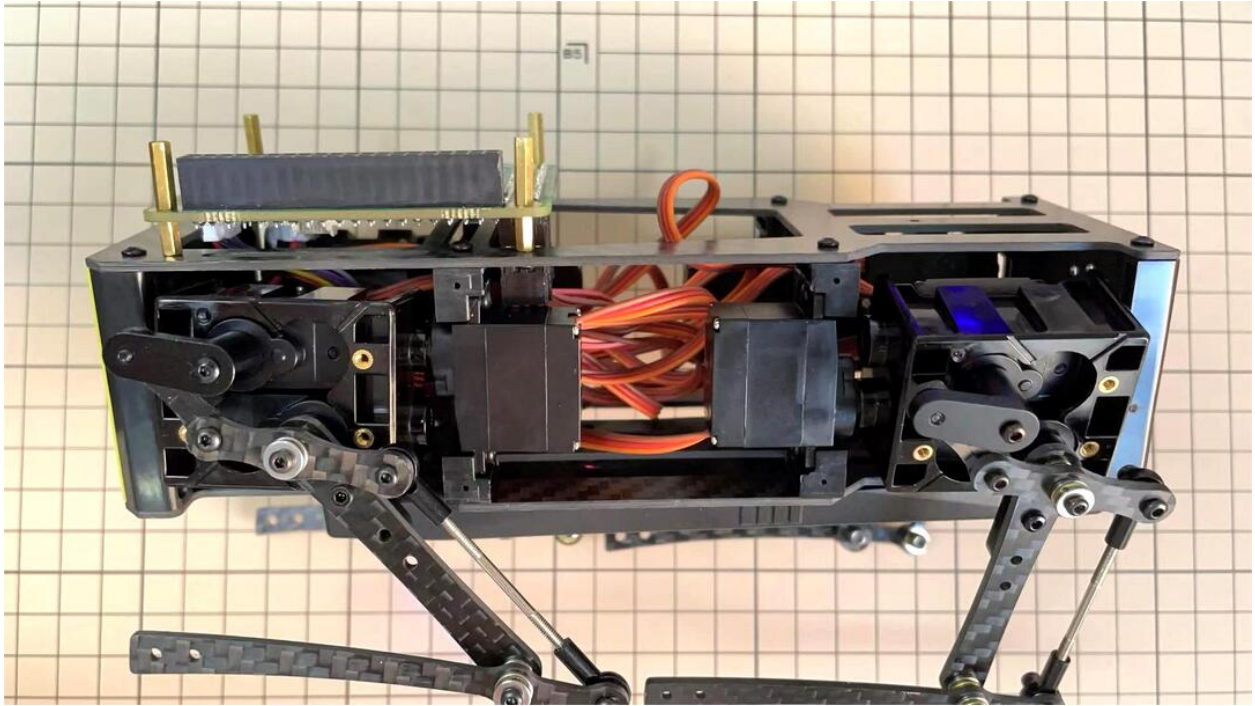


- Use eight M2x5mm screws. The orientation of the plate must be such that the large opening is at the front.

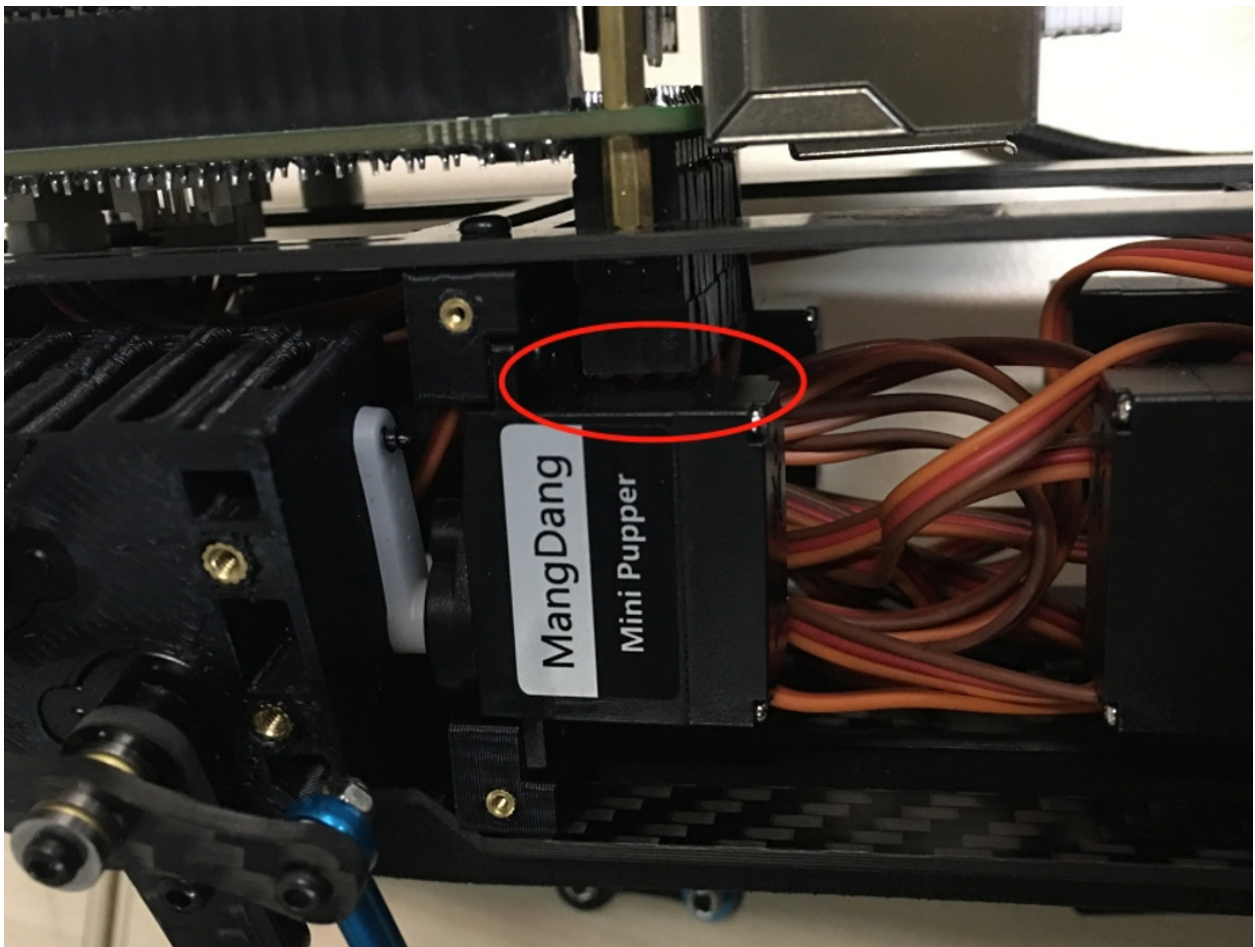


- Pull the custom circuit board closer to the body. The board may float, but you can use four long posts to hold it in place.



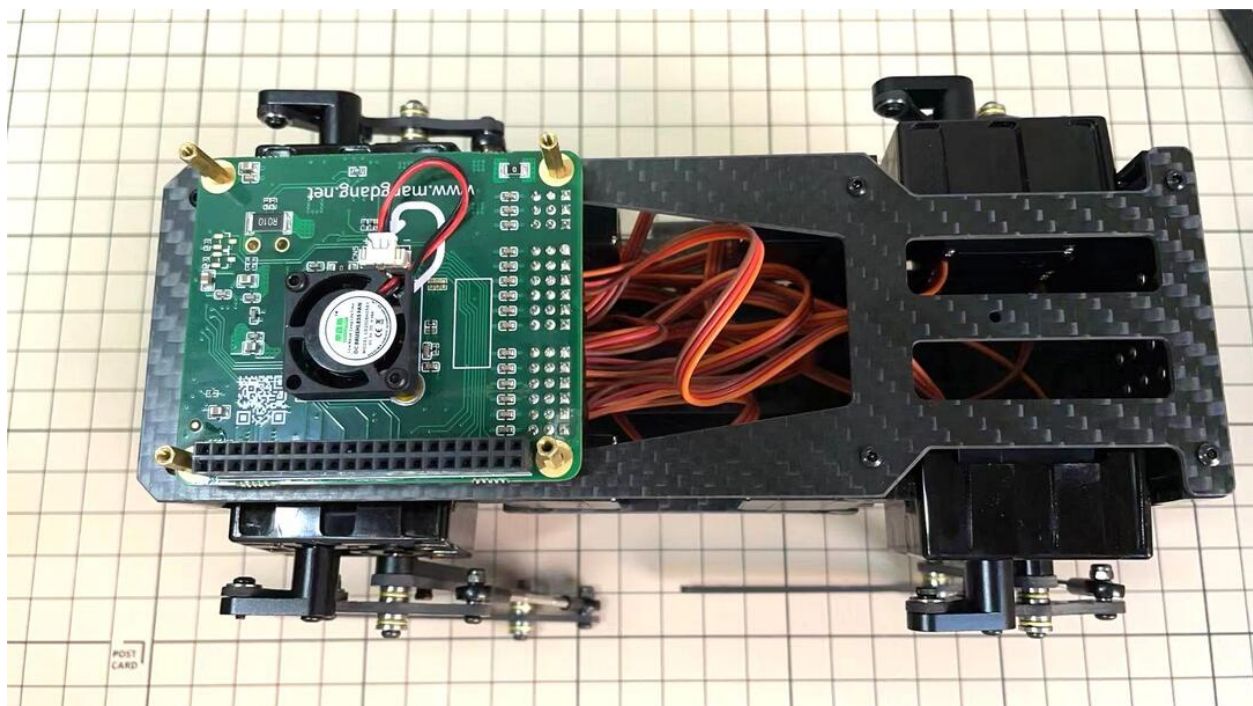
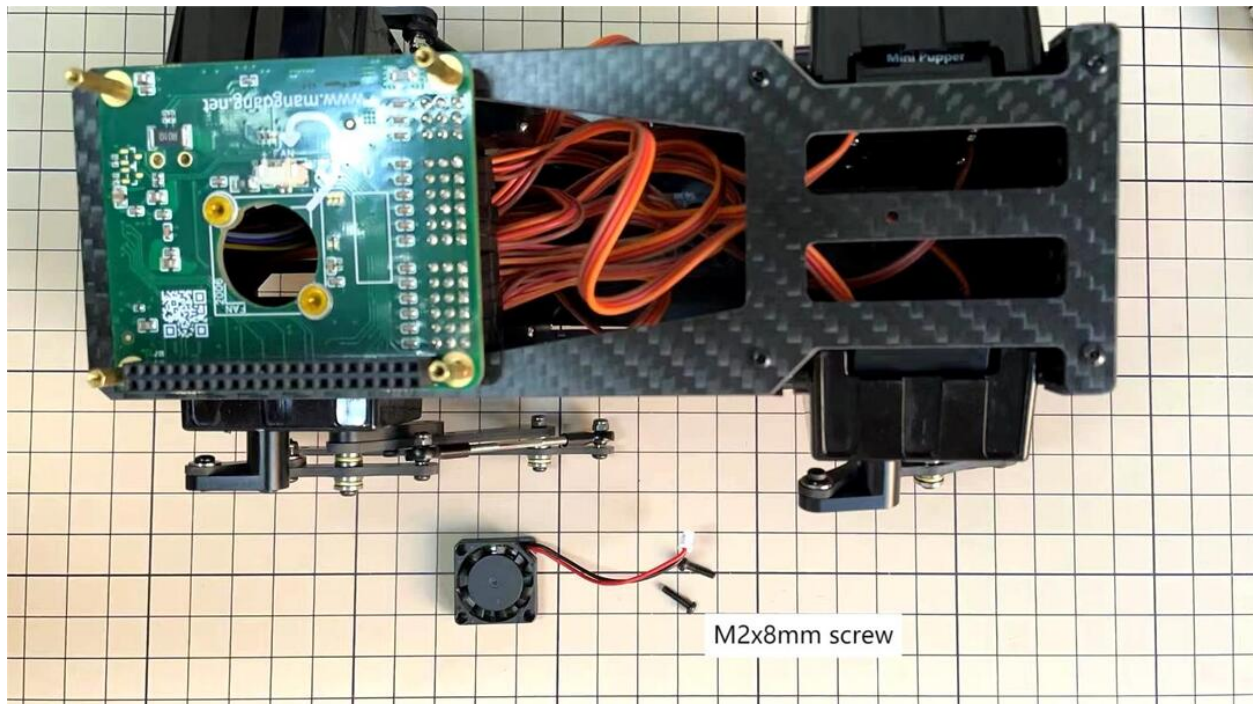


* Need to pay attention to the cable of the No. 1 servo to prevent it from being overwhelmed.

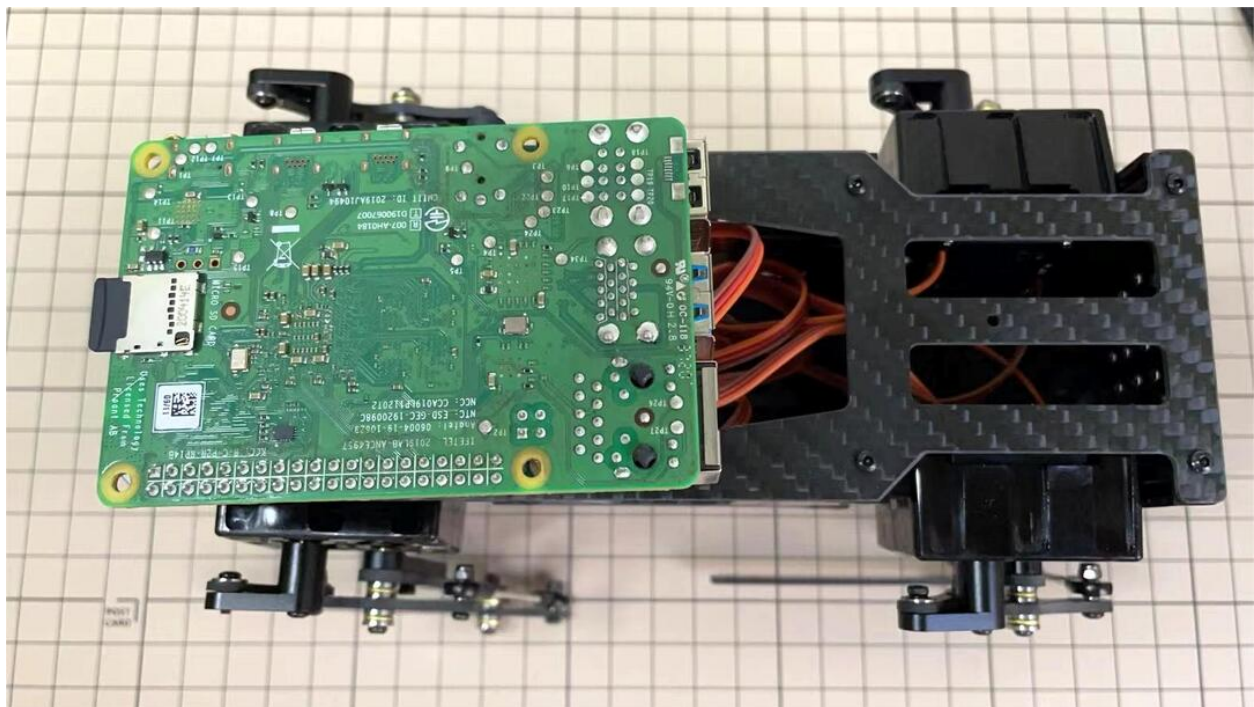
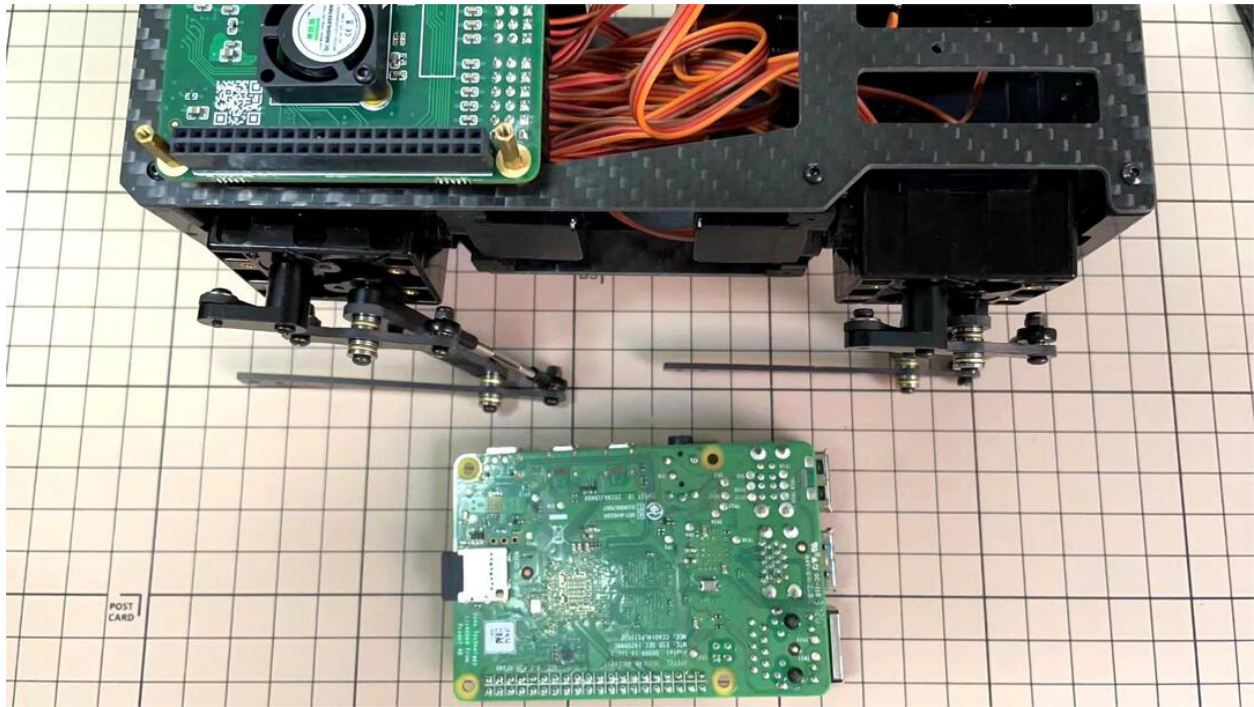


Step 5.8 Fan

- To install the fan.



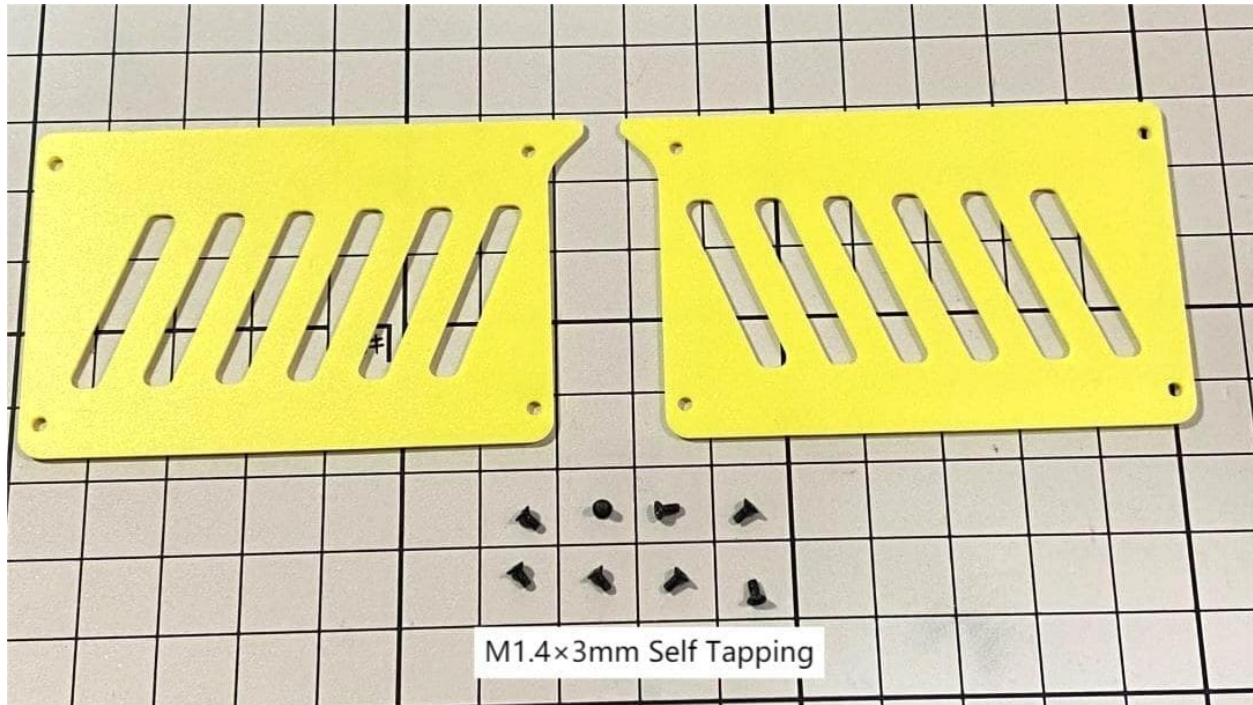
Step 5.9 Raspberry Pi 4

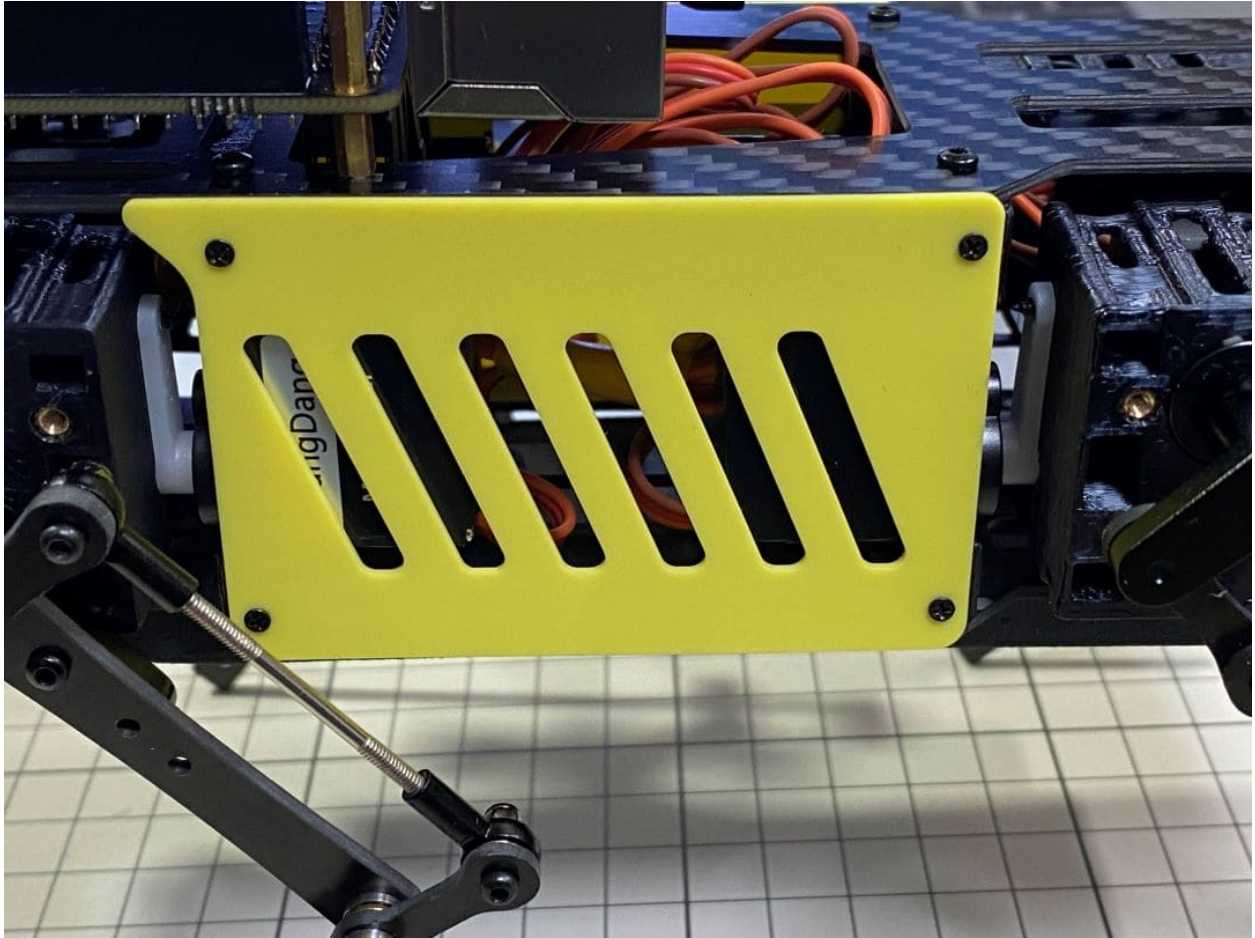


6. Cover Assembly

Please refer to the below video clip.

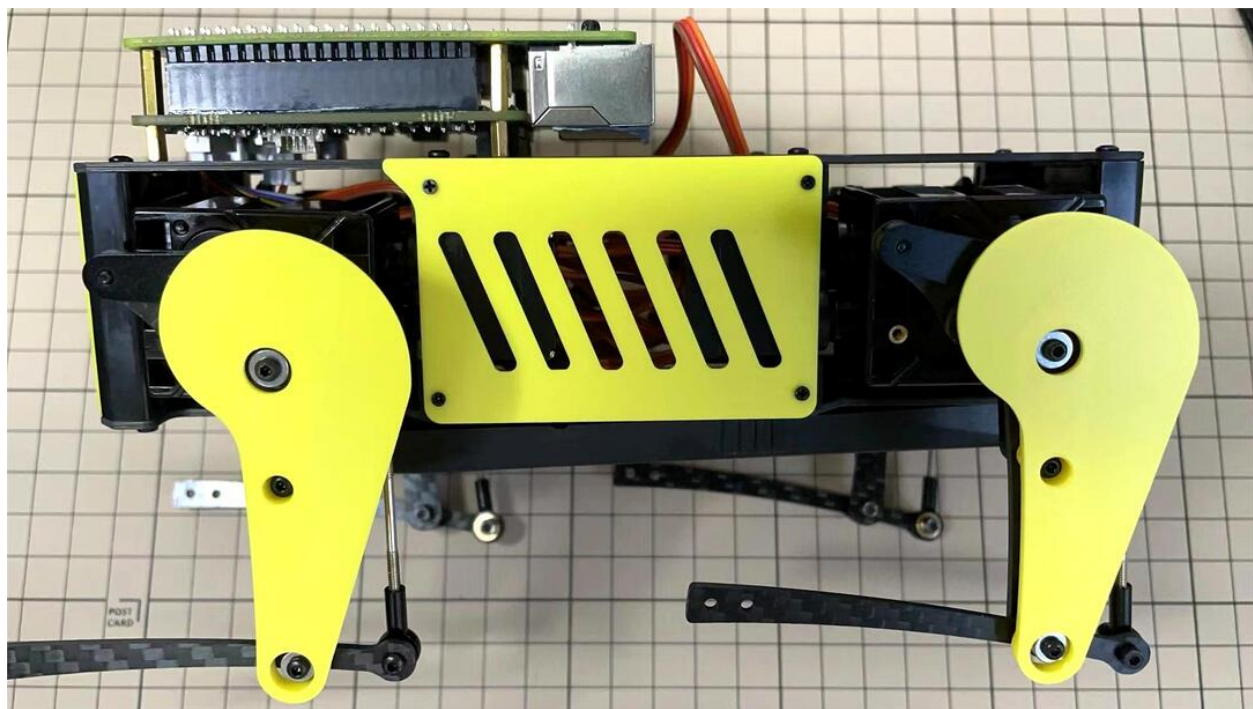
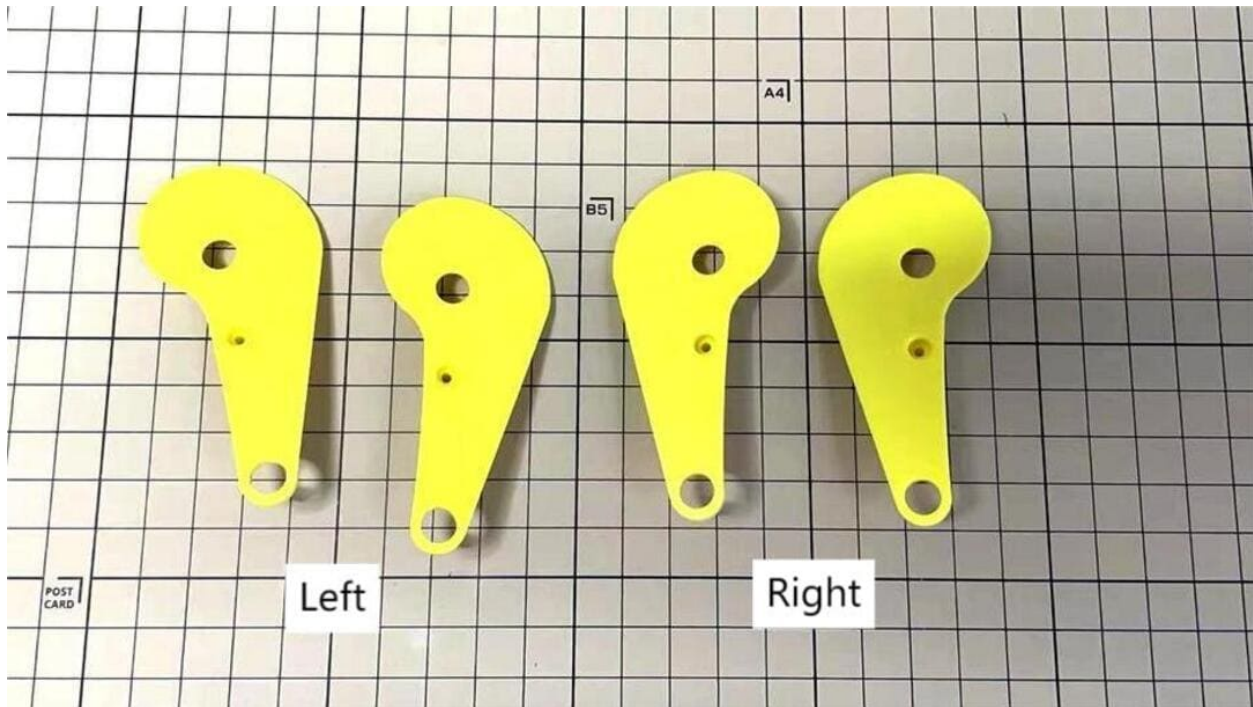
Step 6.1 Side panels





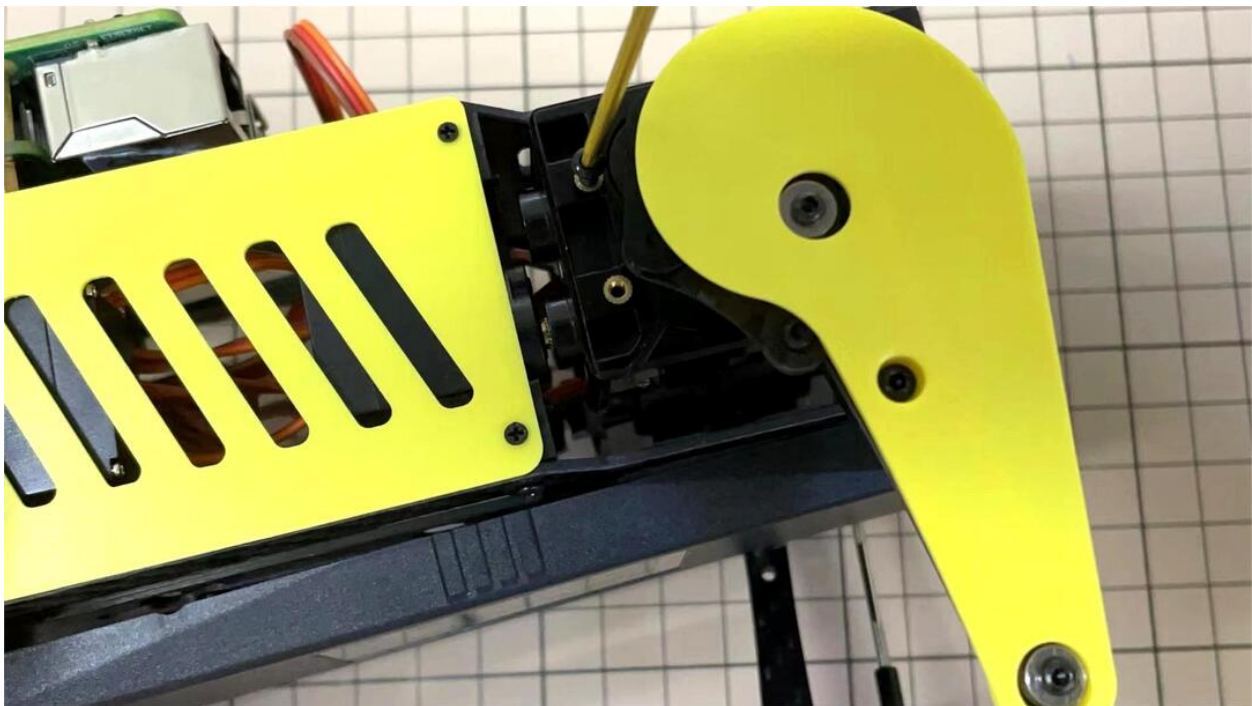
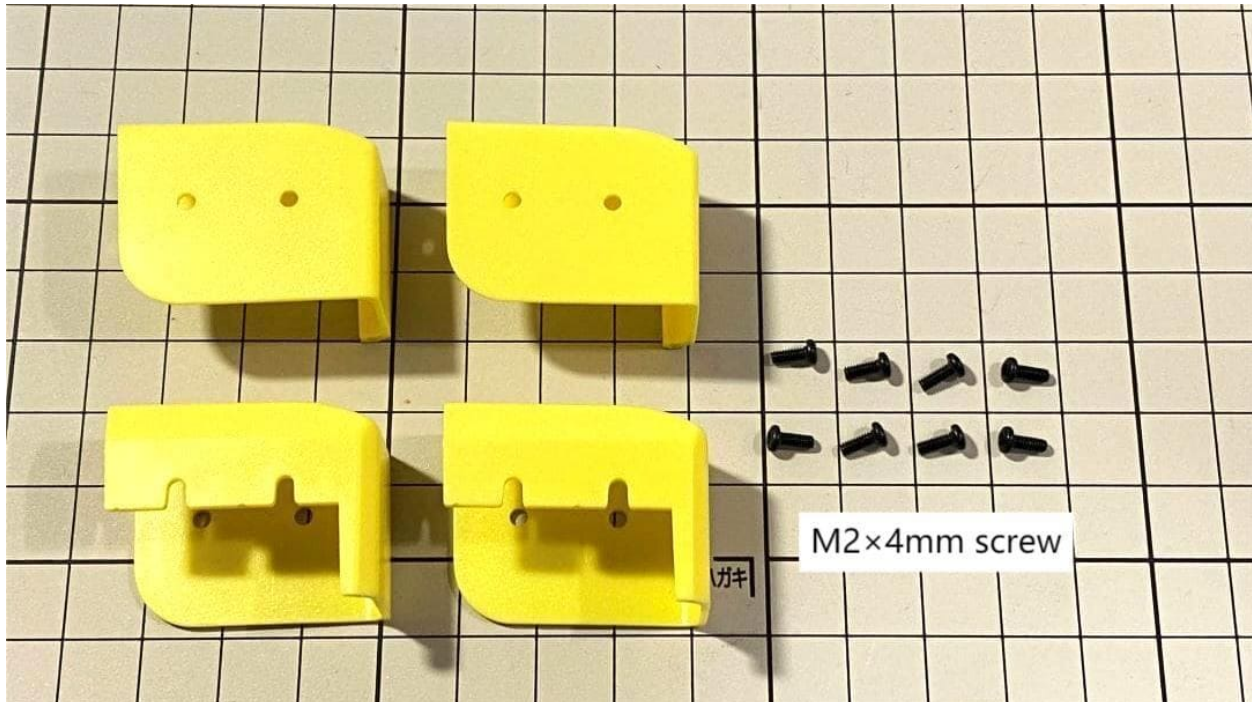
Step 6.2 Shin guards

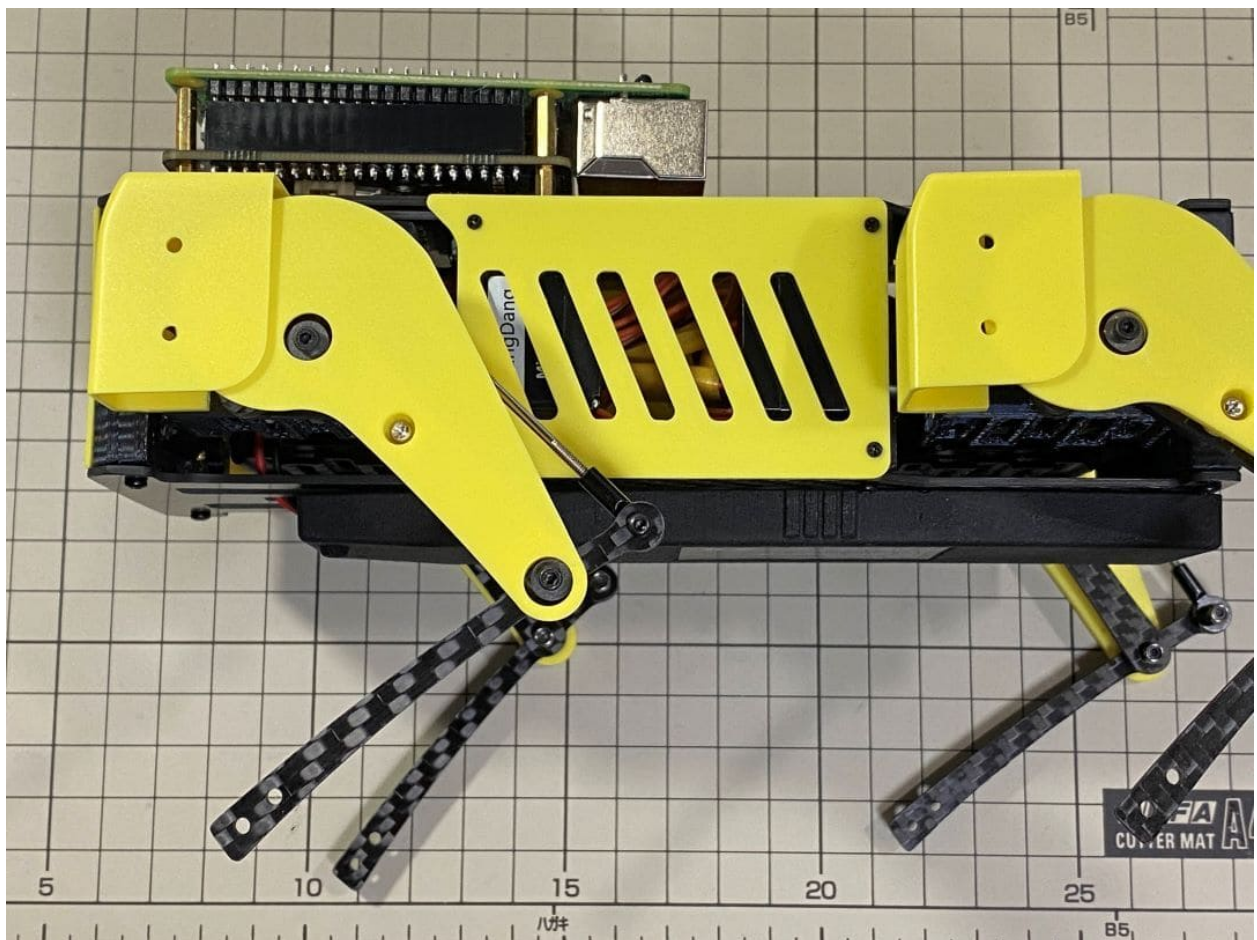
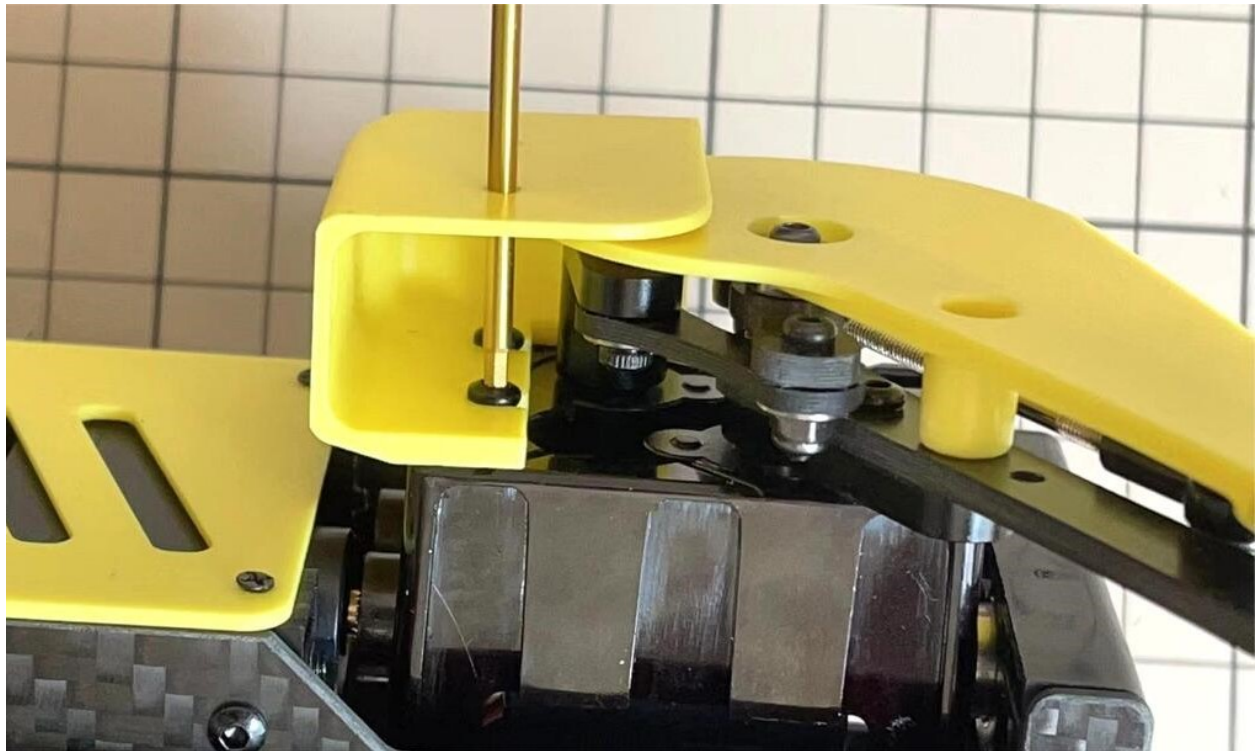
- Use four M2x10mm countersunk screws.



Step 6.3 Shoulders

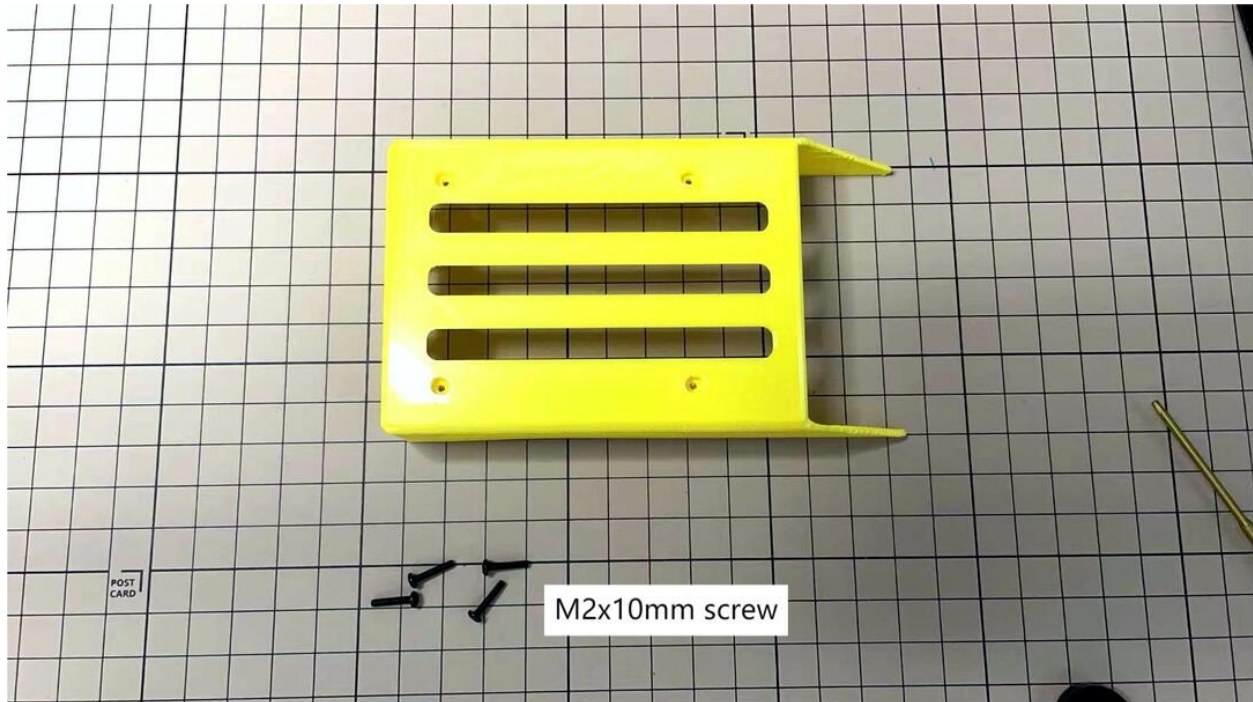
- Insert only the screws first and then insert the shoulder parts into the gap. Insert the 2 mm hex driver into the hole in the shoulder part and tighten the screws.

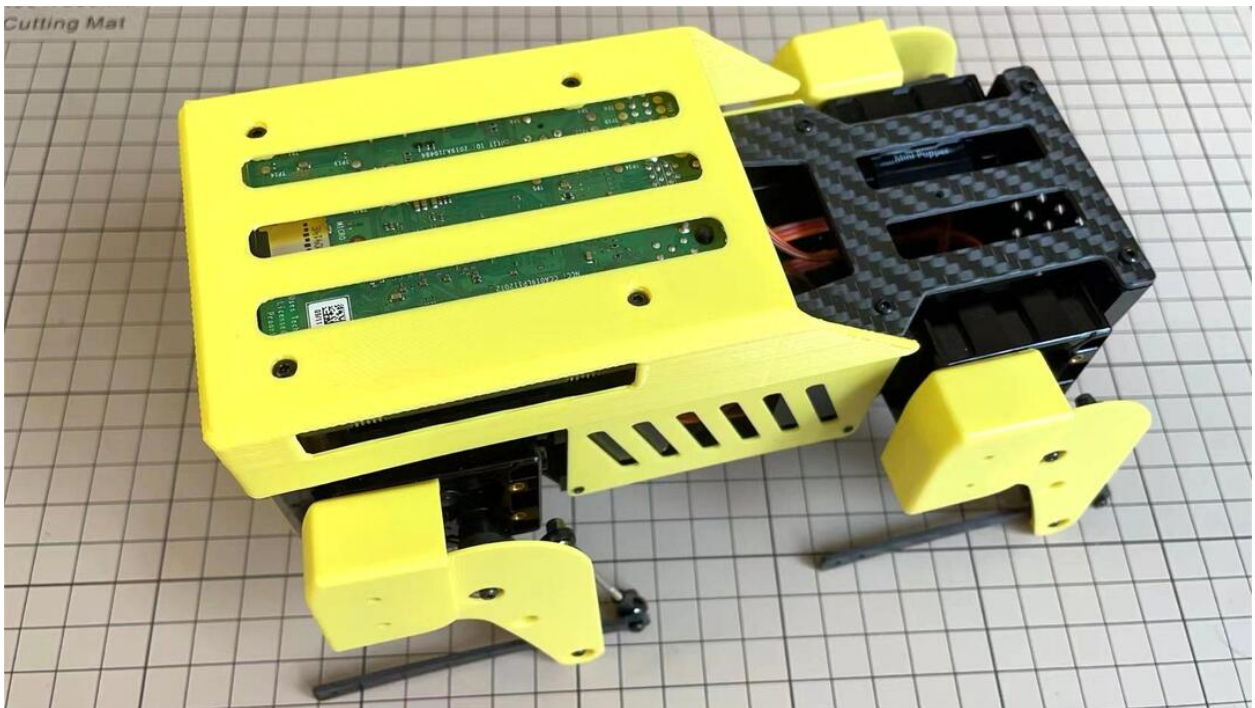
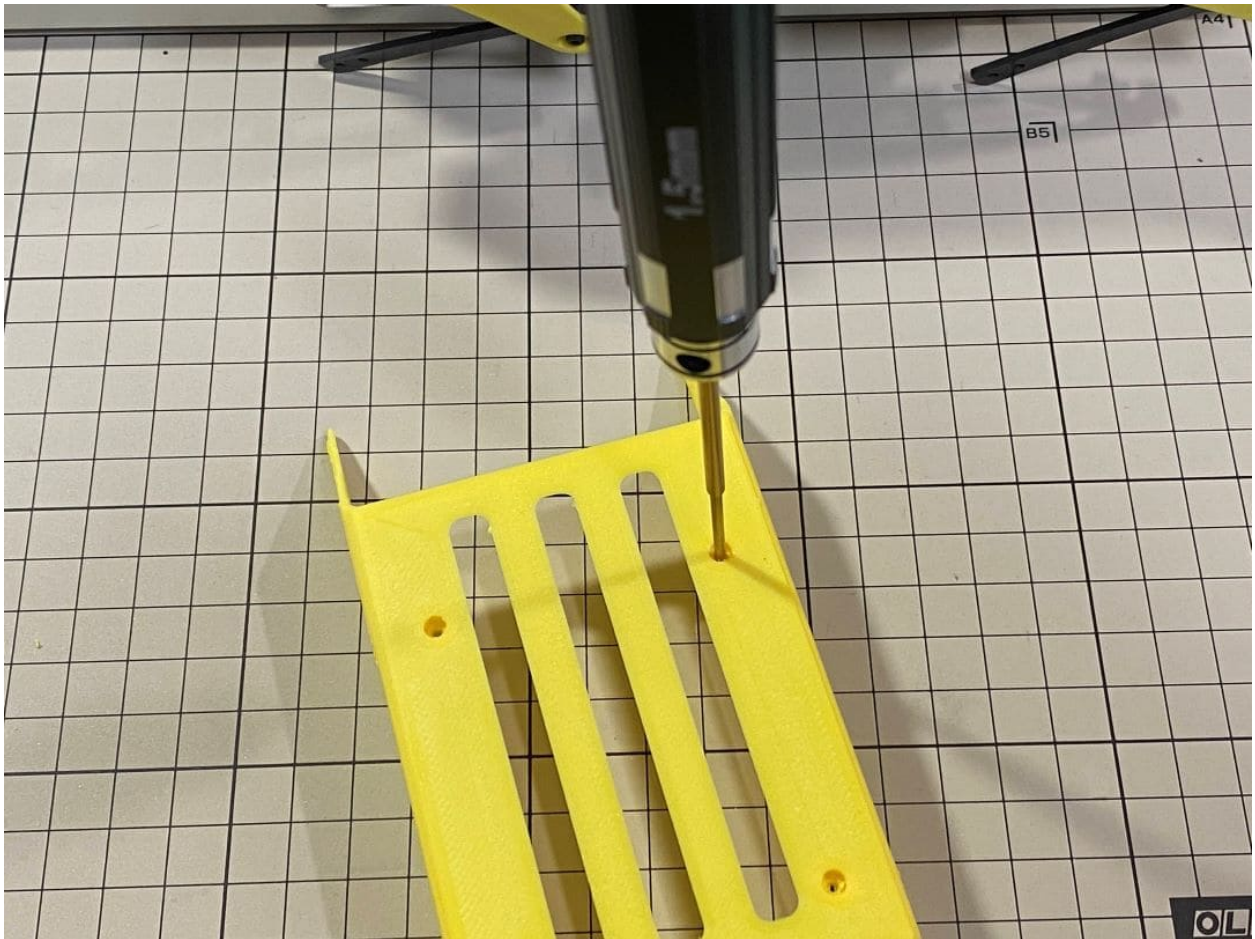




Step 6.4 Top cover

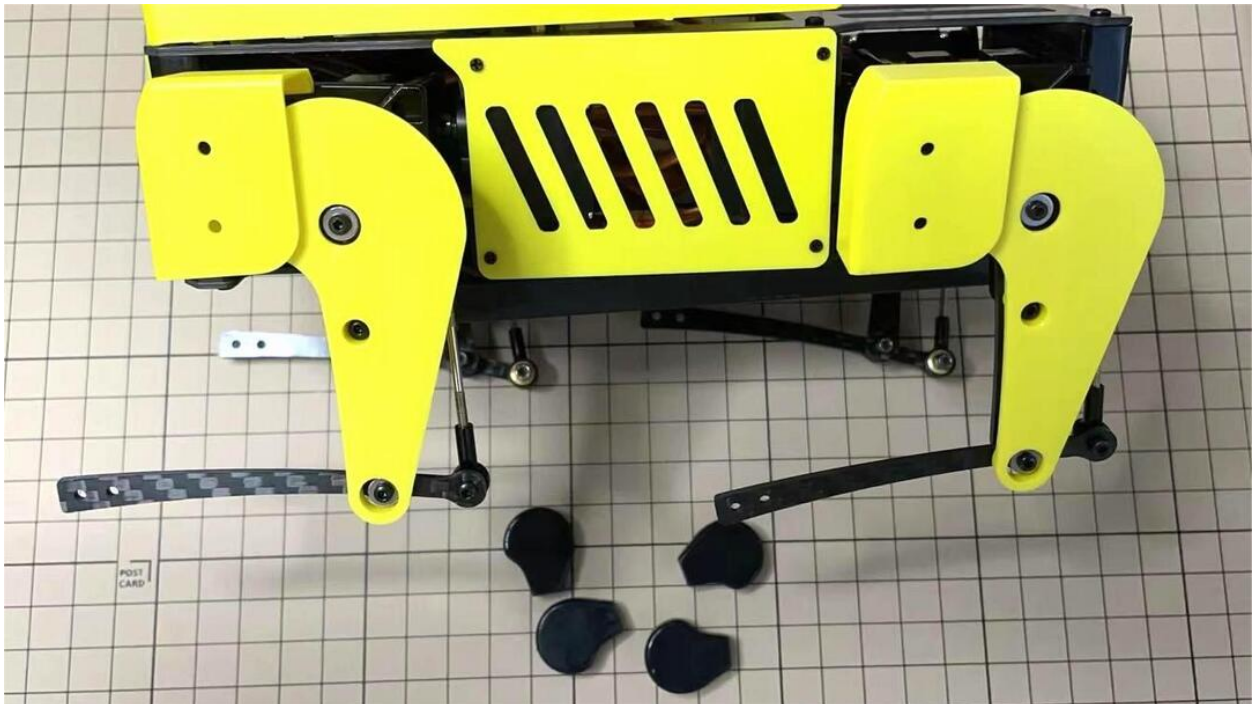
- Use four M2x10mm screws, if the holes are too small to fit the screws, as the part is made with a 3D printer, you can enlarge the holes by turning them with the supplied 2mm hexagonal screwdriver.





Step 6.5 Shoes

- Put on 4 shoes.



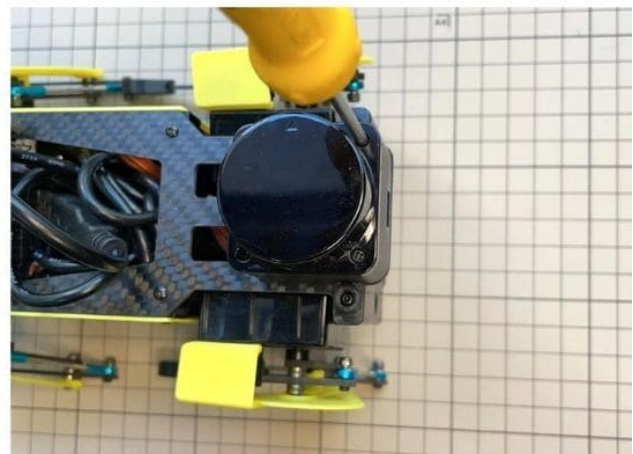
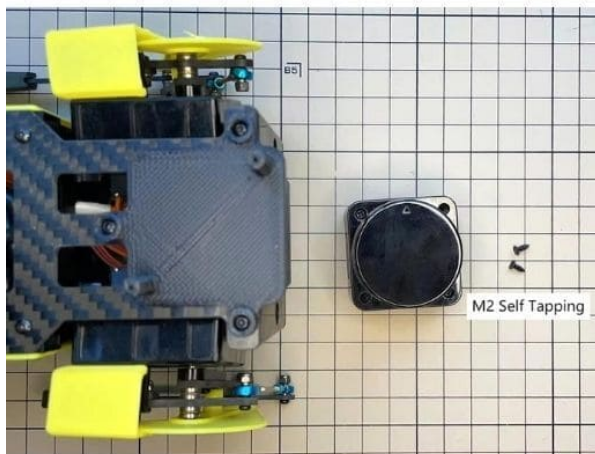
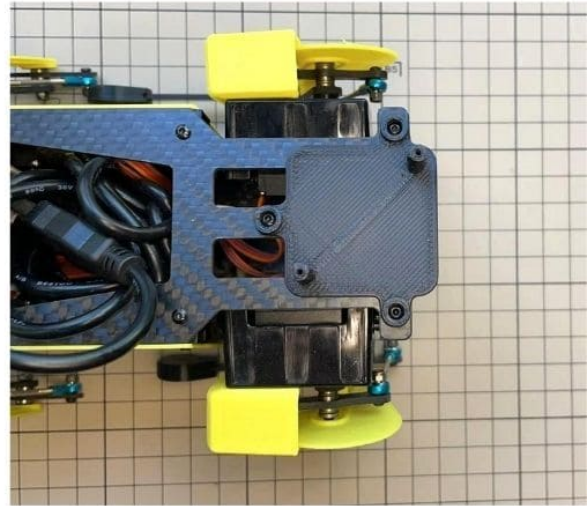
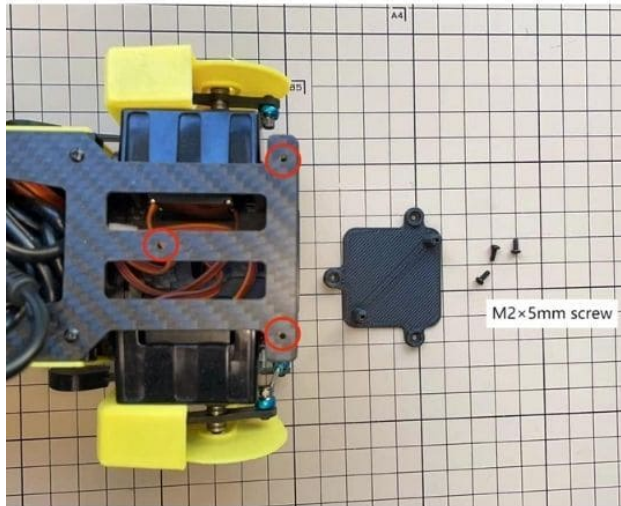
Step 6.6 Completion!

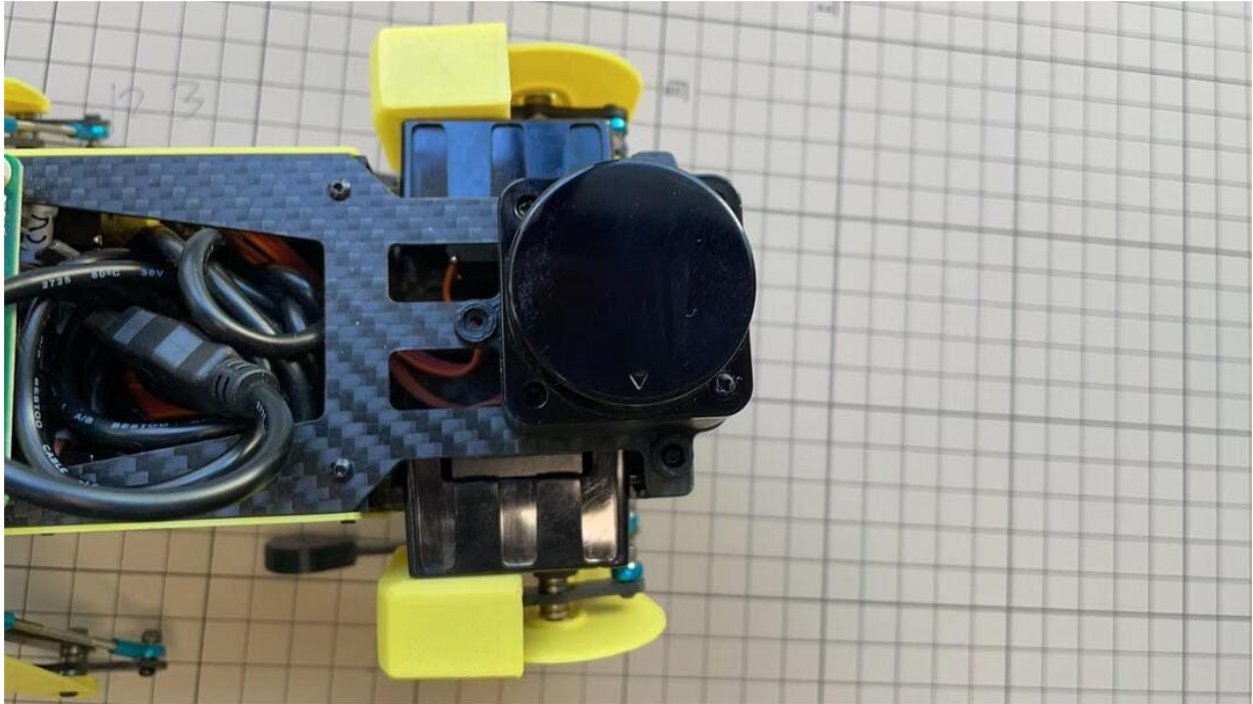


7.Add-On Assembly

Step 7.1 Lidar

If you order the Lidar, the Lidar holder will be shipped together.

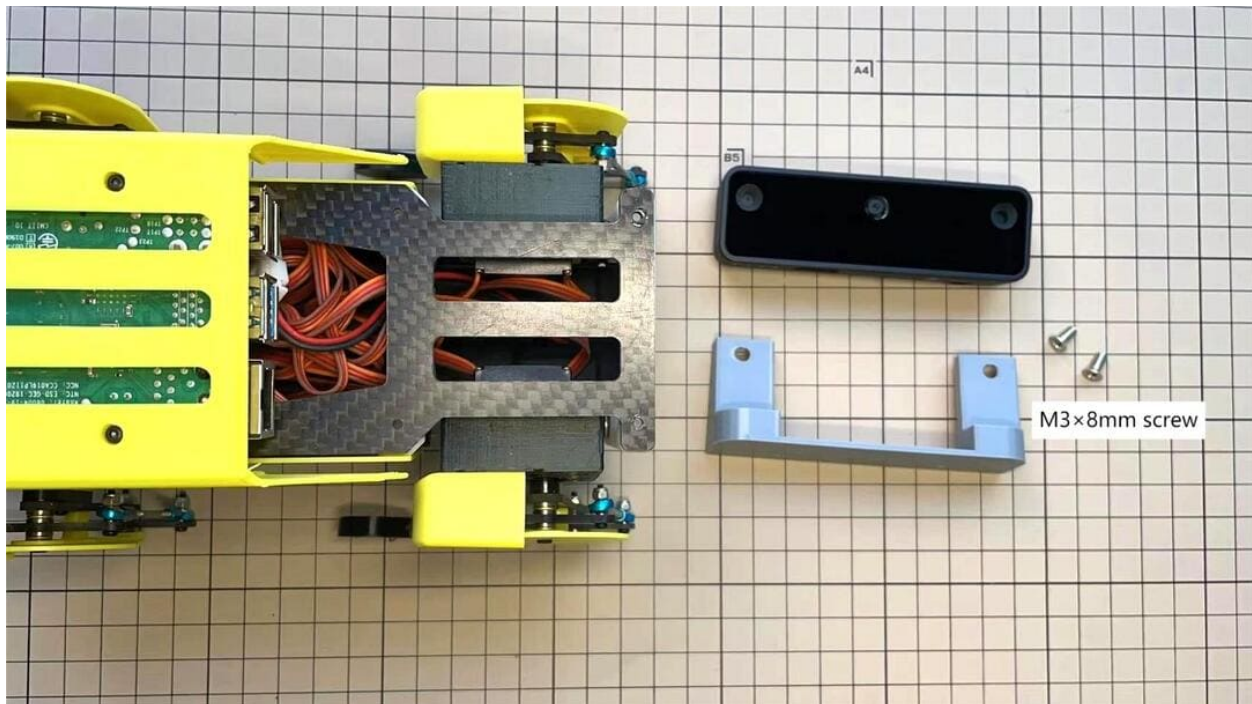


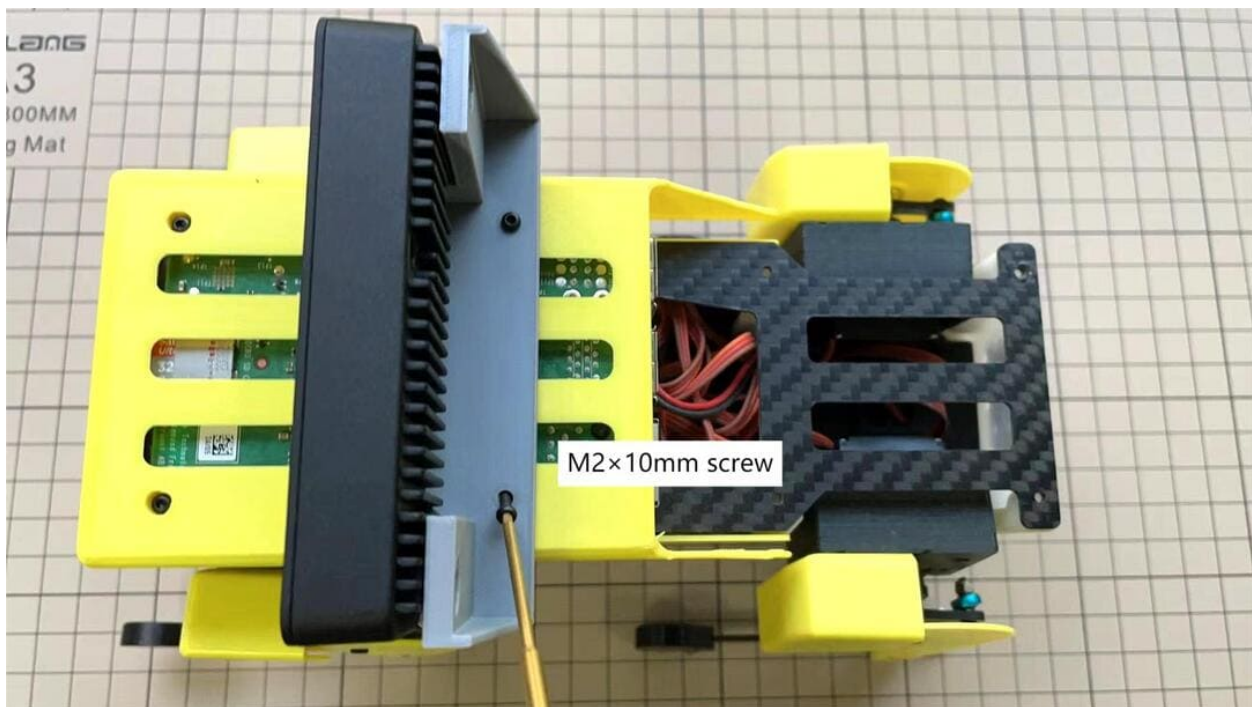
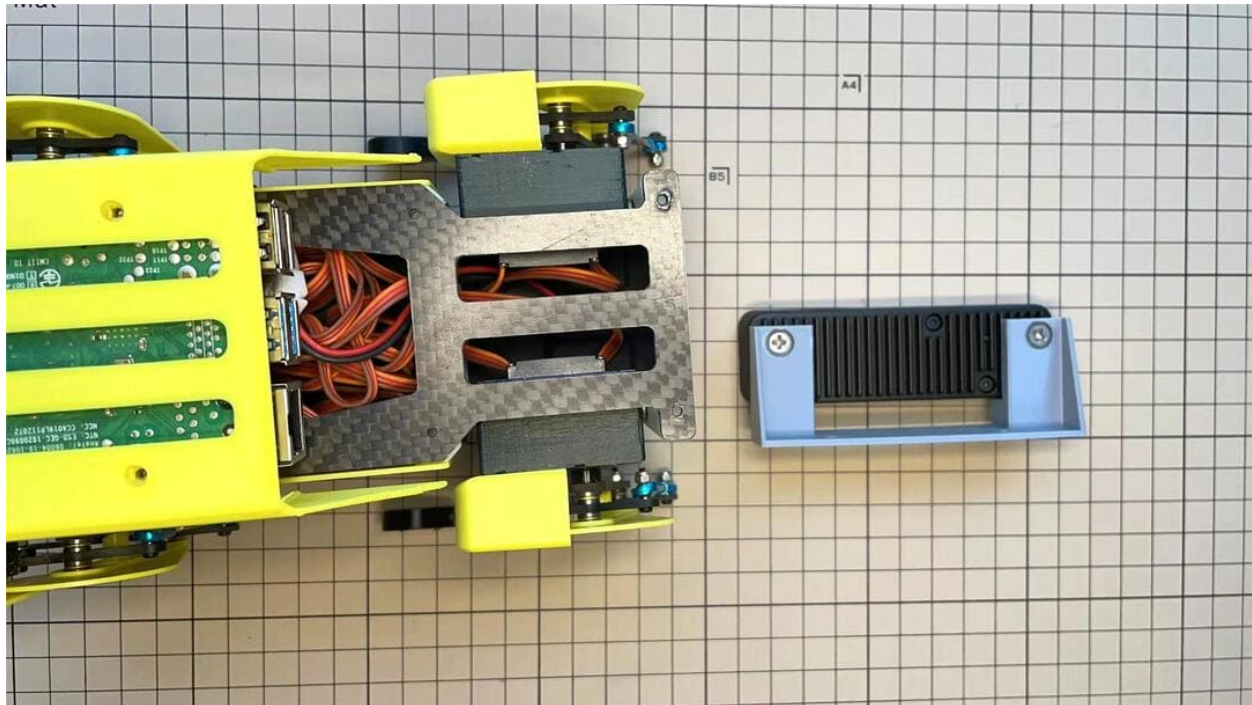


Step 7.2 Camera

If you order the camera, the camera holder is not included in the kit. But you can 3d-print it from the stl file down below.

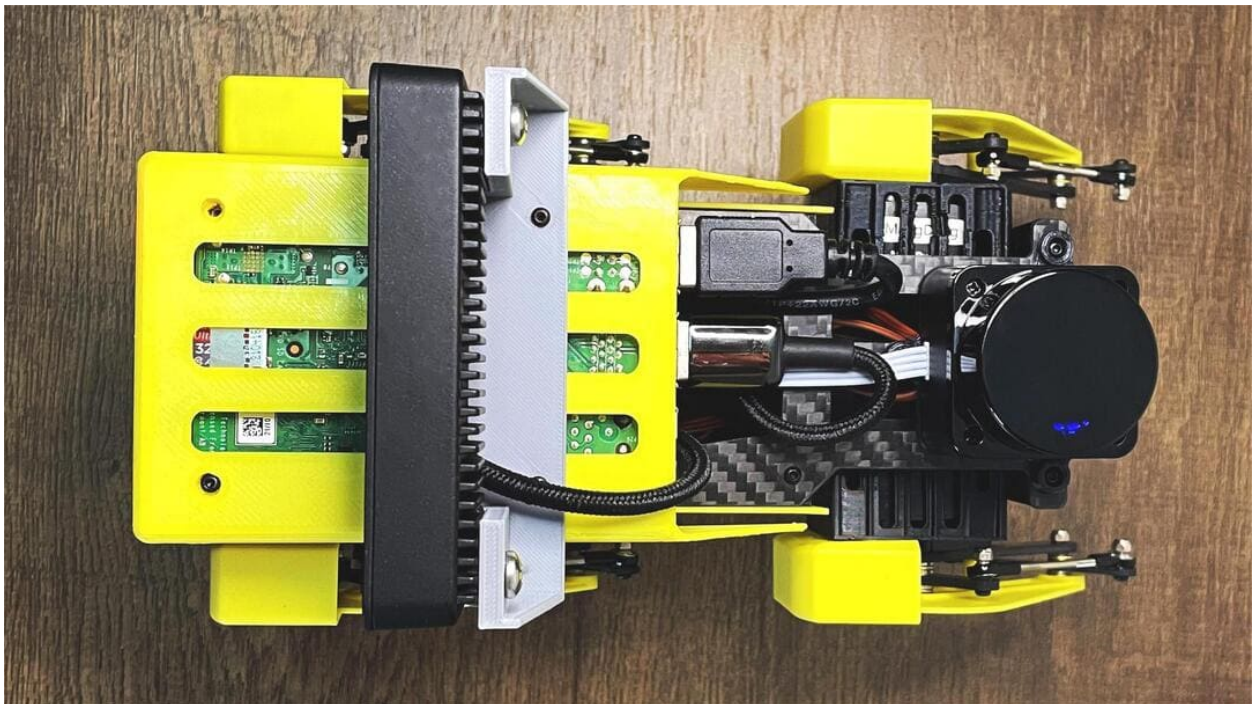
<https://drive.google.com/drive/folders/11RADDbAt7mSBJE4j8HCji1WbWcpneUED>





Step 7.3 Completion!





1.2.5 Assemble Mini Pupper 2

Contents

- *Assemble Mini Pupper 2*
 - *1. Write the pre-built image into microSD*
 - *2. Position of the screws*
 - *3. Legs Assembly*
 - *4. Display and Frame of face*
 - *5. Body Frame and Hips Assembly*
 - *6. Cover Assembly*
 - *7. Add-On Assembly*

This is the video clip for the complete kit, please refer to the below sections for detailed steps.

Please also refer to Mini Pupper 2 Fusion 360 CAD model: <https://a360.co/485n8mP>

1. Write the pre-built image into microSD

Tools

In addition to the tools included in the kit, the following items are required for assembly.

- USB keyboard
- USB mouse
- PC
- microSD card reader
- HDMI Display
- micro HDMI cable
- USB charger

Step 1.1 Charging the battery

- The battery is charged via USB, see picture for USB socket, and can also be charged while attached to the Mini Pupper body.

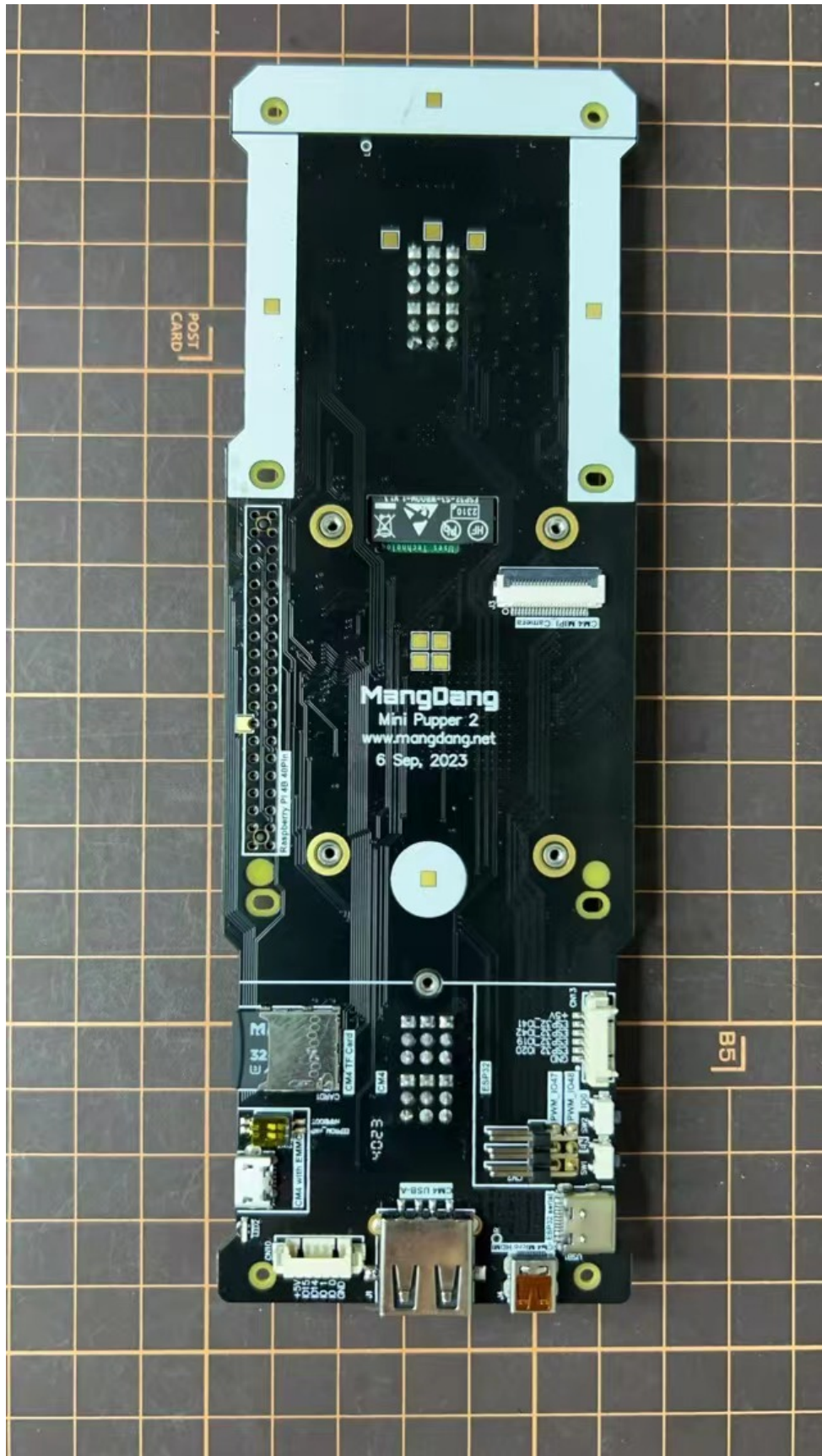
※ LED light: Green means there is enough power, and Red means you need to charge it.

※ We recommend 5V/1A adapter, if you use 5V/2A adapter, the battery IC will change it to 1A. It needs about 1 hour to charge 80% and the light will become green, and an additional 1 hour to 100%, anyway, you can use it when the light becomes green.



Step 1.2 Download the image

- You can download the pre-built image files from [Mini Pupper pre-built images](#)
- ※ “xxx_stanford**.img” means the image is for Ubuntu 22.04 version.
- The picture below is the custom carry board.



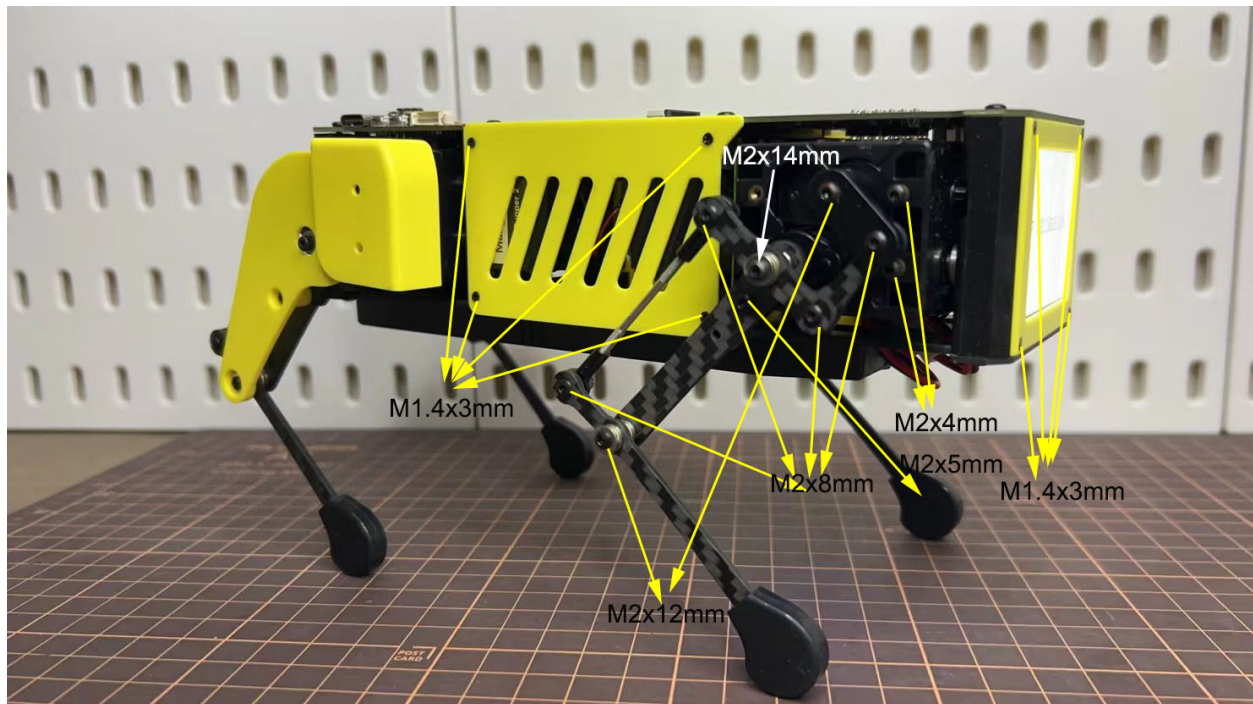
Step 1.3 Write the image into a microSD card

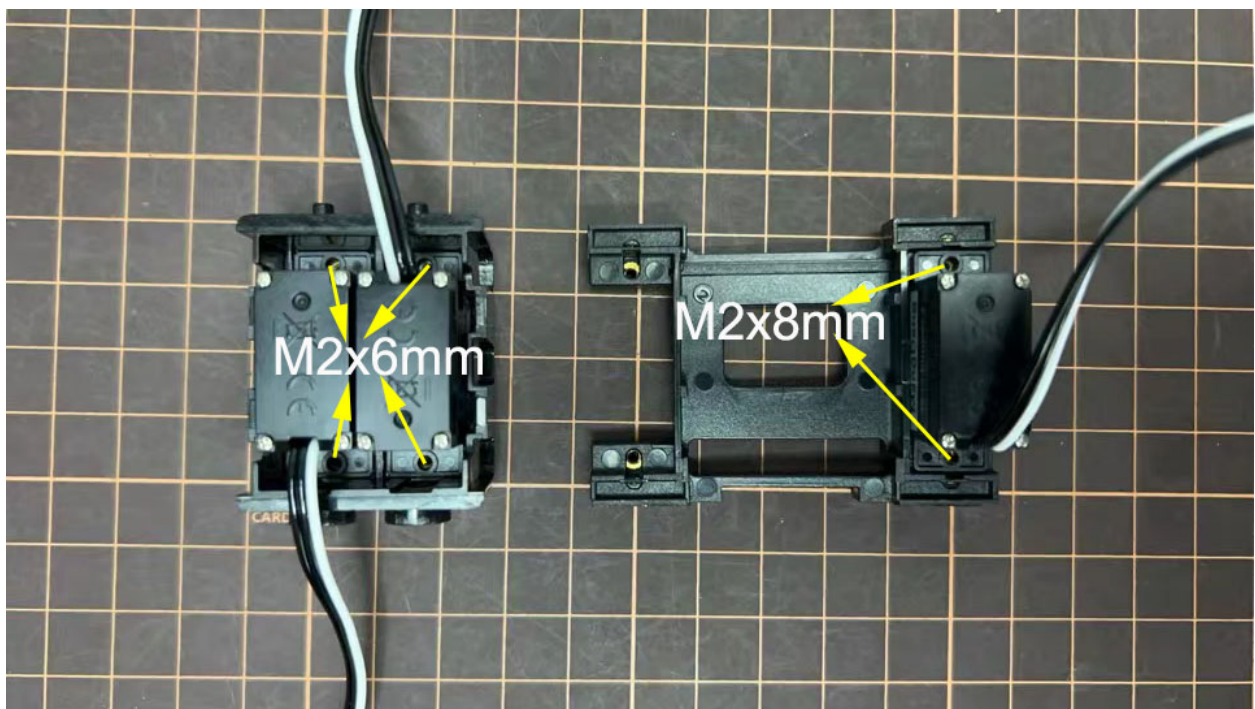
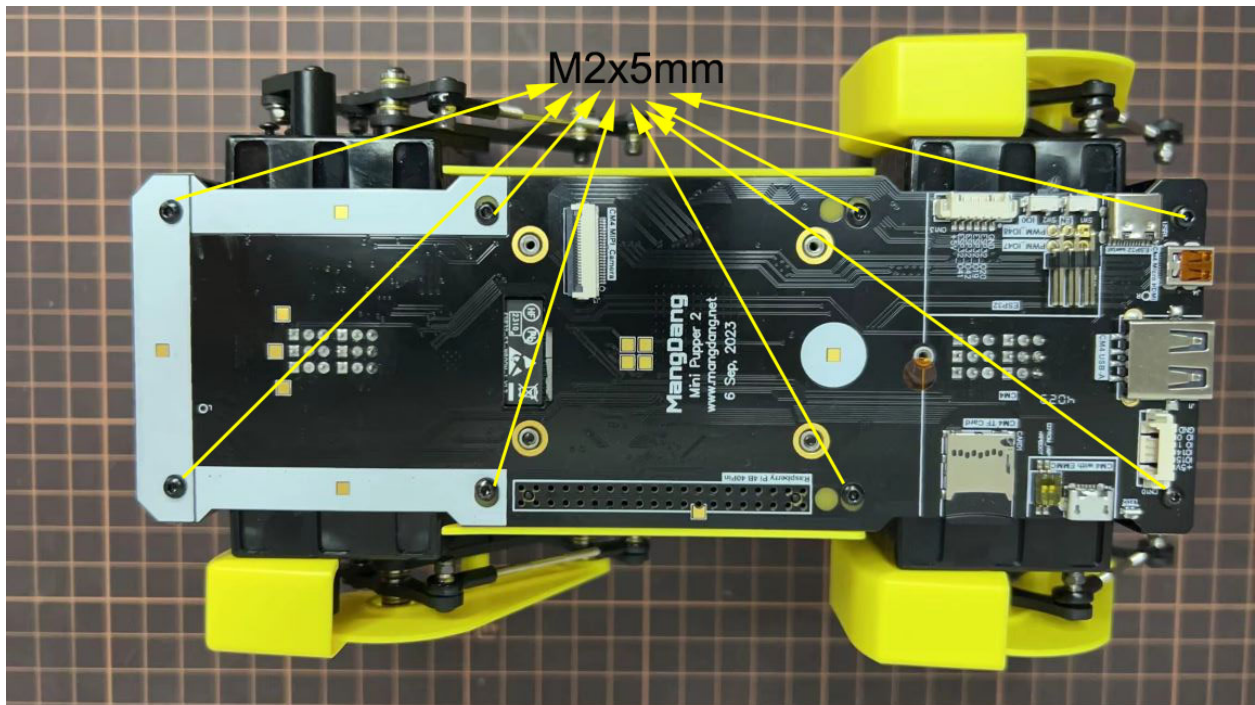
- Insert the microSD card into your PC's SD card reader and write the image. We recommend the image creation tool balenaEtcher or Win32DiskImager as it is easy and reliable. Please take a look at the official manual. It may take a while to complete.

✱ Reference Link: [Download Etcher – Flash OS images to USB drives & SD cards](#)

2. Position of the screws

- The pictures show the position of the screws briefly.





3. Legs Assembly

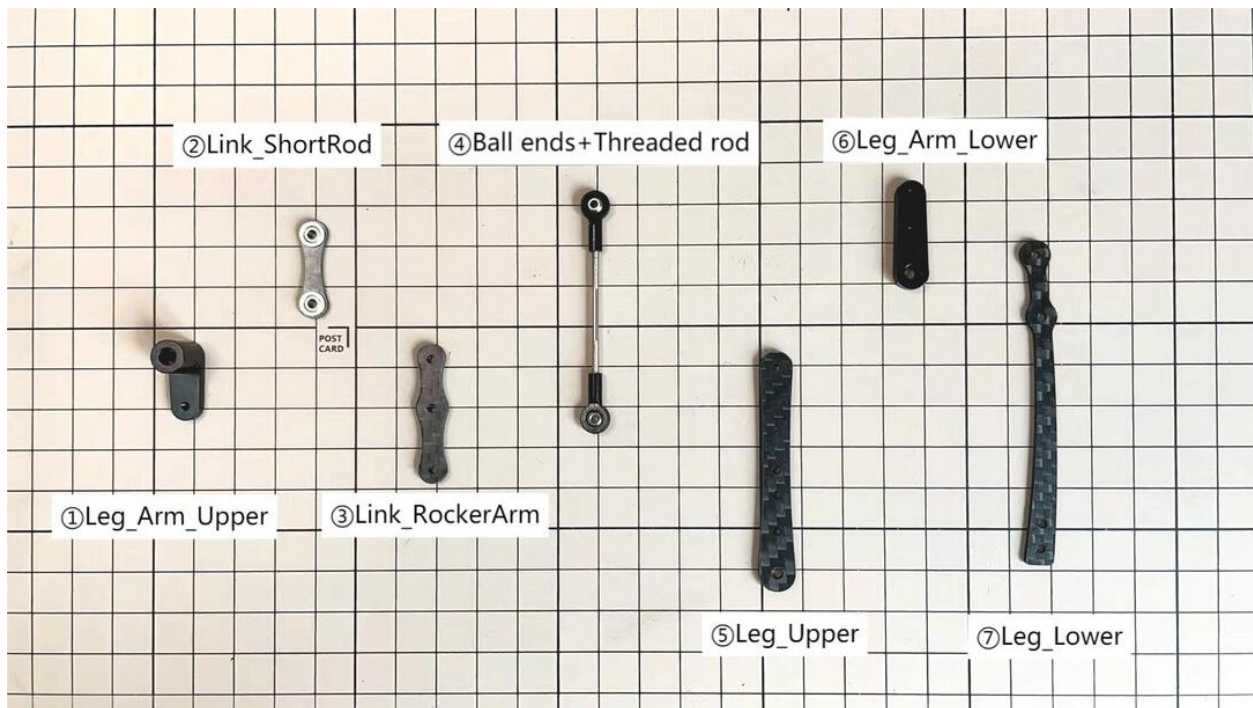
Please refer to the below video clip.

Bolt to use

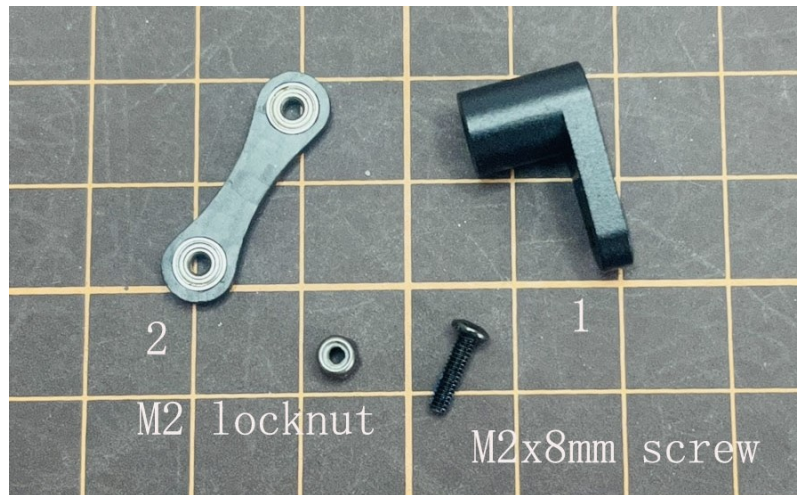
- M2x5mm 2x4=8 +, +
- M2x8mm 3x4=12 +, +, +
- M2x12mm 1x4=4 +
- M2x14mm 1x4=4 +

Step 3.1 Single leg

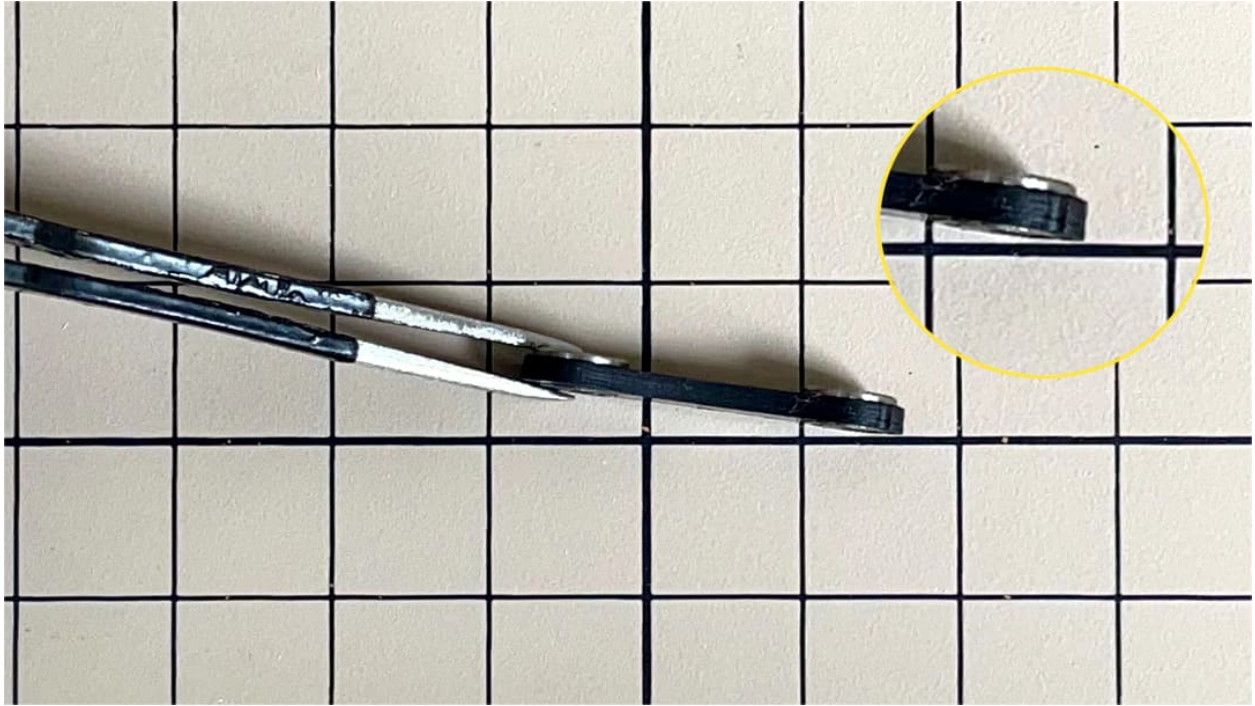
- Assemble the four legs. The front and back of the right side are the same, and so are the front and back of the left side. Show you how to assemble the right side.
- Video Instructions, please refer to the link <https://youtu.be/Ut7UnS3CTZs>
- The parts are numbered as follows to explain.



Assemble and

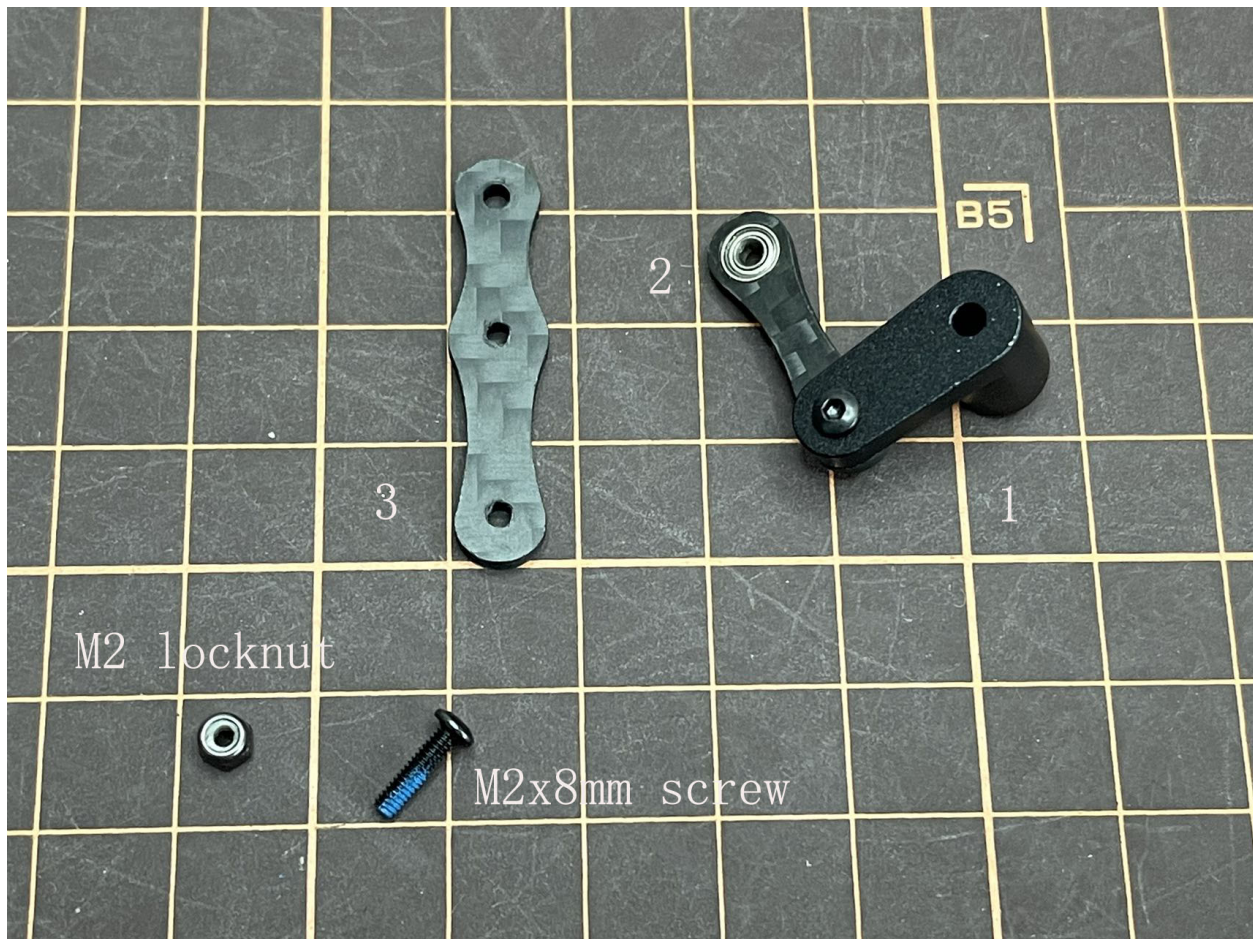


- The two sides of bearings inside are different.



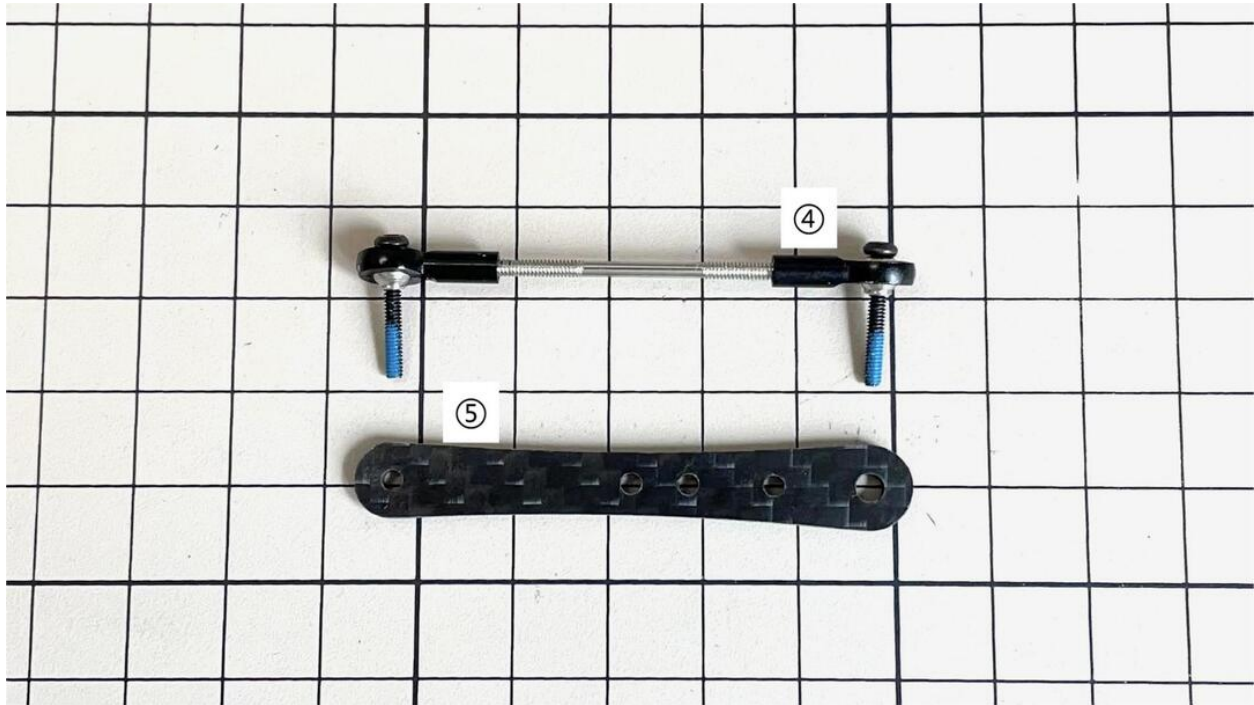
Assemble and

- Use an M2x8mm screw and an M2 locknut. Insert the screw from the bottom to the top of , pass through and tighten with the nut. It is important to pay attention to the orientation of . Look carefully at the position of the hole in the middle.

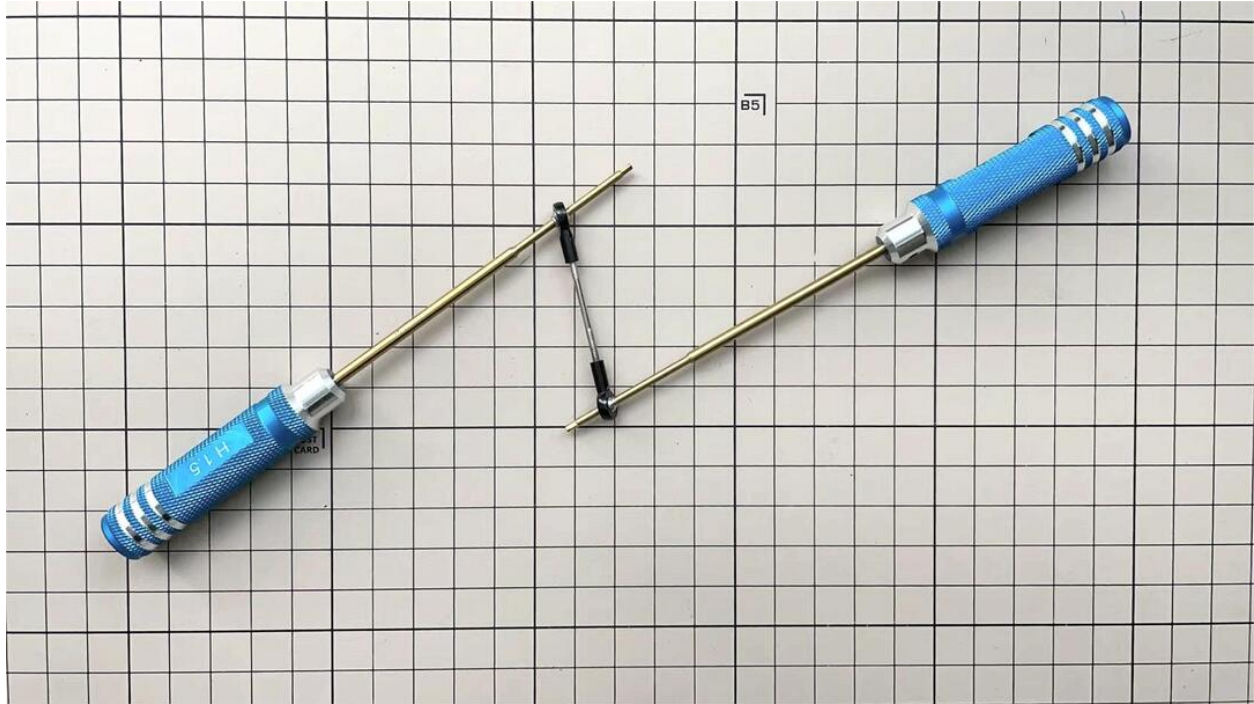


Adjustment of the length of

- The length of must match the length of . When adjusting the length, it is easier to use two long screws to make sure that the lengths match. Once the lengths have been adjusted, take apart all.

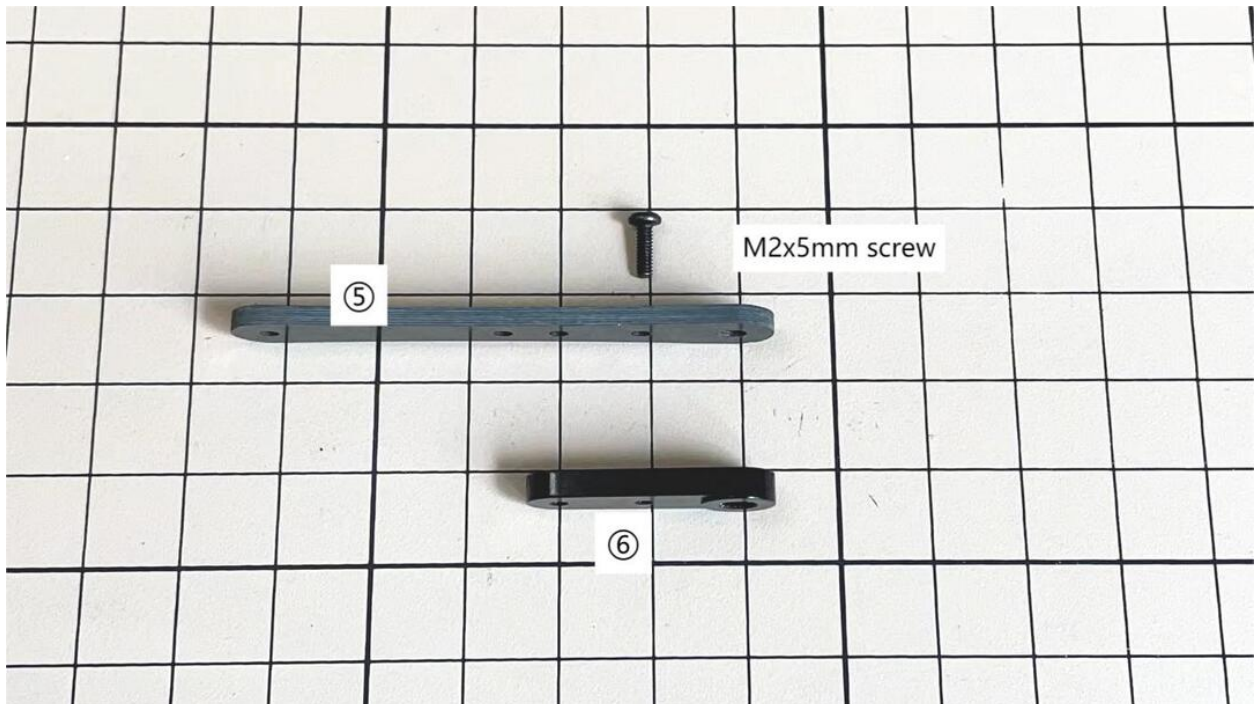


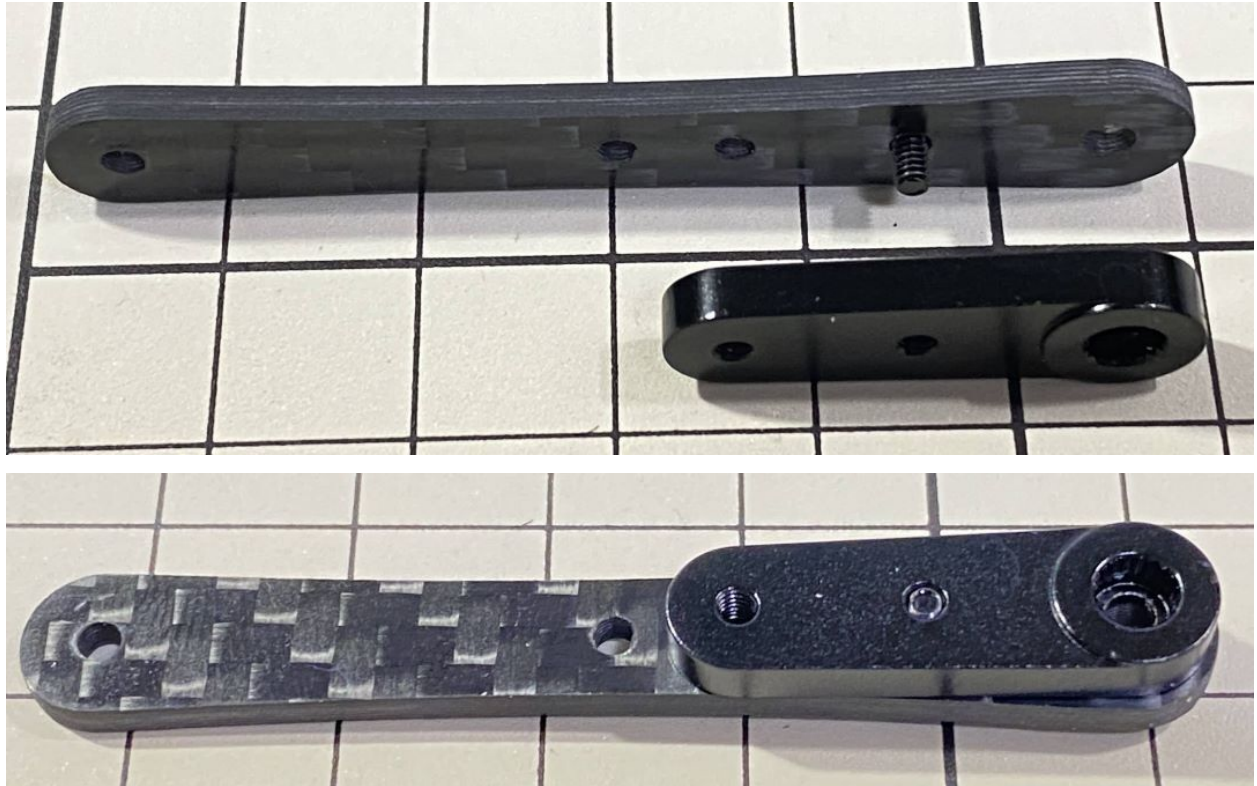
- If it's hard to twist, you can use two screwdrivers to assist.



Assemble and

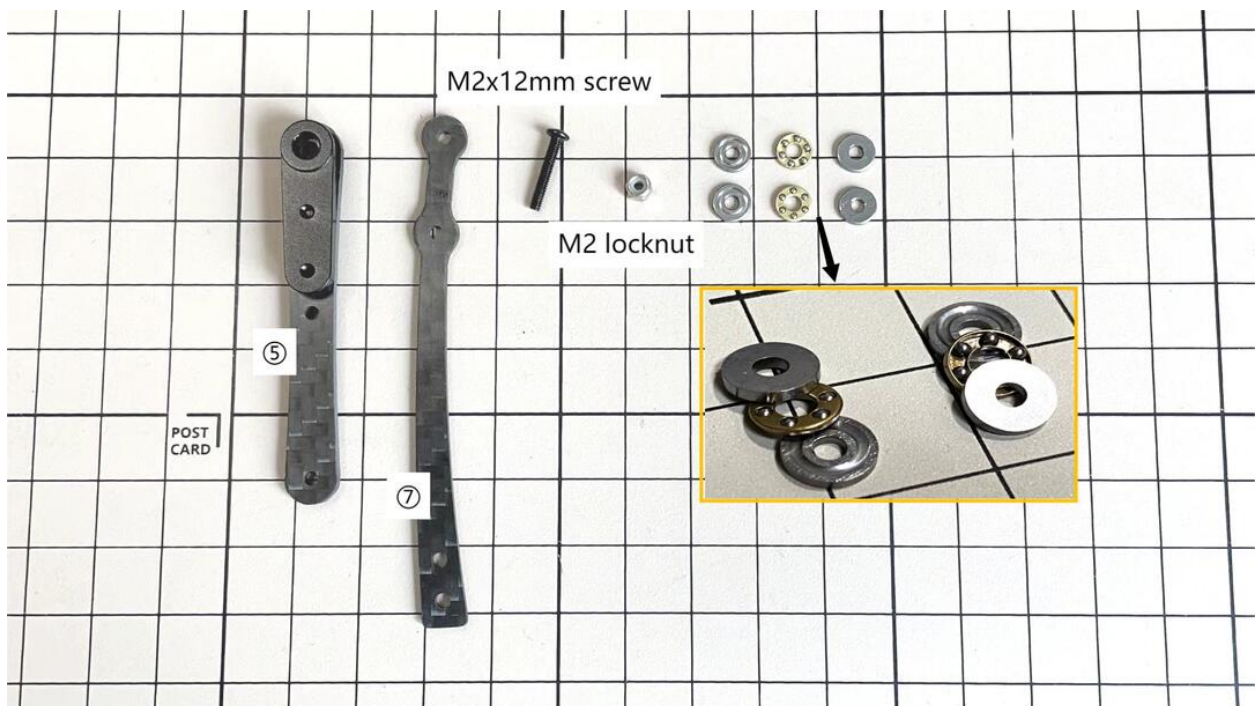
- Use one M2x5mm screw. Insert the screws into first, insert them into the holes of , and tighten them. The large hole in should be facing the surface.

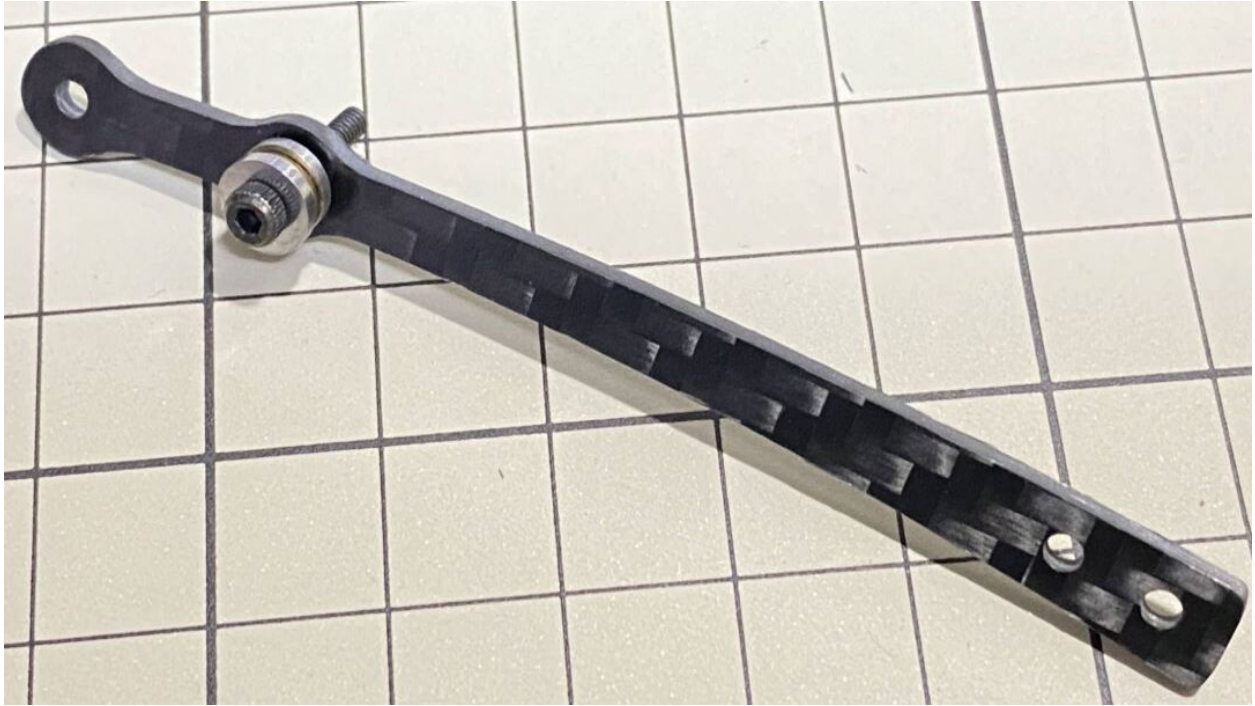


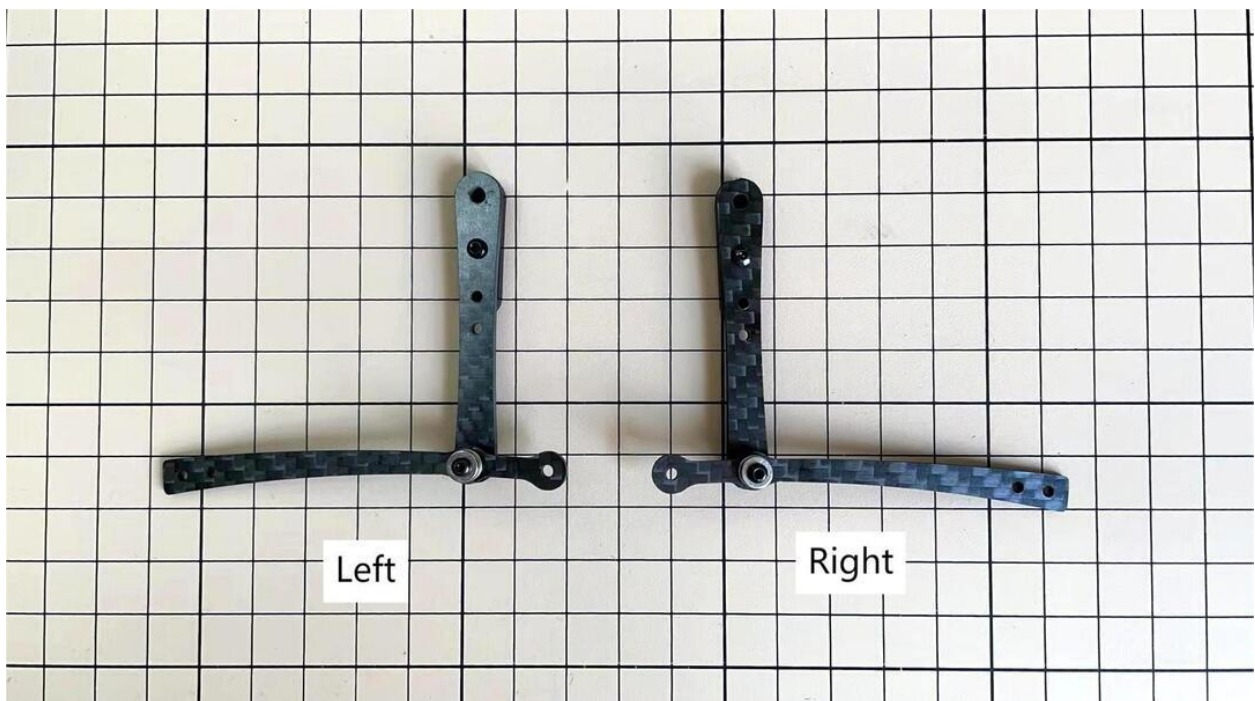
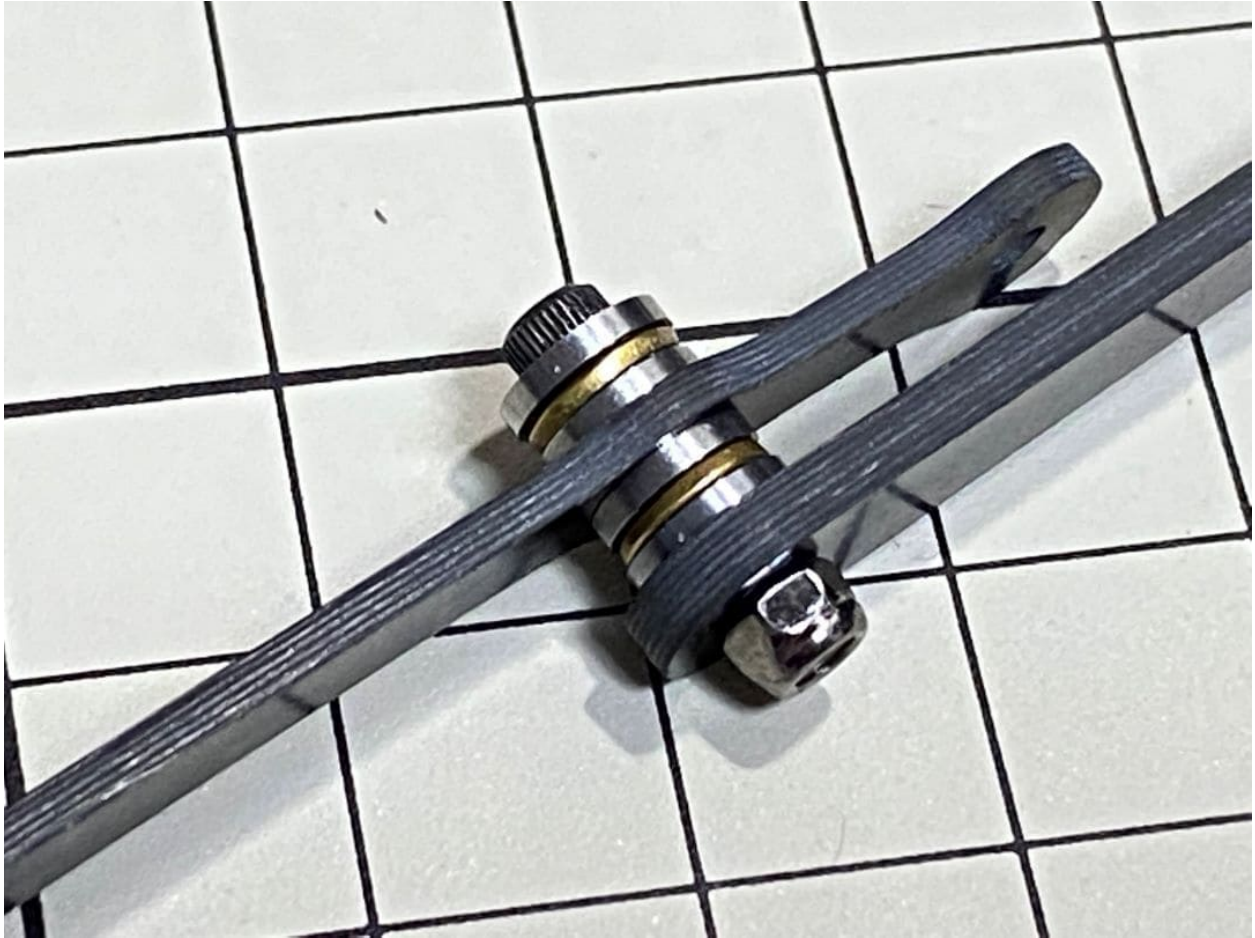


Assemble and

- Use an M2x12mm screw, an M2 locknut and two sets of ball bearings. Each ball bearing is made up of three parts, the top and bottom parts with the grooved side facing inwards. Insert a screw into a set of ball bearing. Then insert the screw into the hole. Taking care to look at the warped side of to make sure it is facing the right way. Now screw in the another set of ball bearing. Finally, insert screw into and tighten it with the nut.



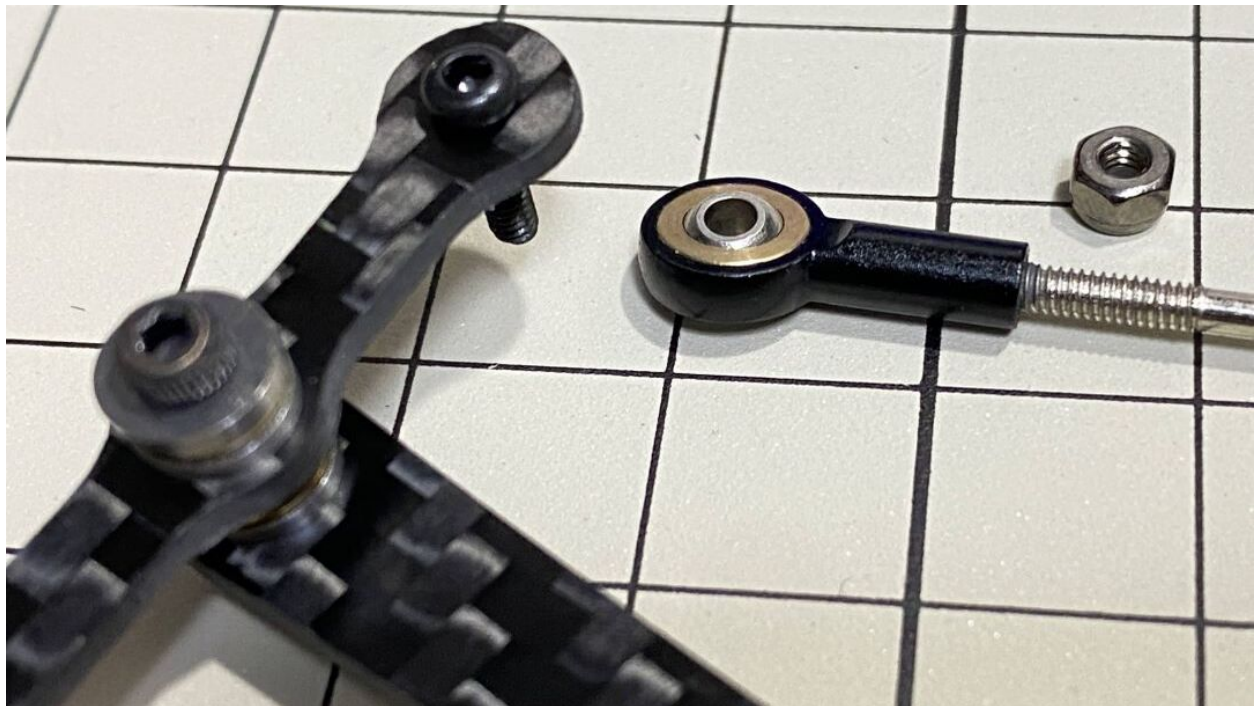
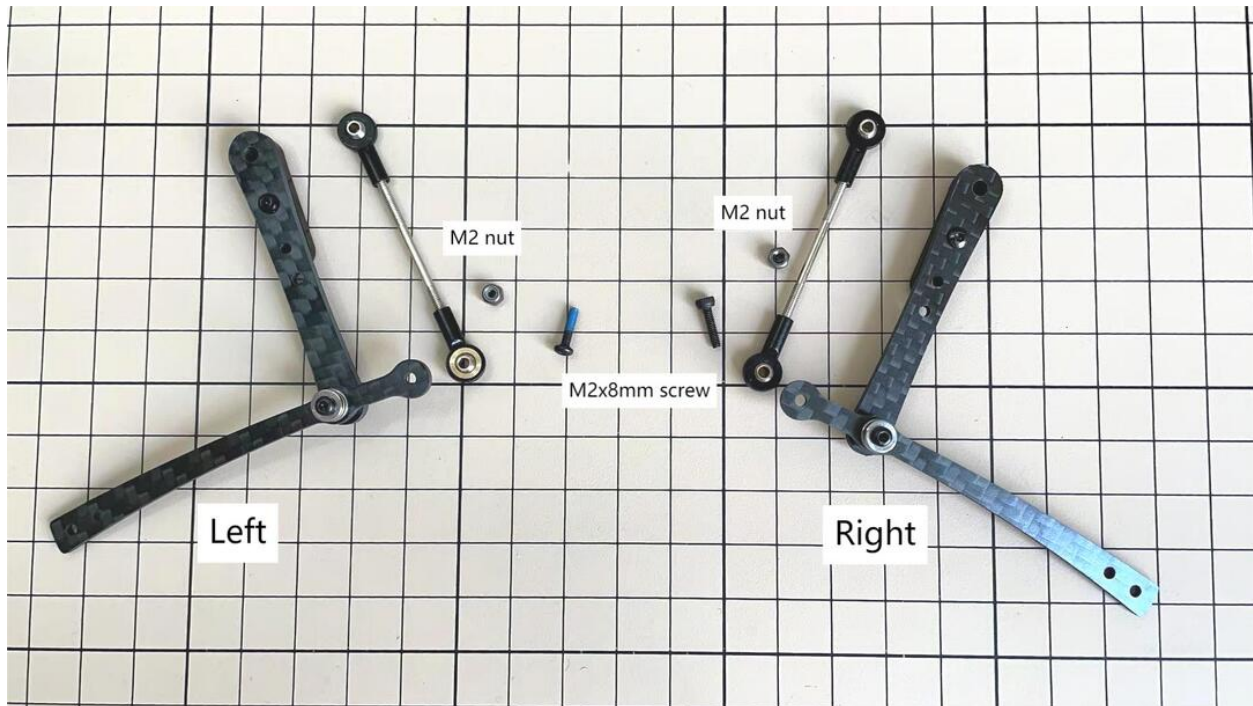


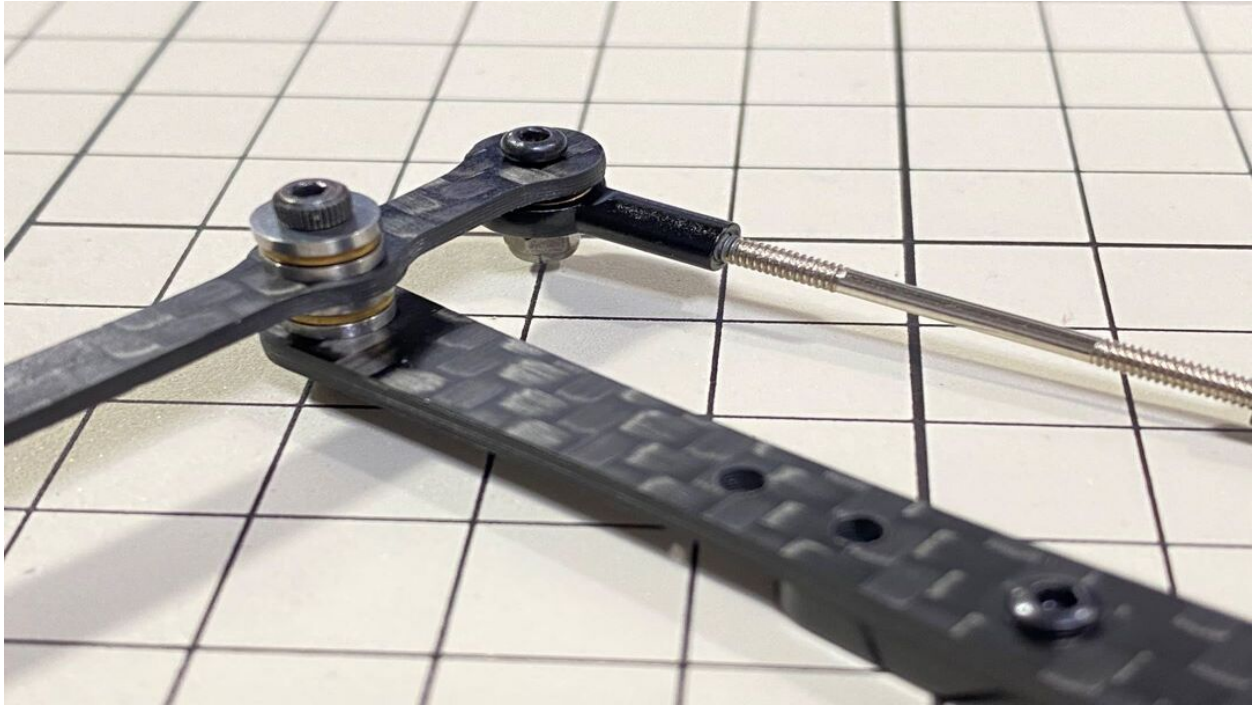


Assemble and

- Use an M2x8mm screw and an M2 nut. Insert the screw into and put through, then tighten it with the nut. The direction of the front and back of can be either.

Left and right leg

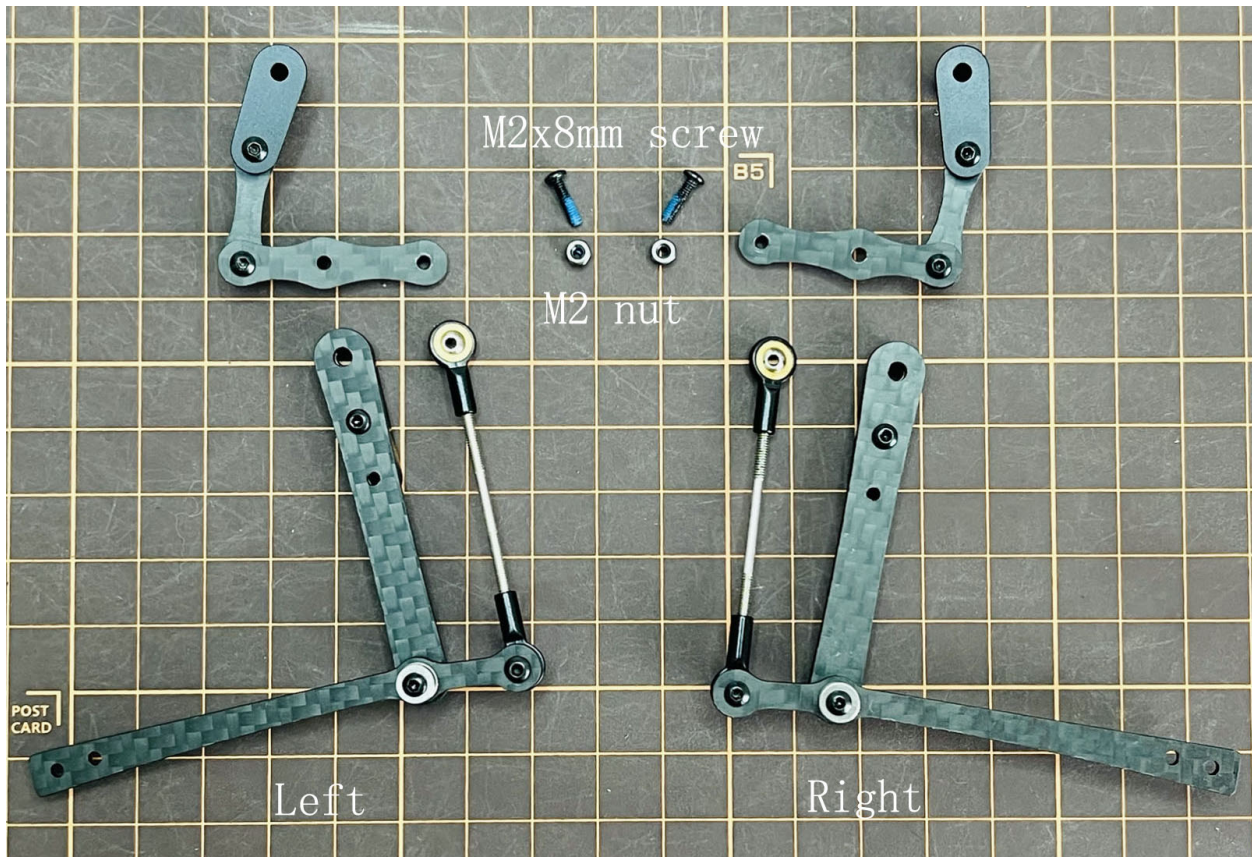




Assemble and

- Use an M2x8mm screw and an M2 nut. Insert the screw into and put through, then tighten it with the nut.

Left and right leg

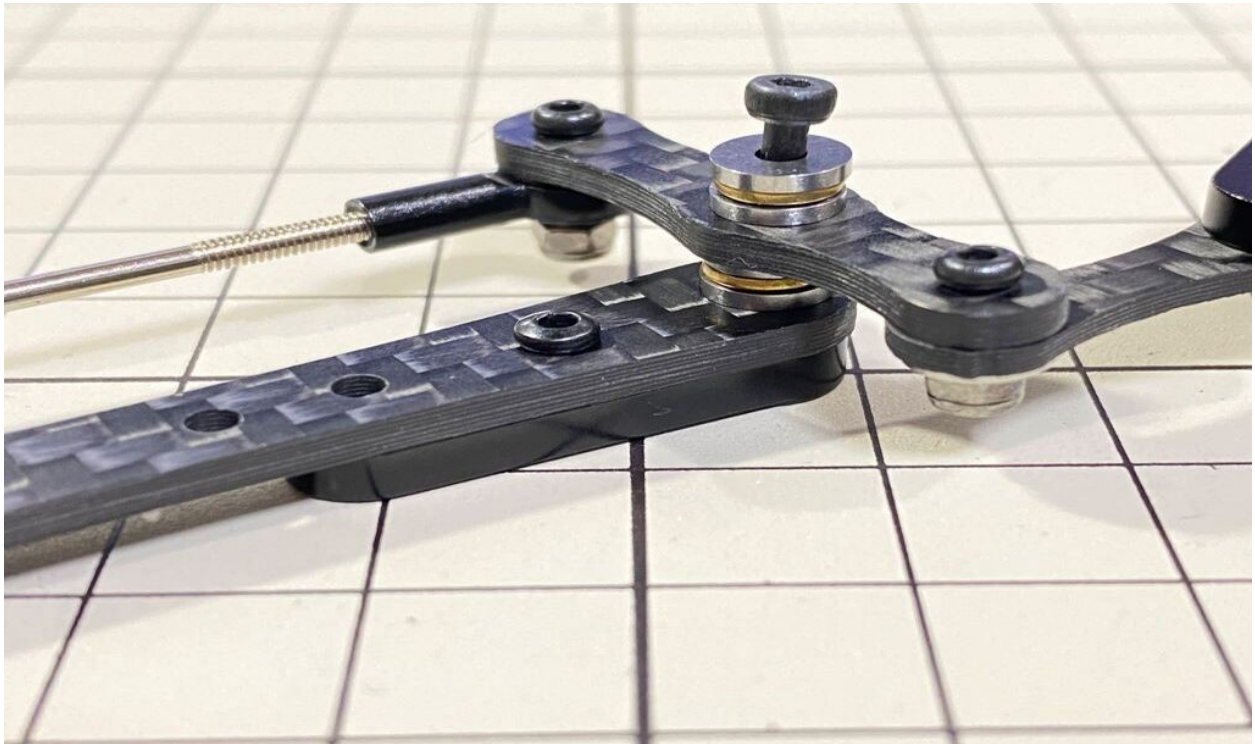
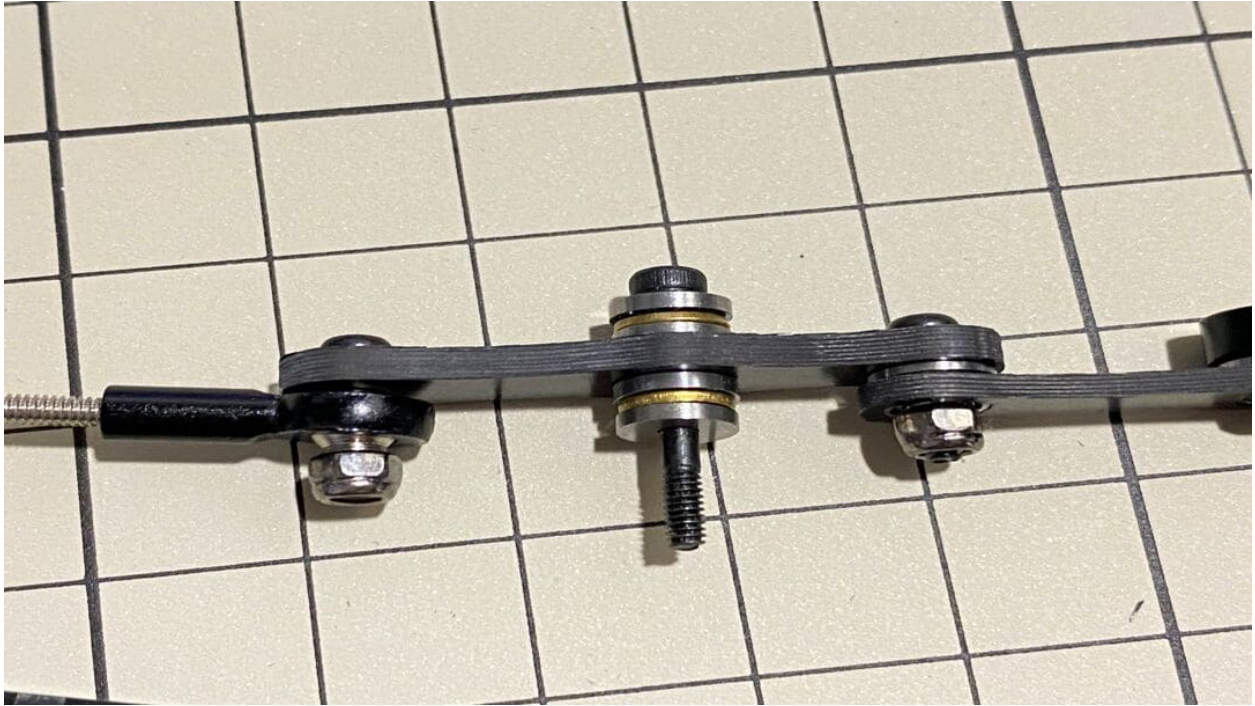




Assemble and

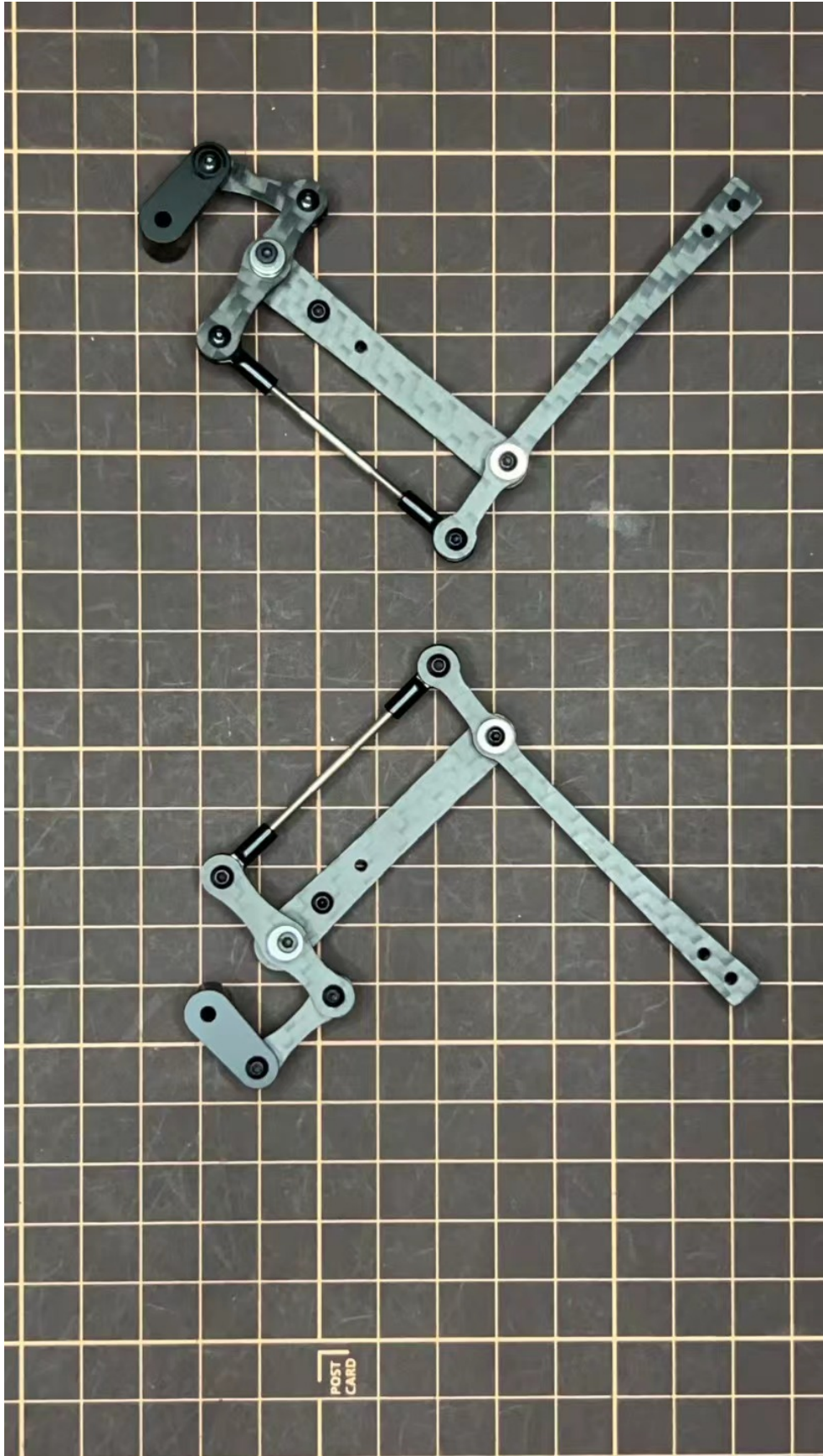
- Use M2x14mm screws and two sets of ball bearings. Thread the screws through the bearings, , bearings, , in that order. The screws are not fixed, but you will tighten them when you mount the servo in the next step.

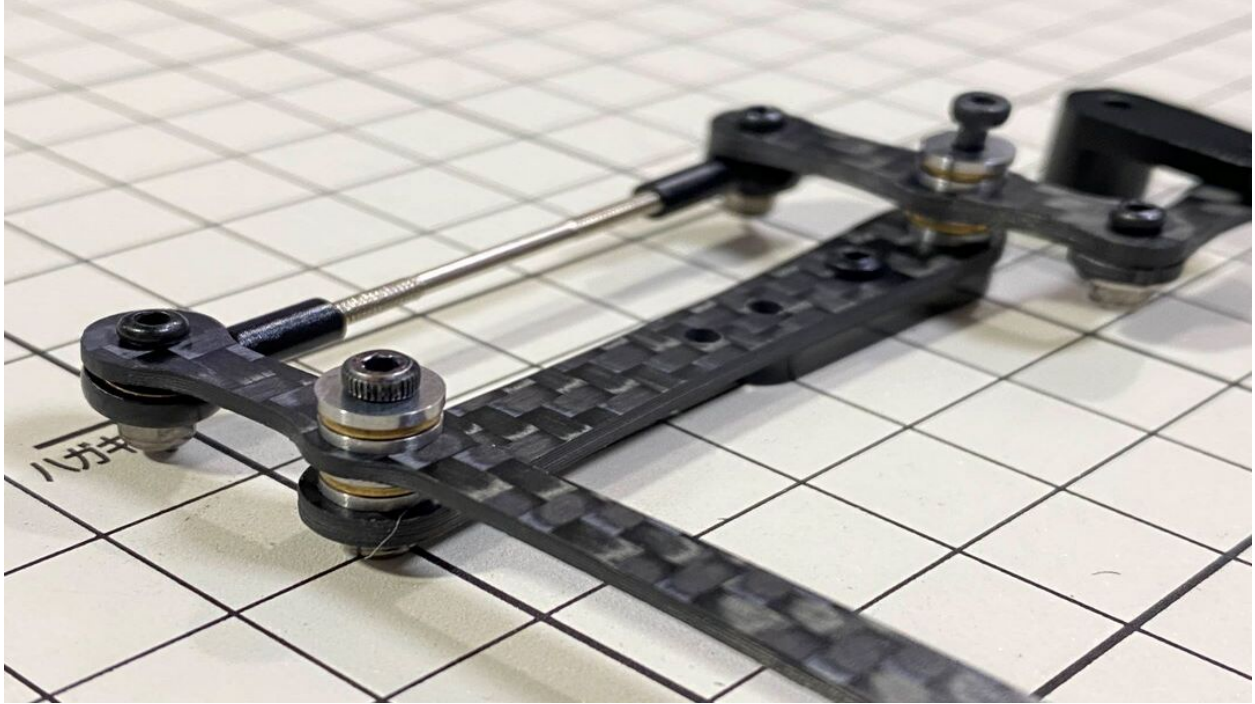




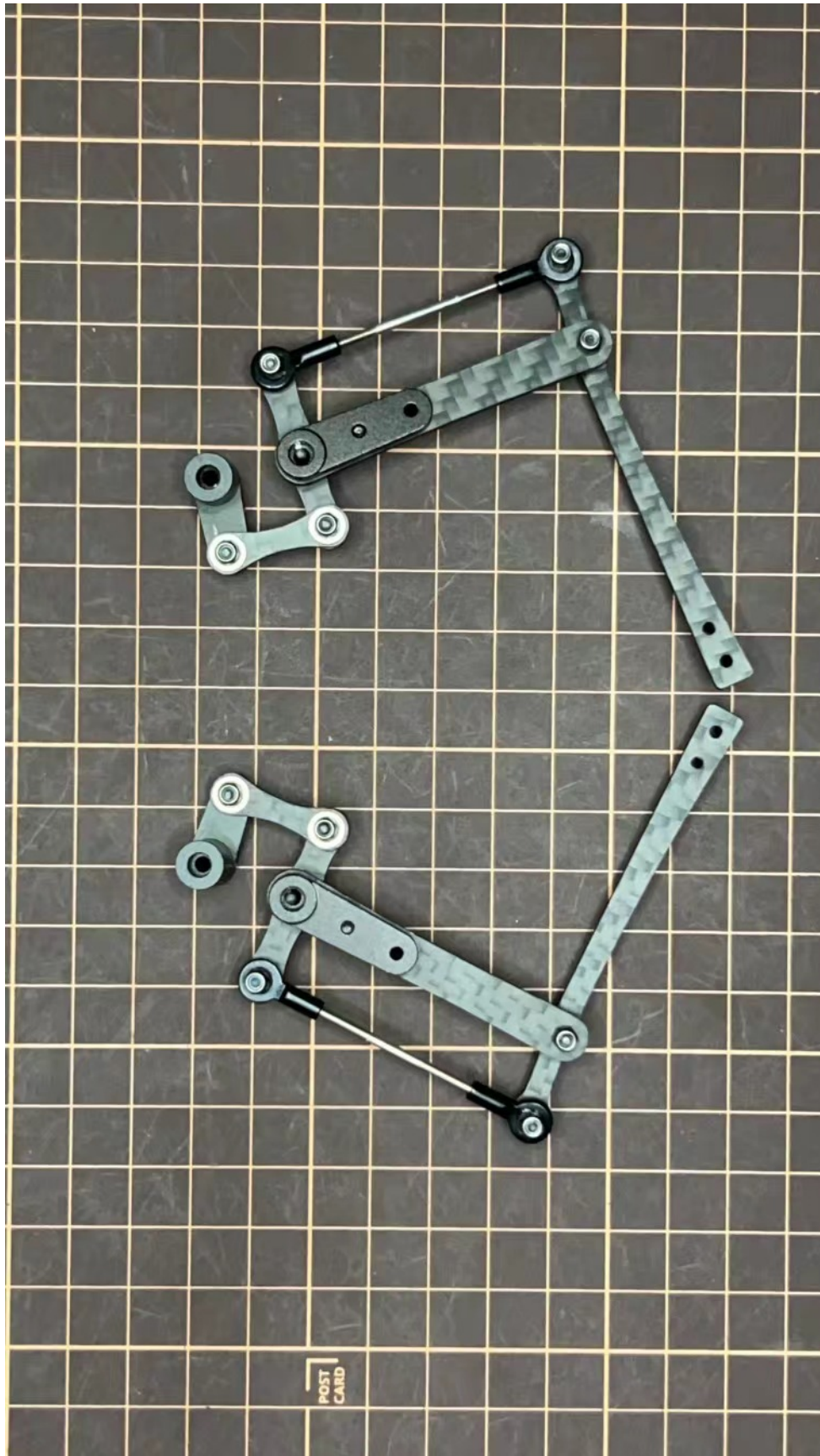
Completion of a right leg

- Now we have one leg on the right side. Here are some pictures so you can see it from different angles. The left leg should be symmetrical with the right one.





opposite side



Step 3.2 Four legs

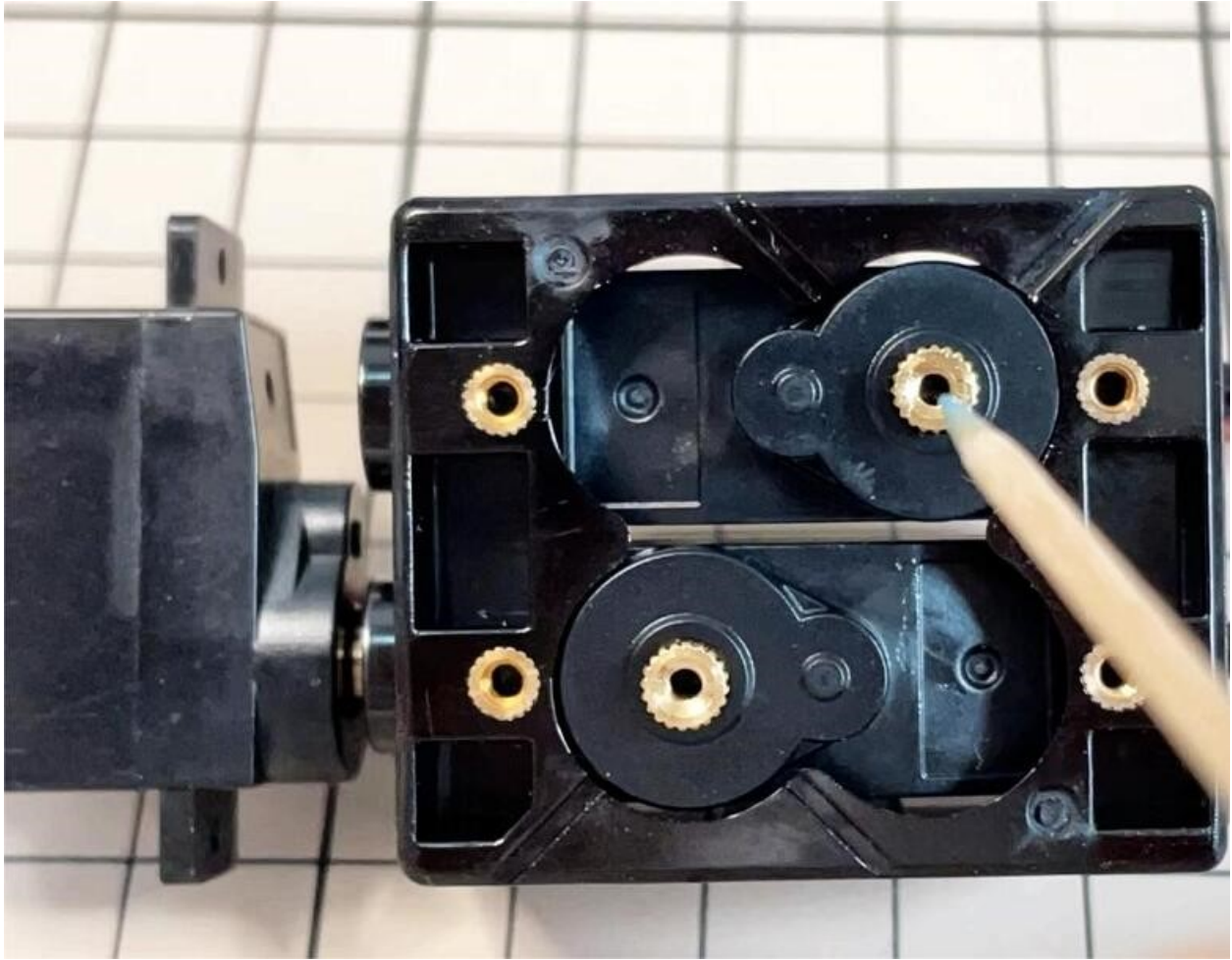


Step 3.3 Loctite

After Mini Pupper run sometime, some screws or nuts will loose, you have to check and tighten them if needed. It's helpful to understand how it works.

- * We don't recommend new users to use the Loctite at first, you can use it after you have much background.
- * Loctite prevents the nut from loosening, but it is not essential, as it can be tightened only when looseness is noticed.



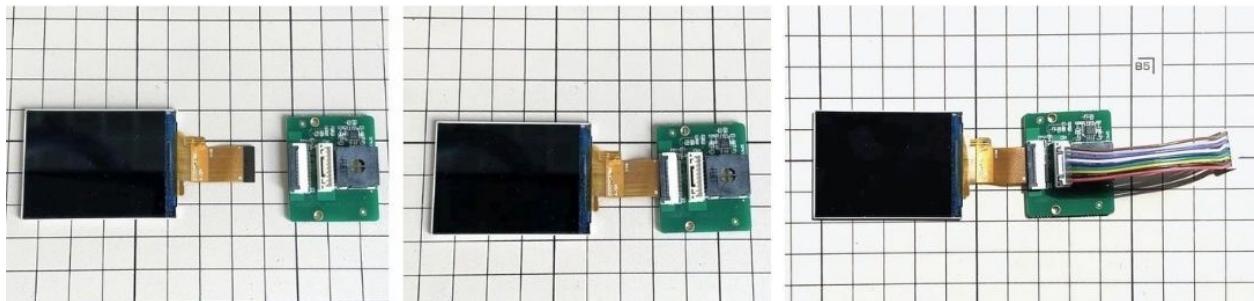


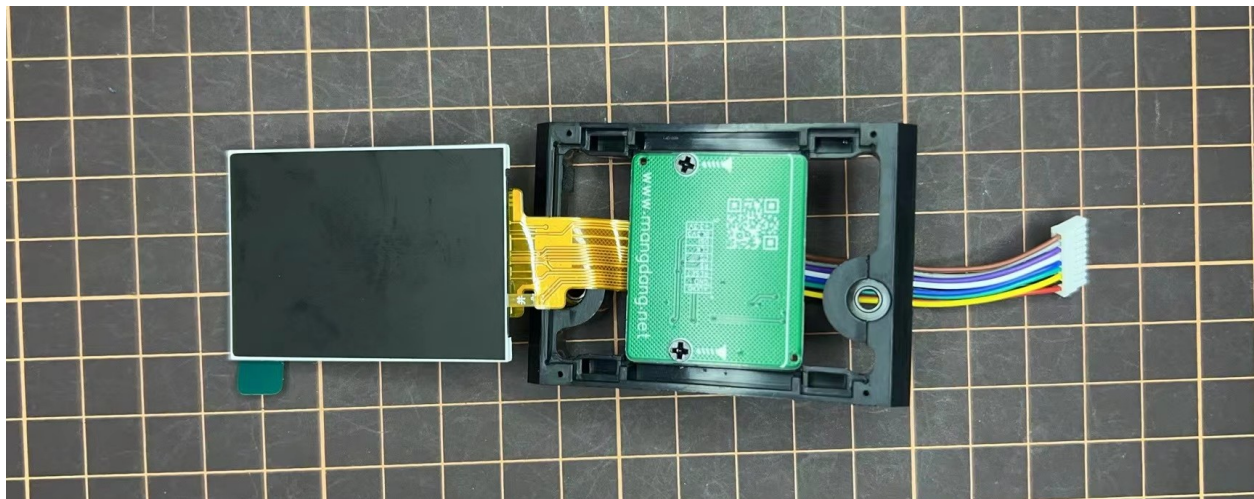
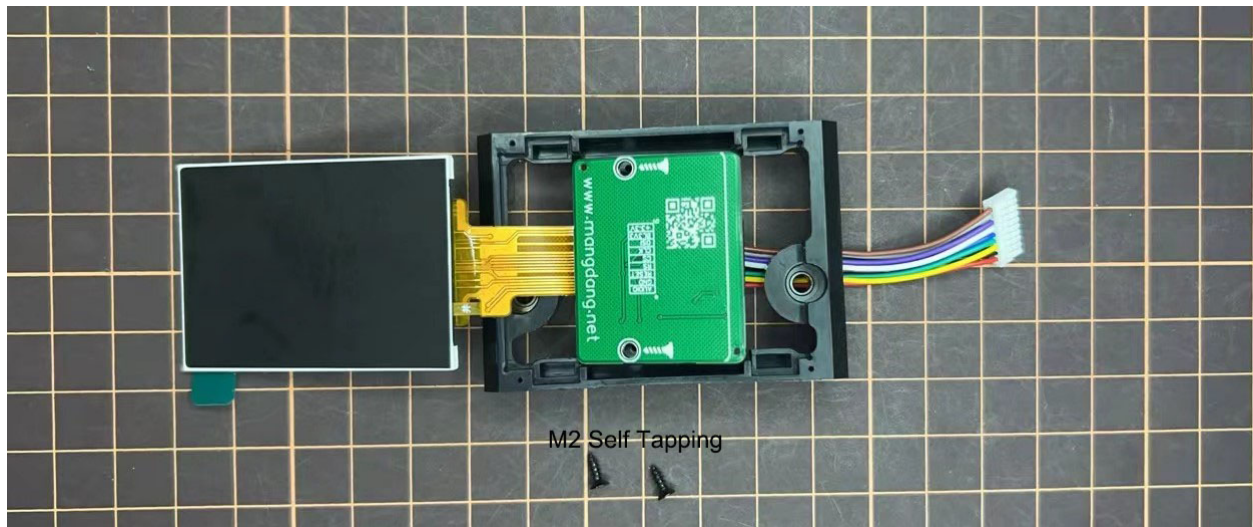
- Some screws are also secured with glue as the below picture shows.

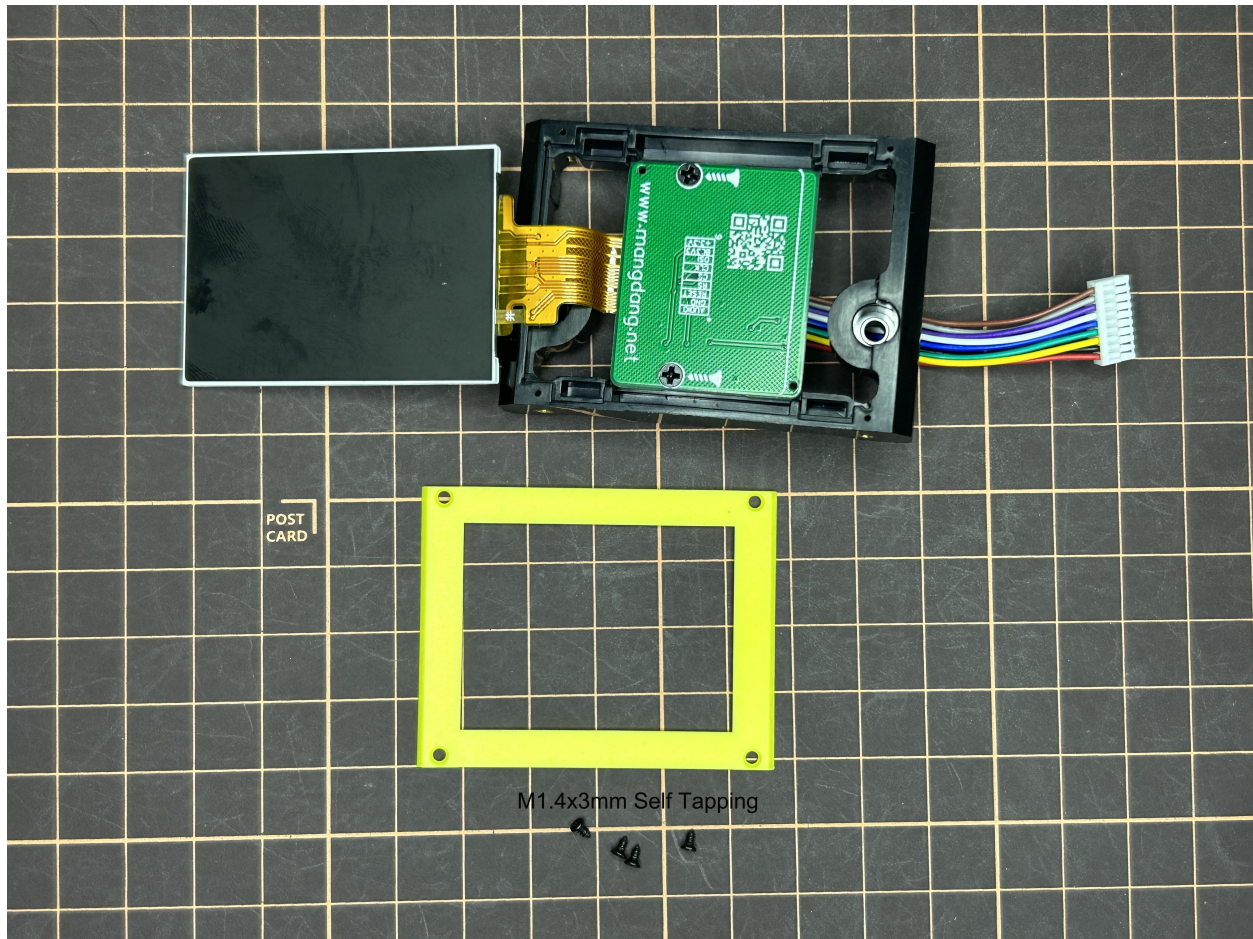


4. Display and Frame of face

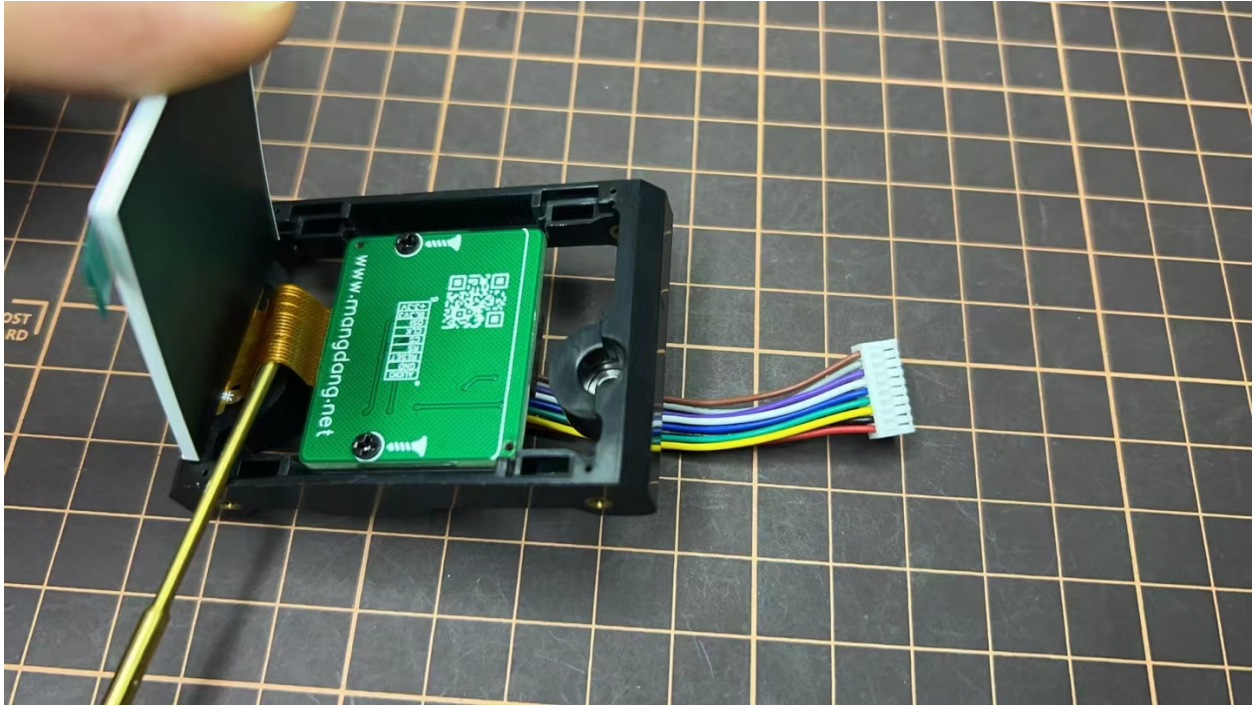
Remove the protective sheet for the display. Fold the thin flexible cable at the edge of the display. Attach the board and the display to the main unit.







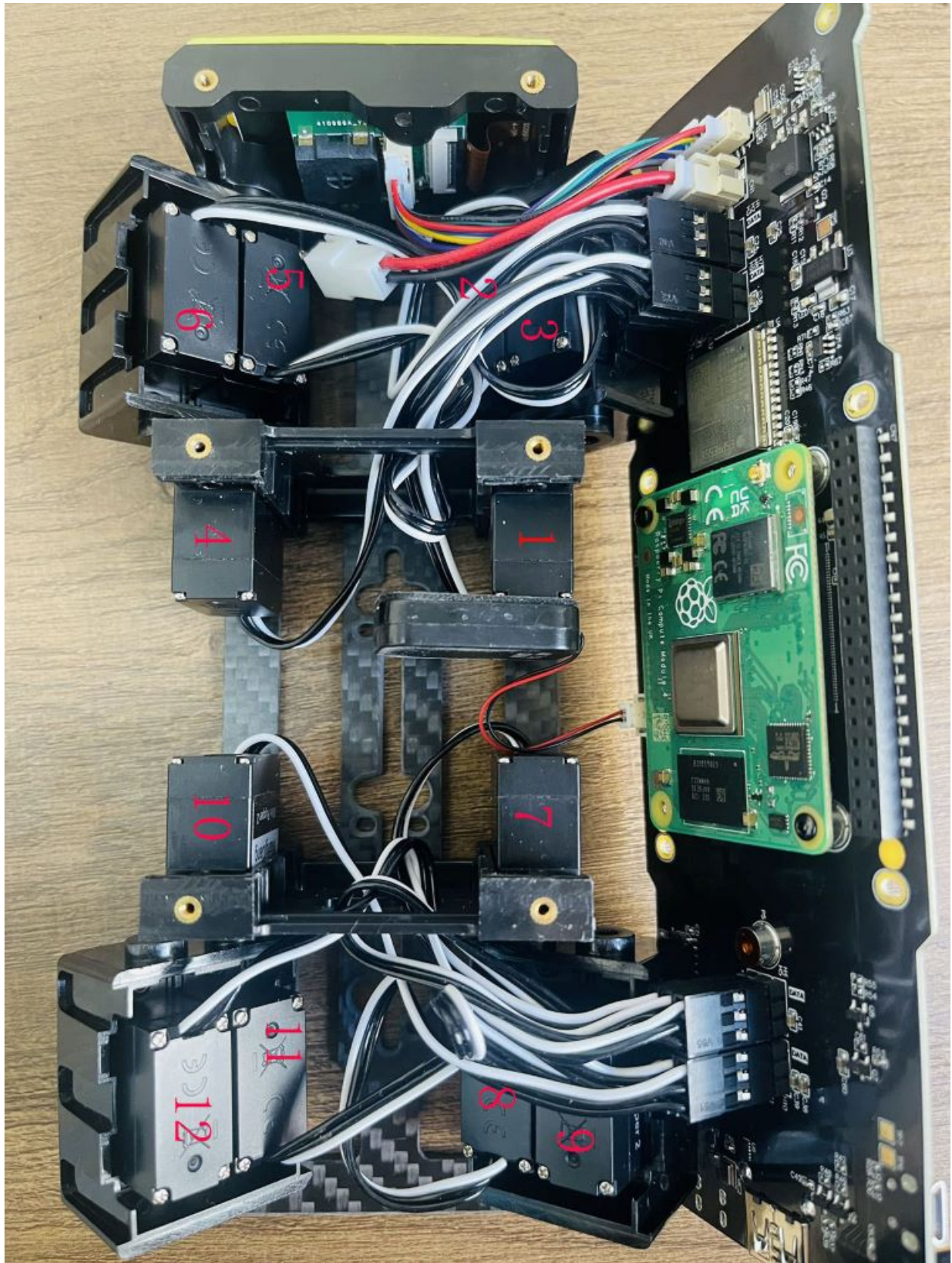
- When attaching the display, you can use a stick to gently push the flexible FPC cable, so that it goes as far back as possible. Don't bend this FPC cable at 180 degrees.





5. Body Frame and Hips Assembly

- Refer to the top video for how to set servo ID.
- For the position of each servo, please refer to the below picture.



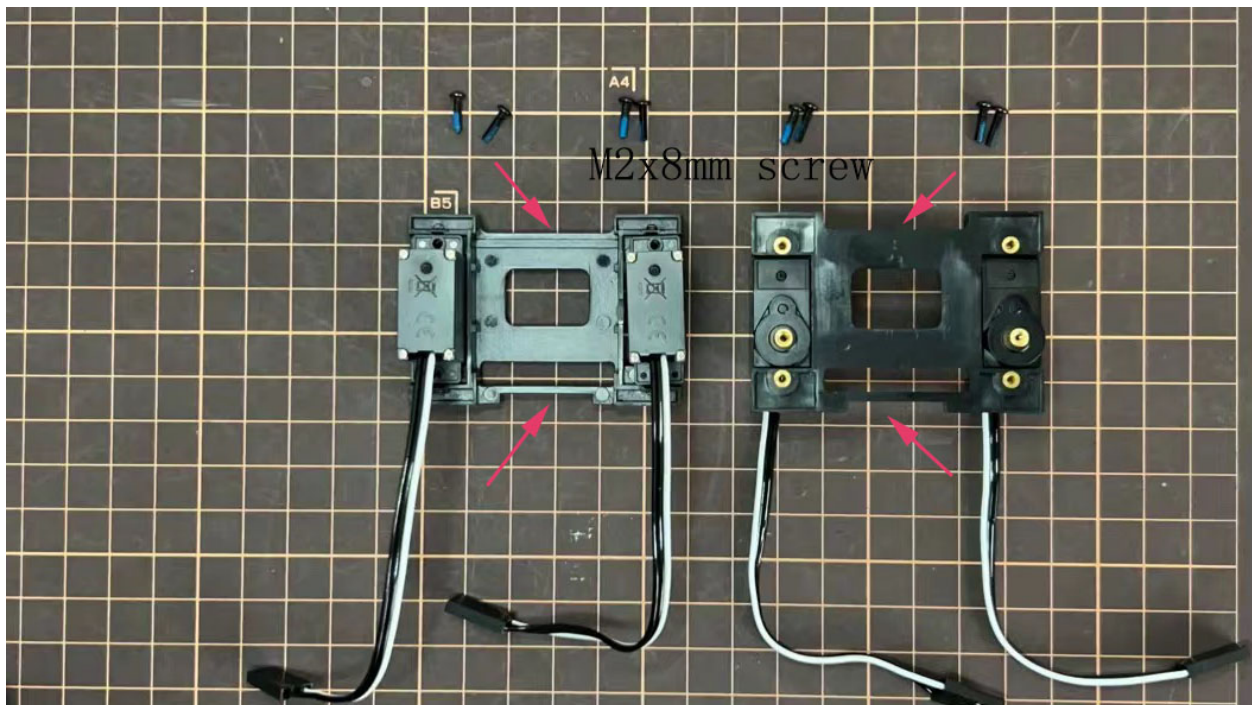
Step 5.1 Body center parts

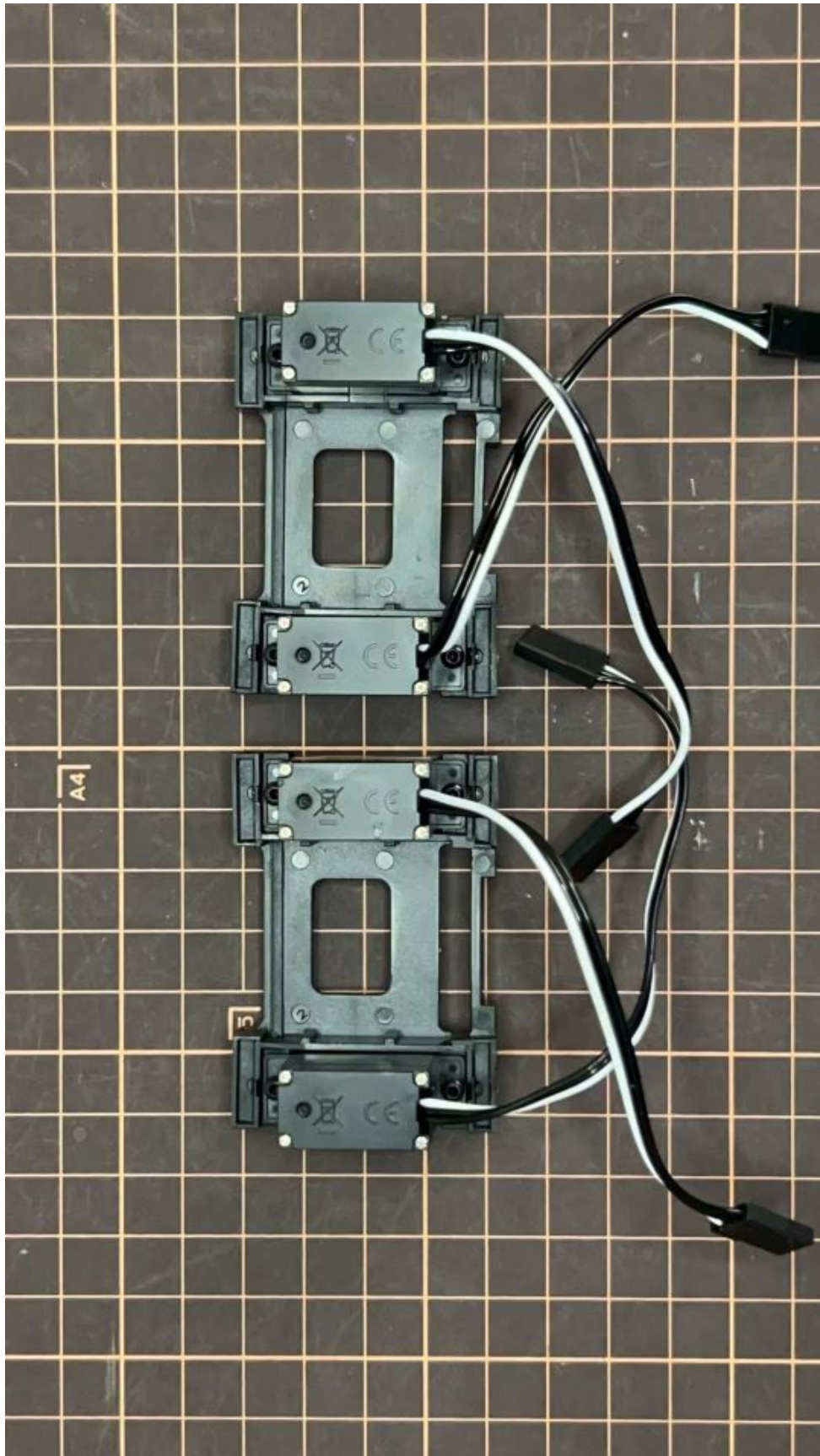
Connect the No.1, 4, 7, 10 servos to the body center parts.

- It is useful to put masking tape on the cables and write the number of servos during this process to make it easier later.



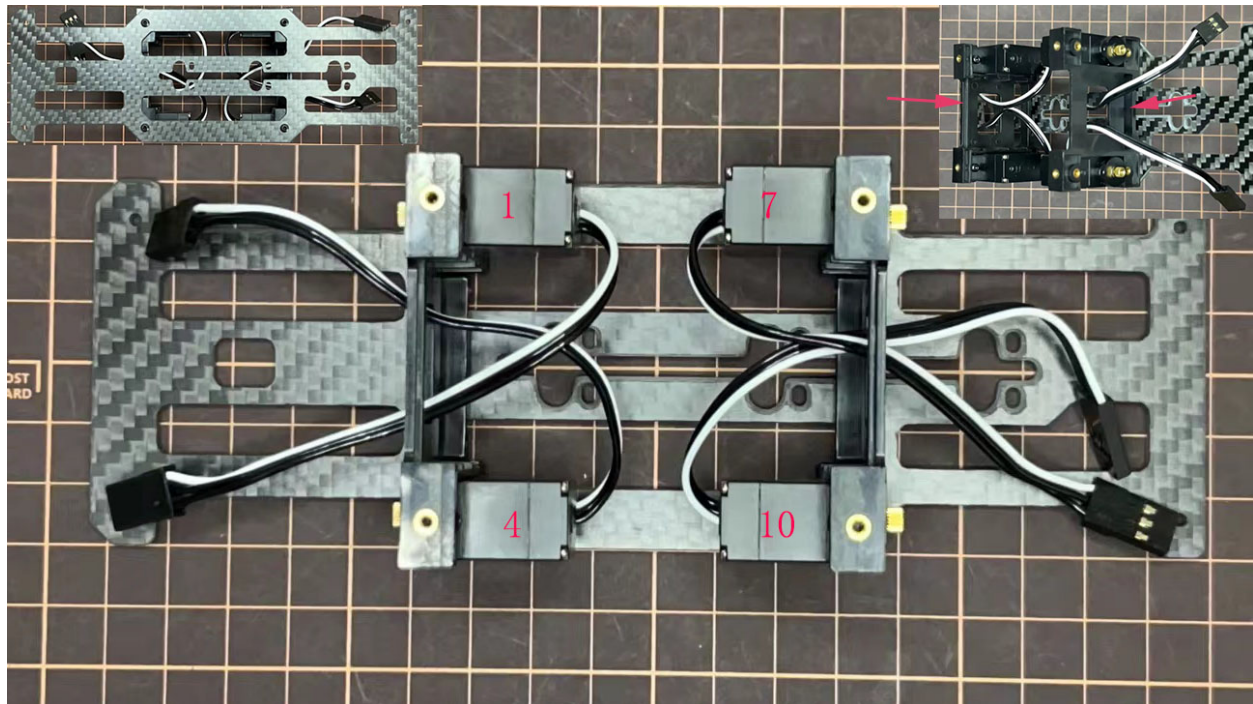
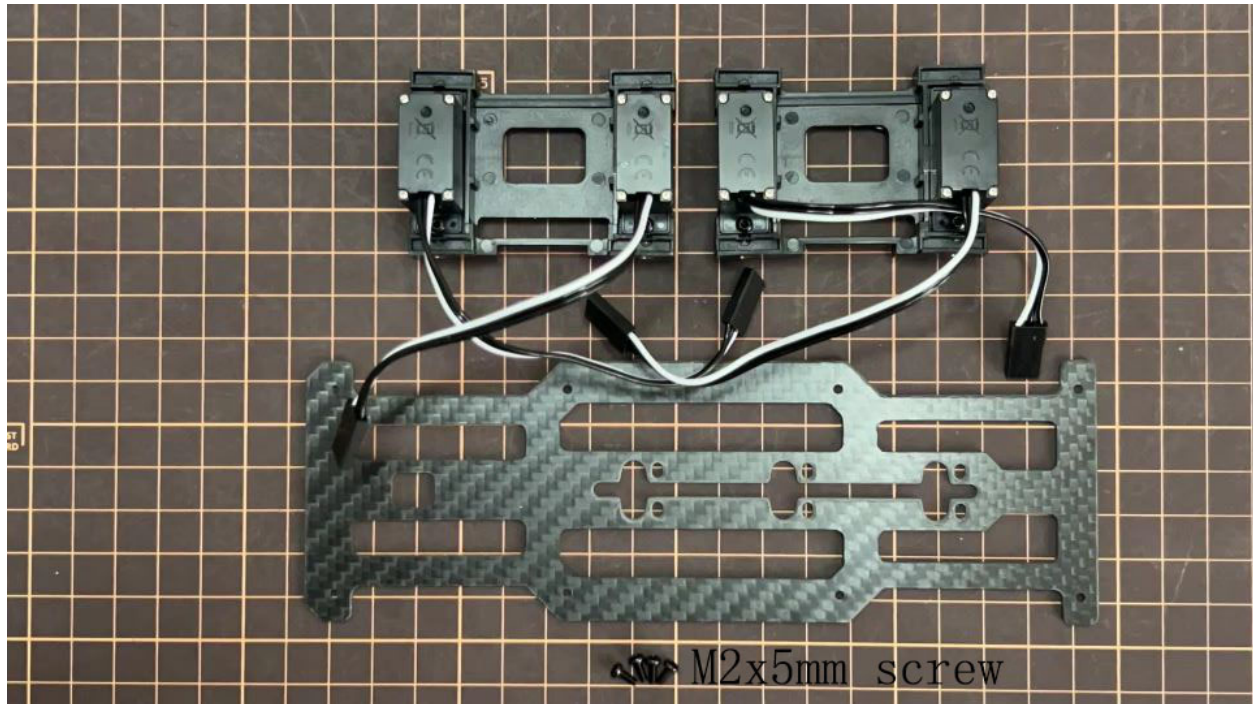
- Pay attention to the center part direction.





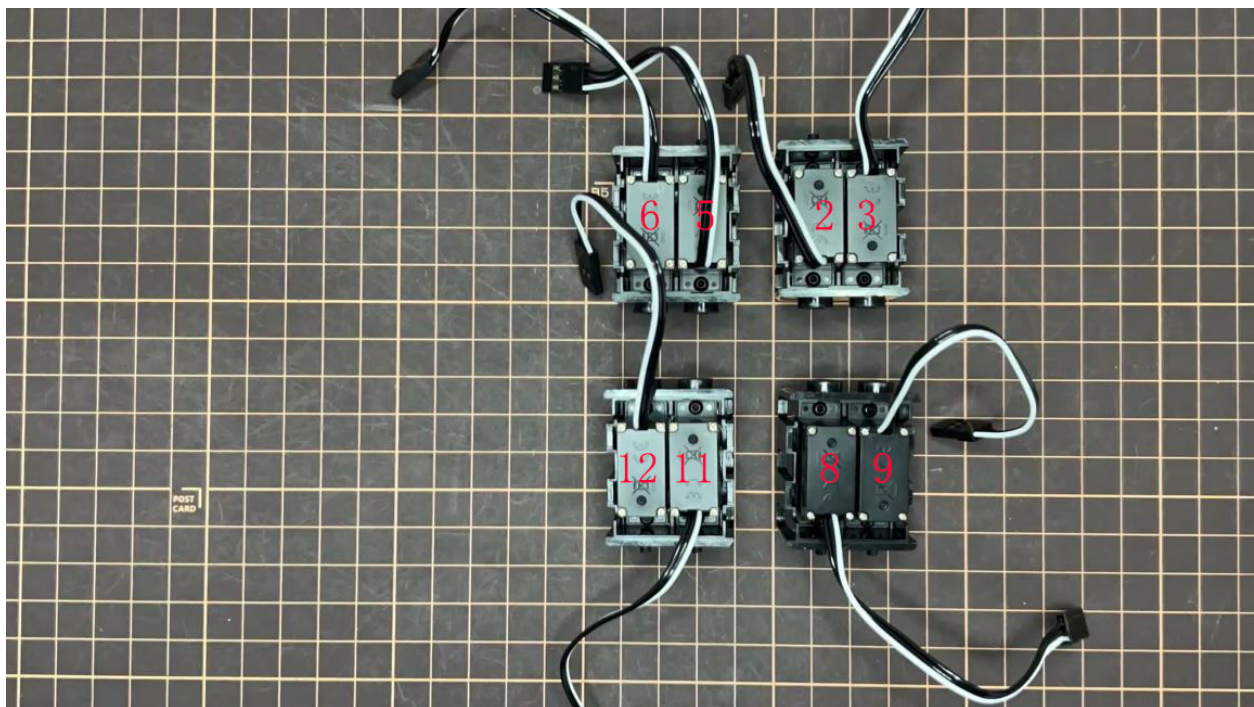
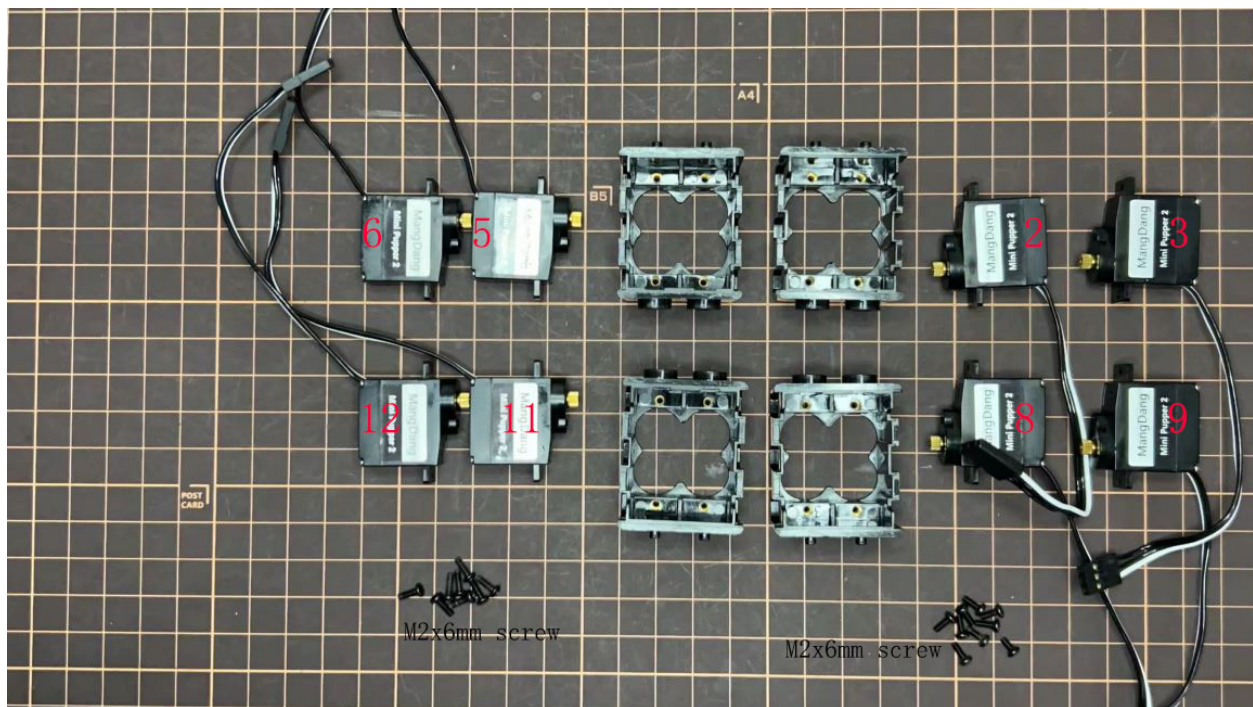
Connect the center parts to the bottom carbon fiber

- Be careful of the carbon fiber front and rear orientation.

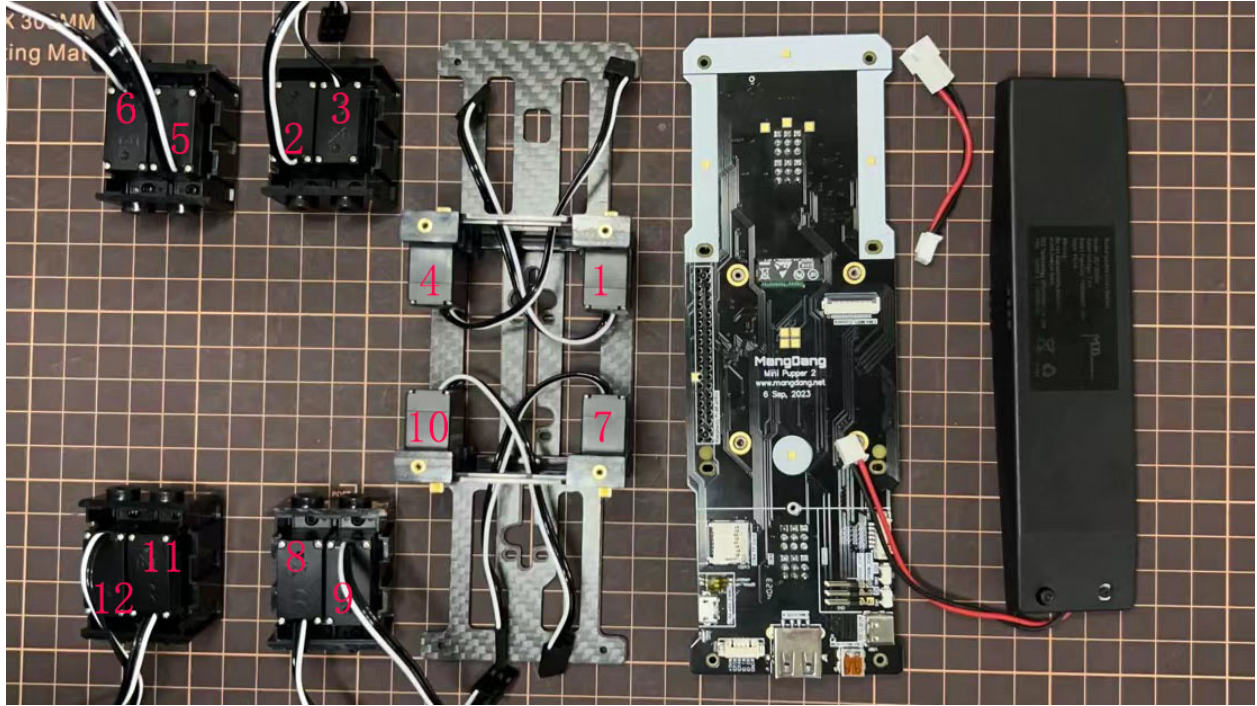


Step 5.2 Hip parts

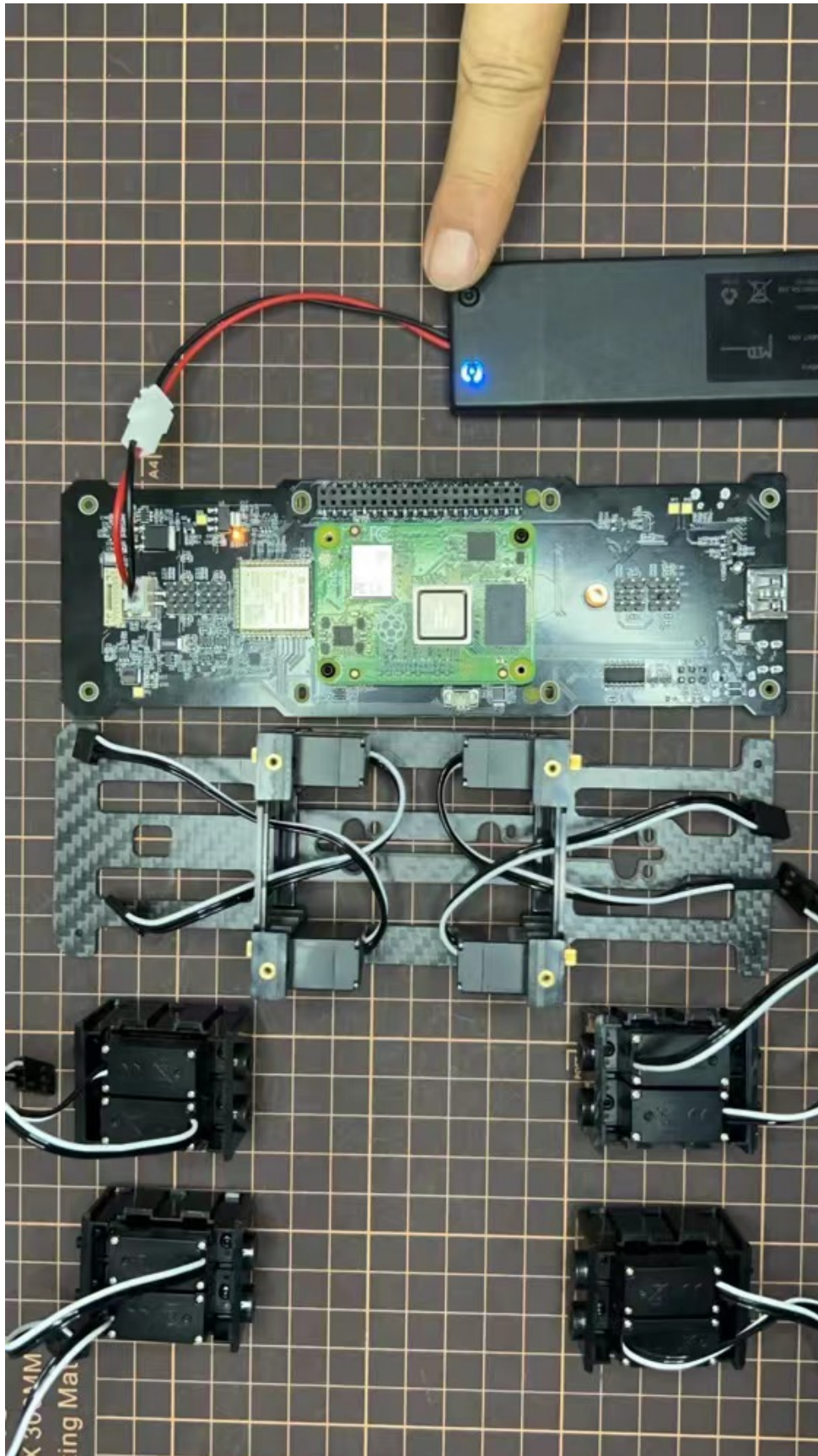
Assemble four hip parts, please refer to the servo positions.



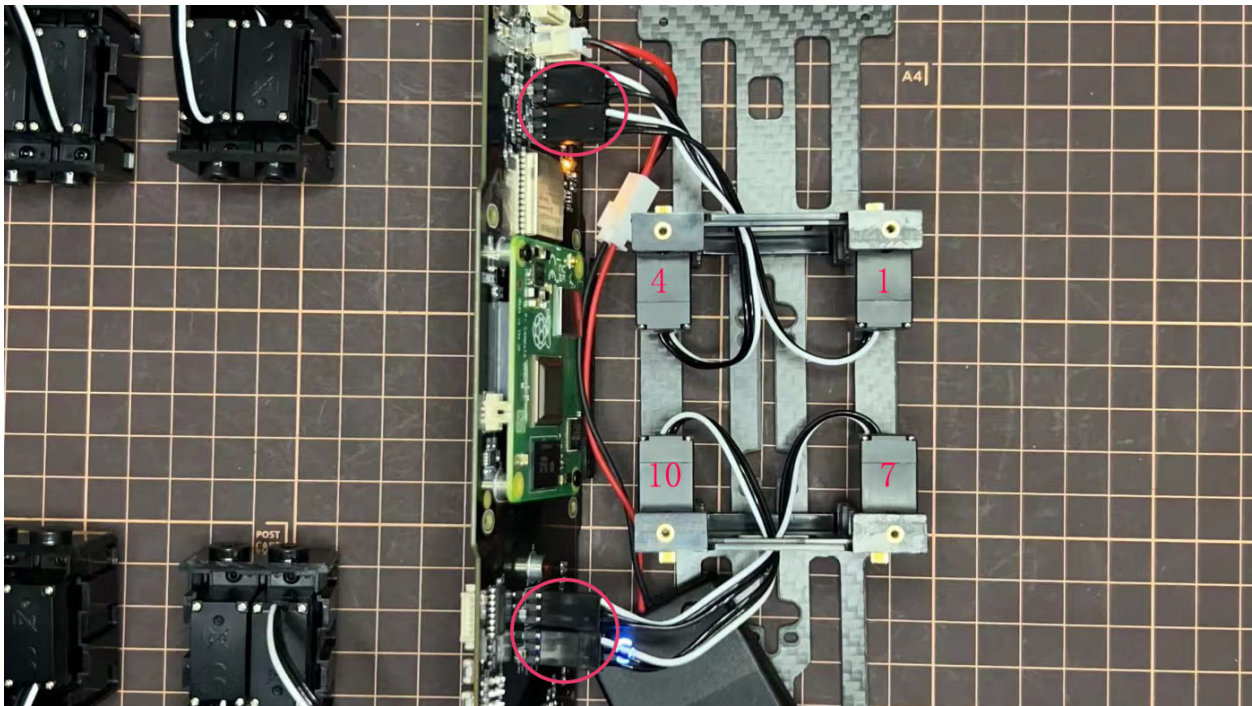
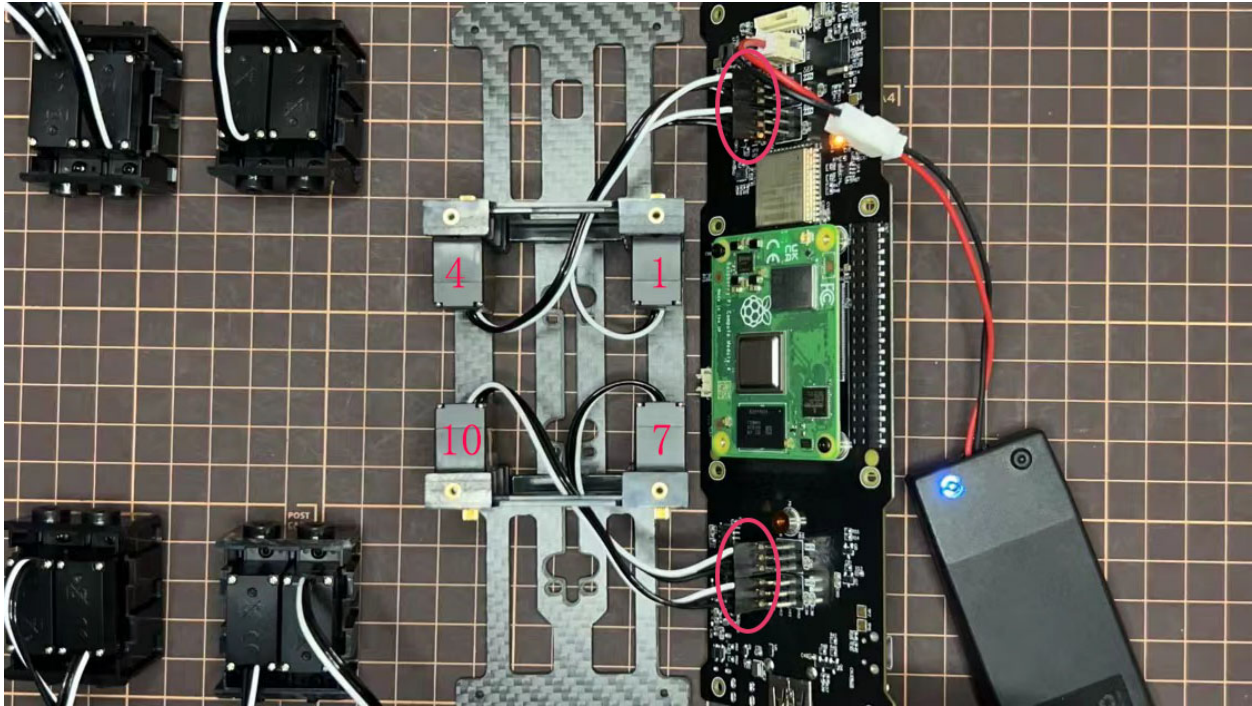
Ensure the No.1, 4, 7, 10 servos at the right position.



Use the custom cable to connect the battery to the top PCB board, and click the battery button for more than 3 seconds to boot up it.

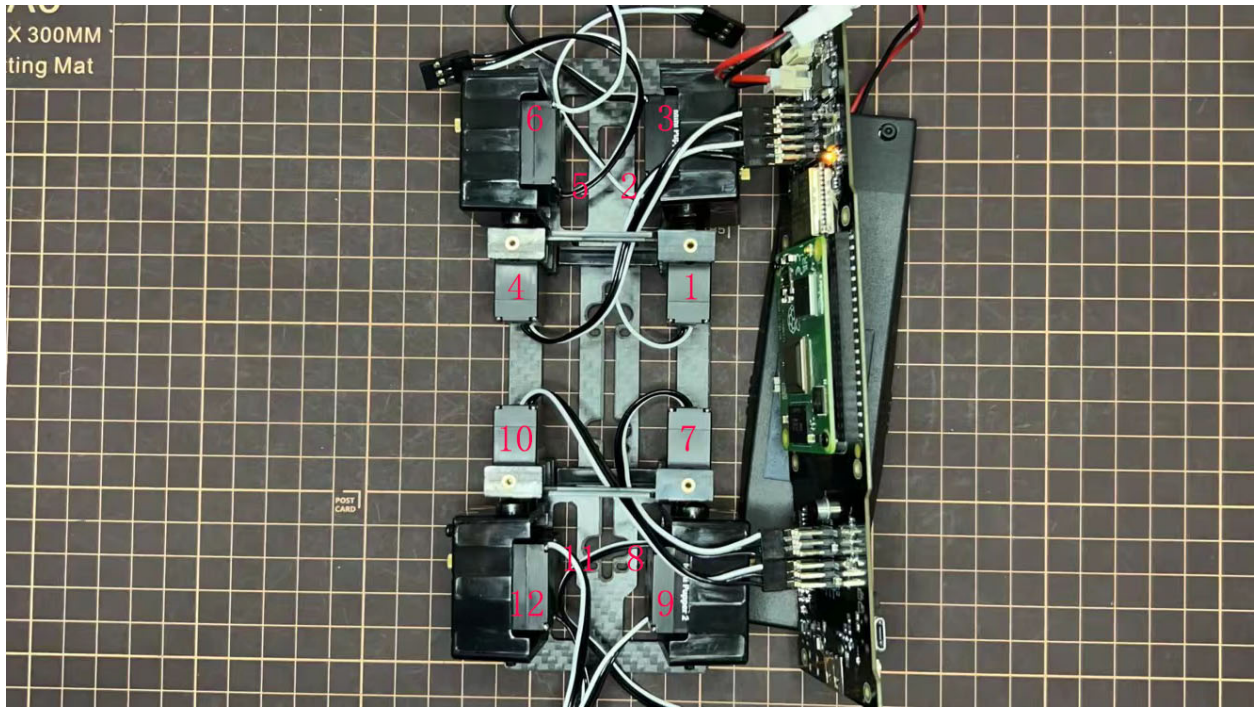


Connect the servos to the top PCB board, please pay attention to the servo connector directions.



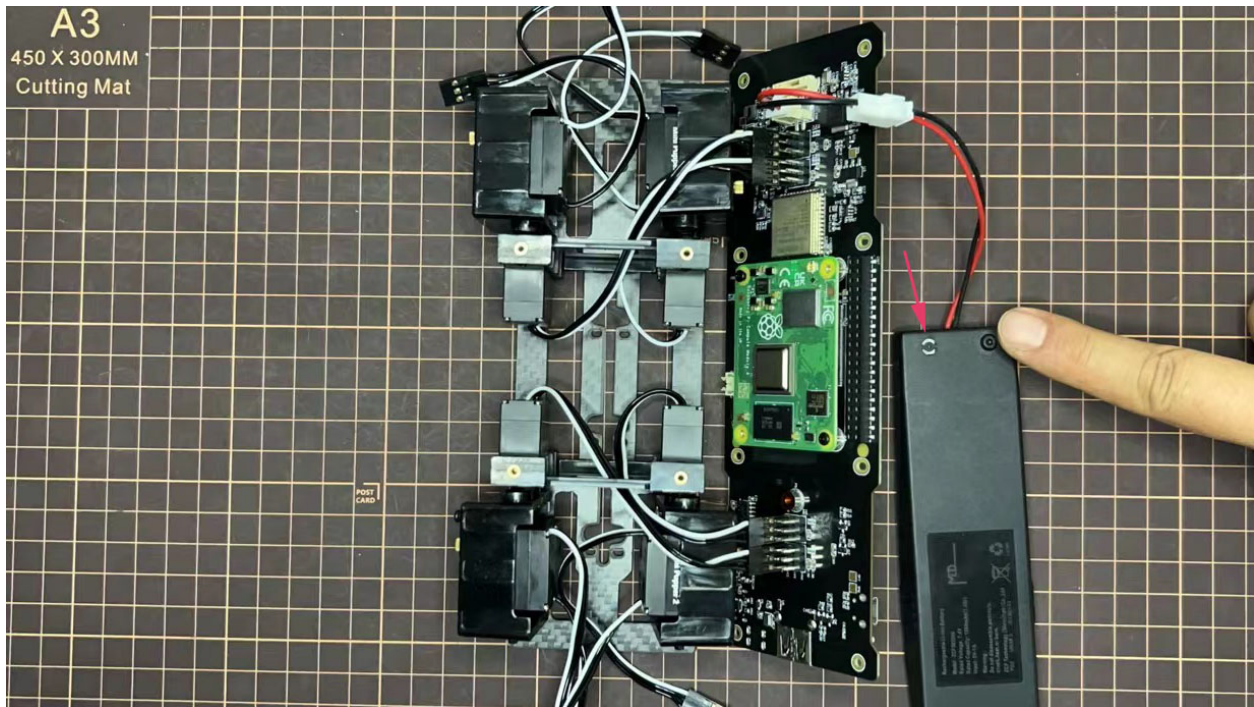
Connect the four hip parts to the body, please pay attention.

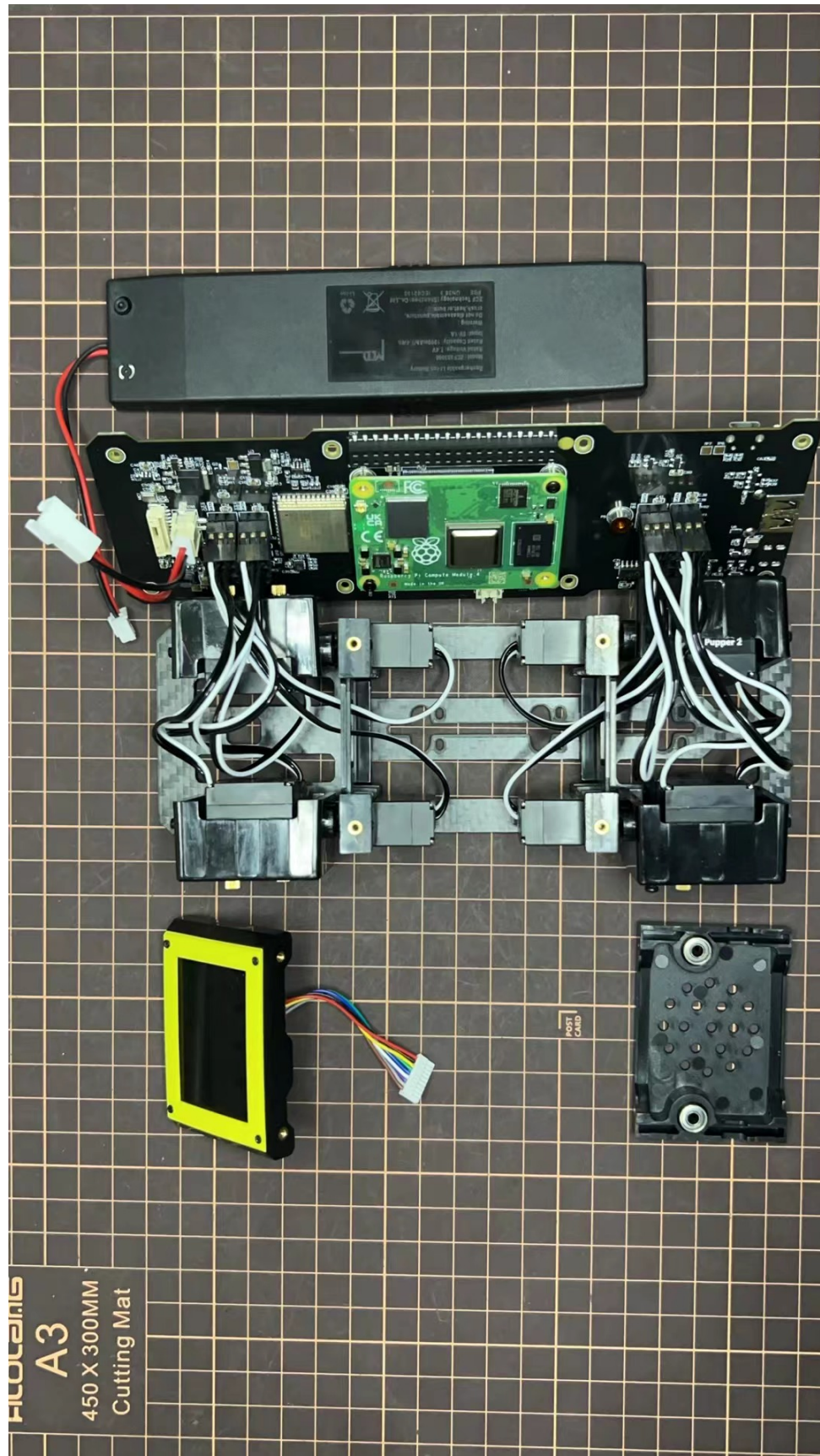
- Don't power off the battery now.
- Ensure all the servo positions are right.



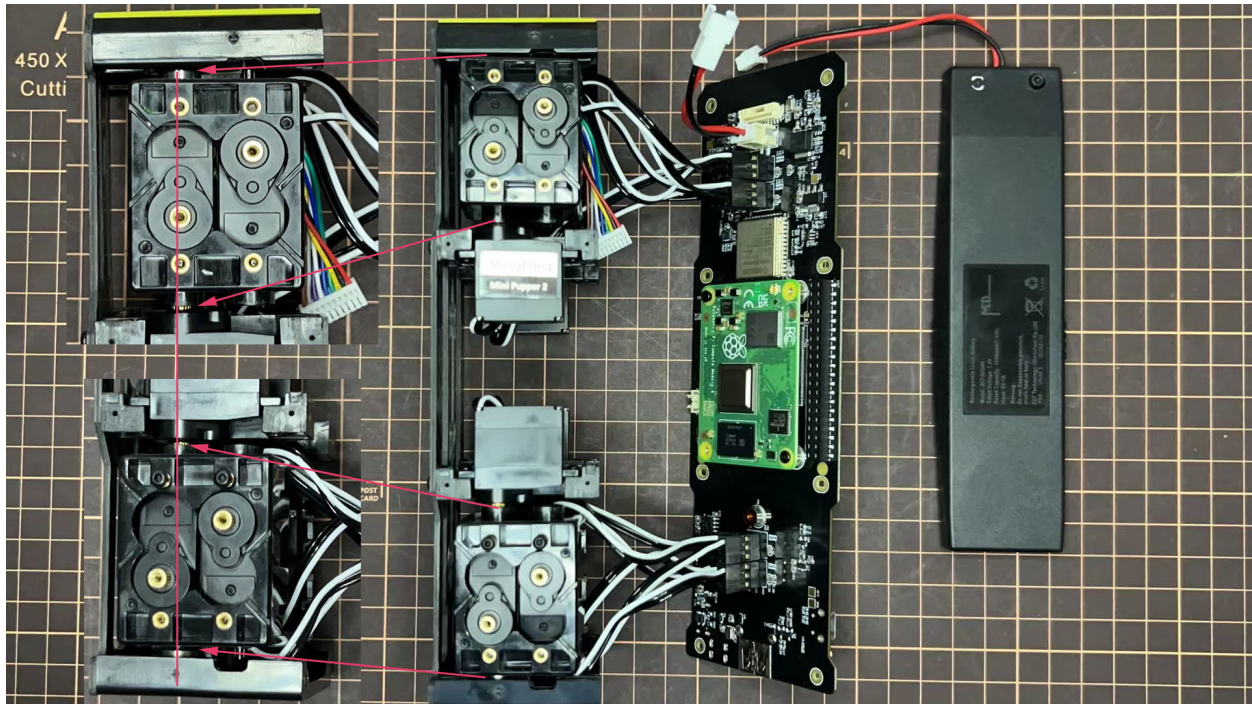
Step 5.3 Front and back body parts

Power off the battery, and connect the front and back body parts.

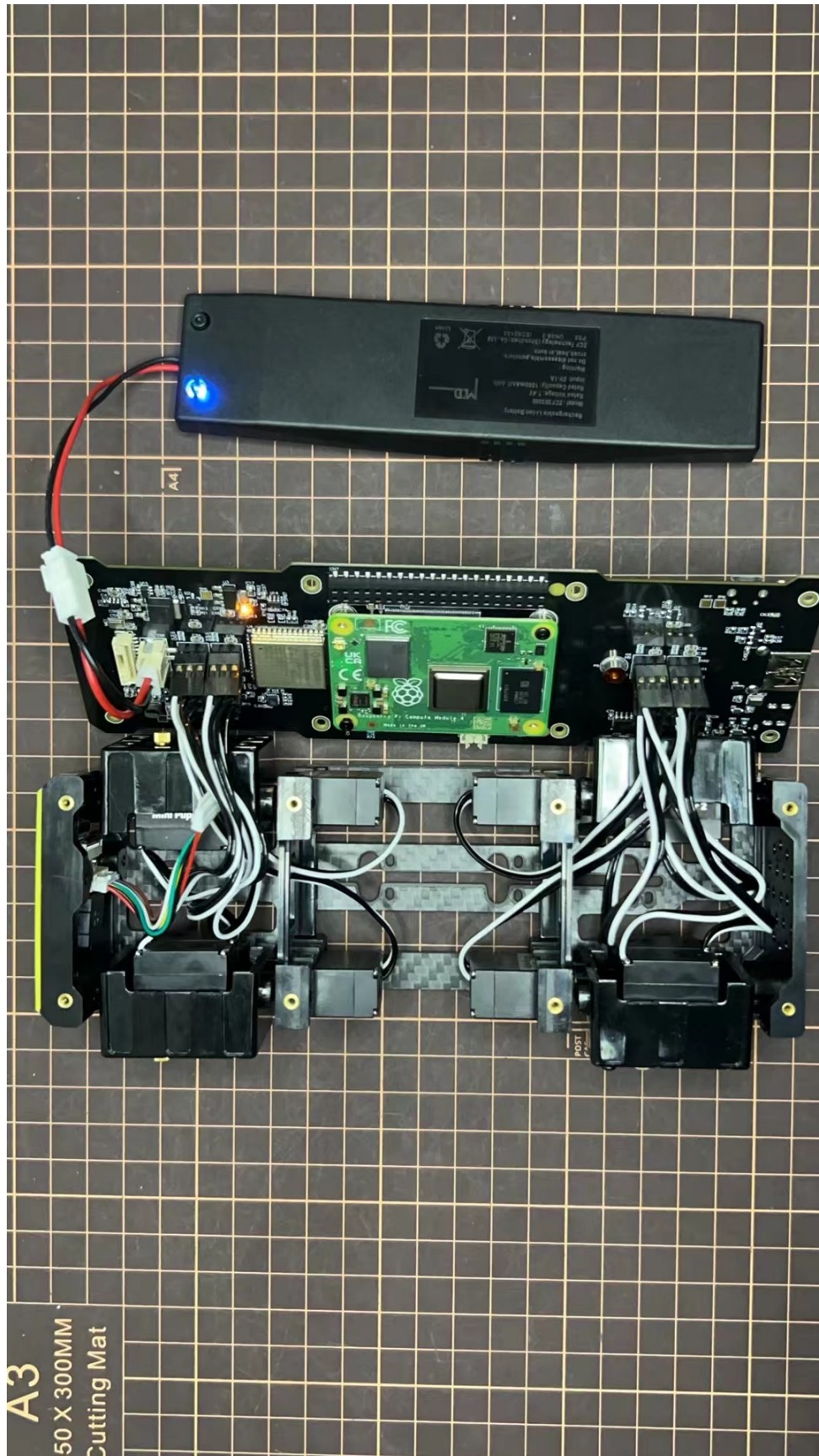




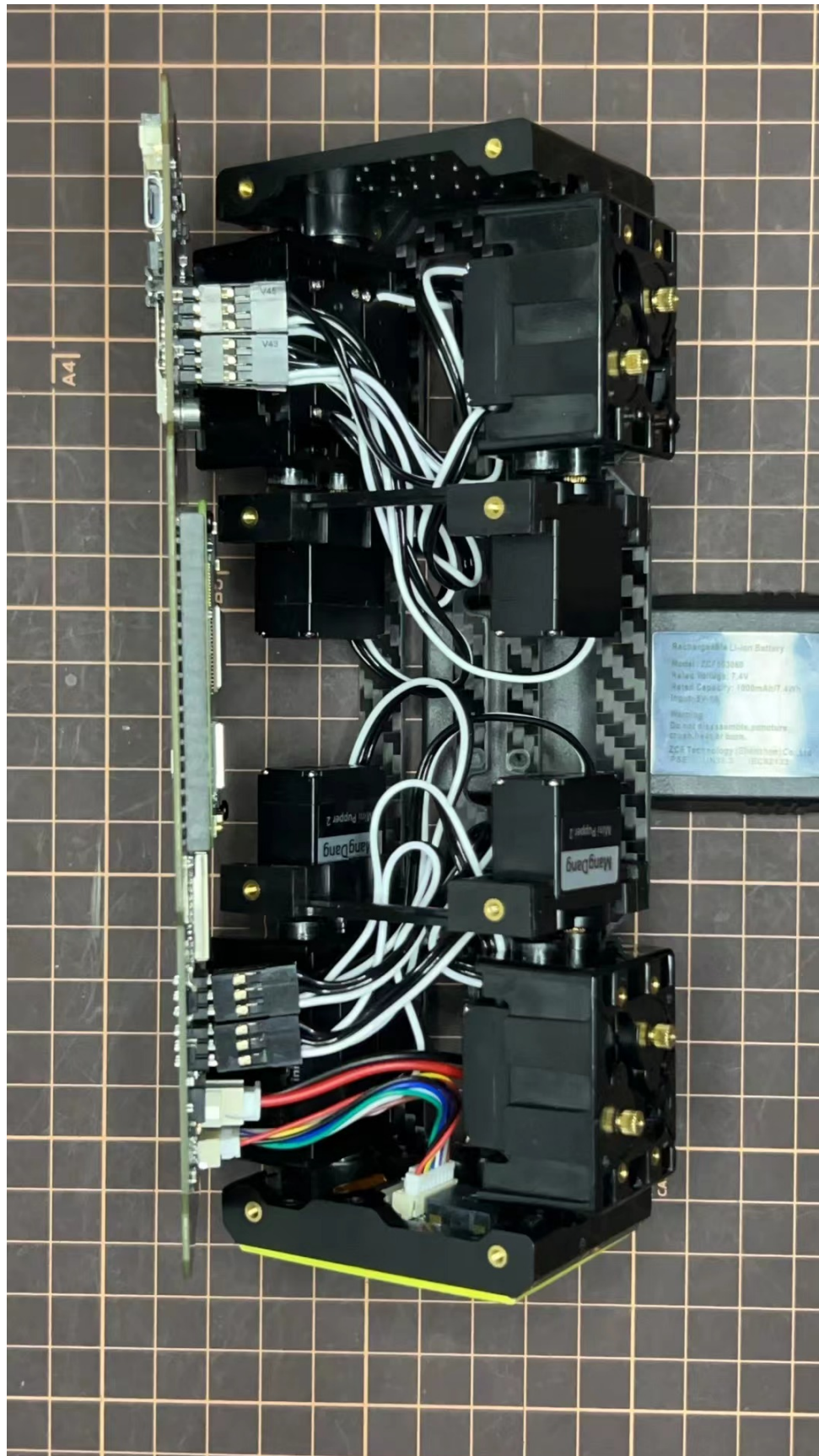
Pay attention to the directions.

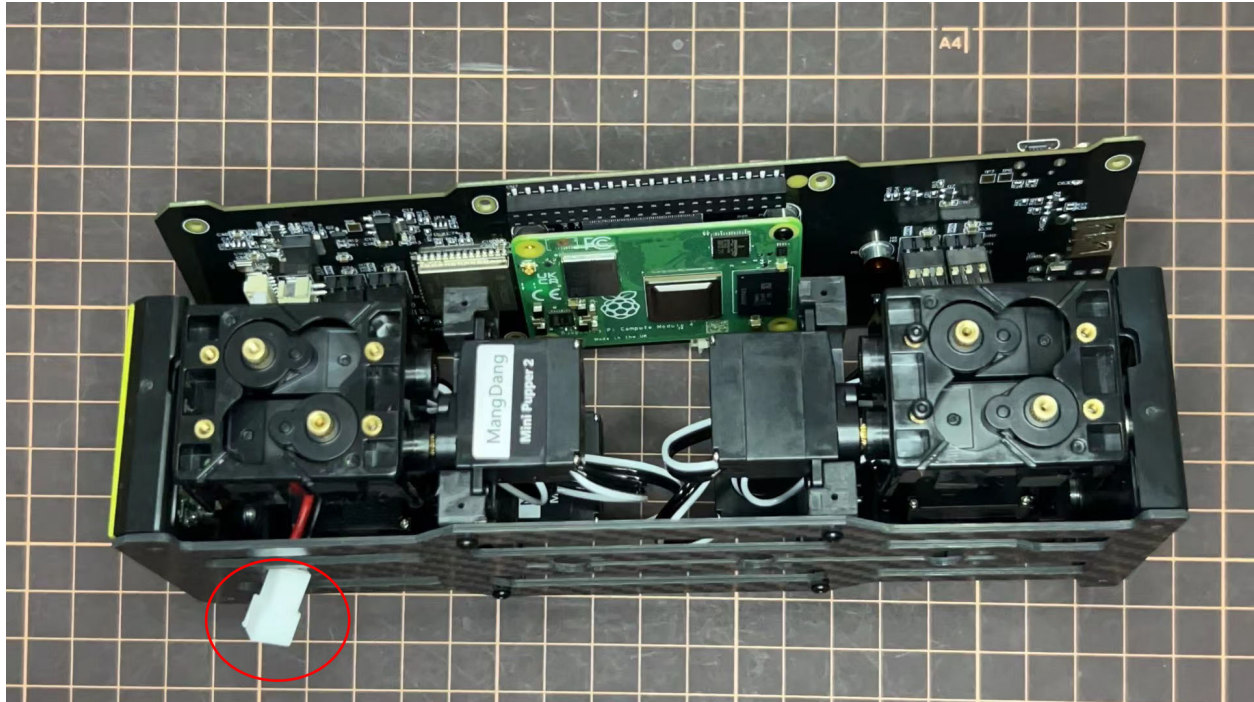


Power on the battery to check the hip parts all at their right positions, connect all the rest servos to the PCB board, and then power off the battery and go ahead.

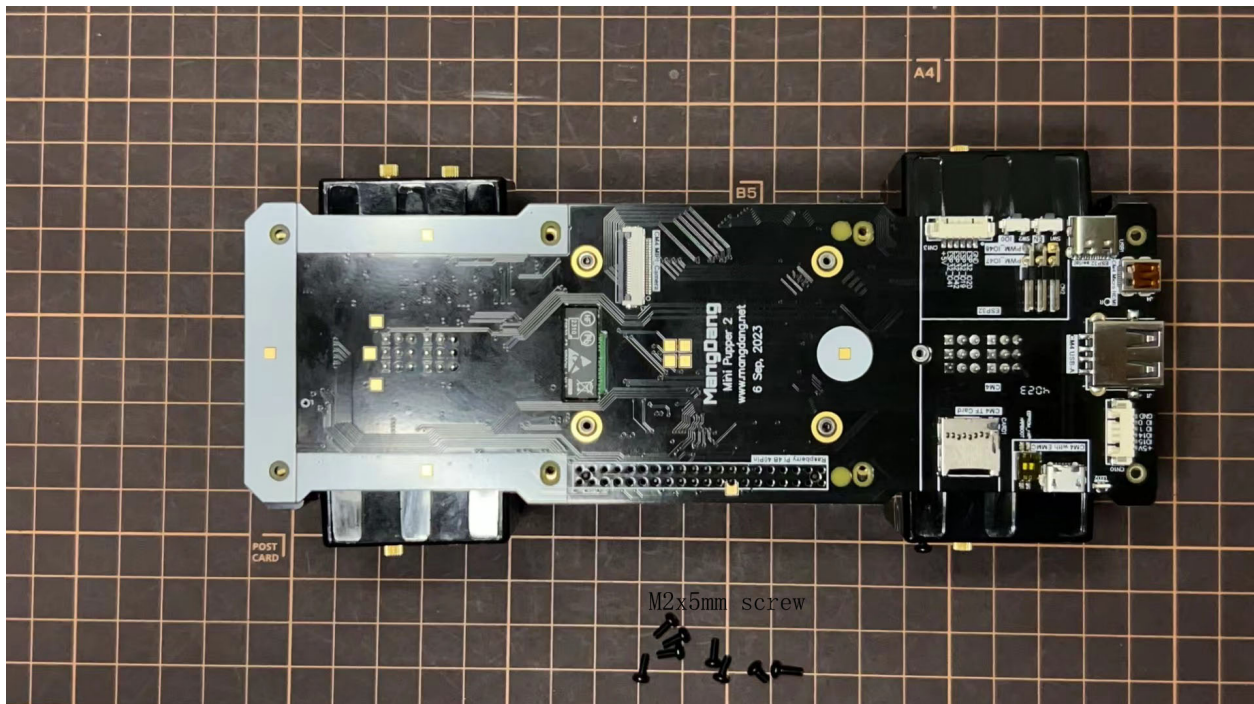


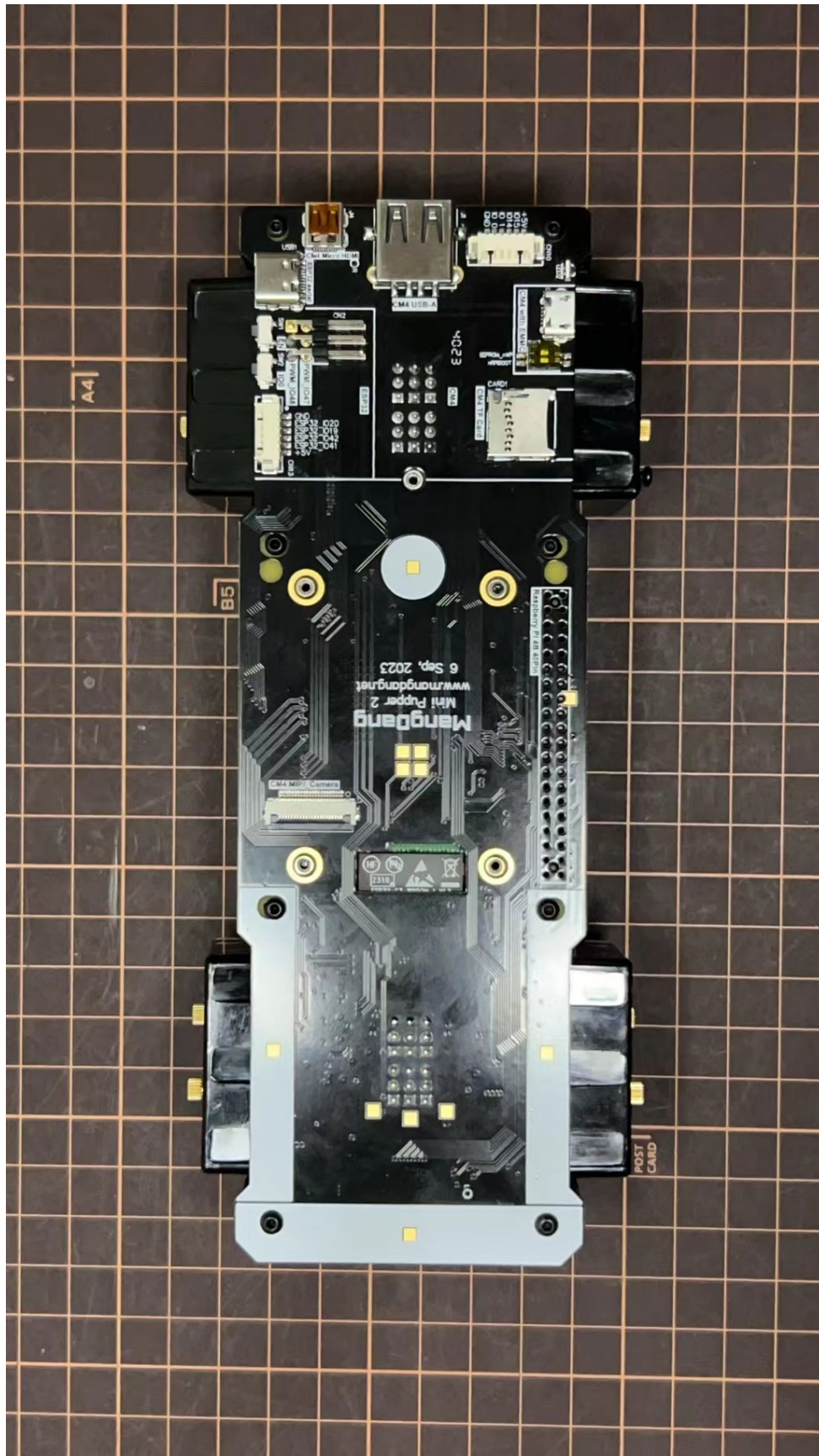
Connect the LCD cable to the PCB board, make the servo cables clear.

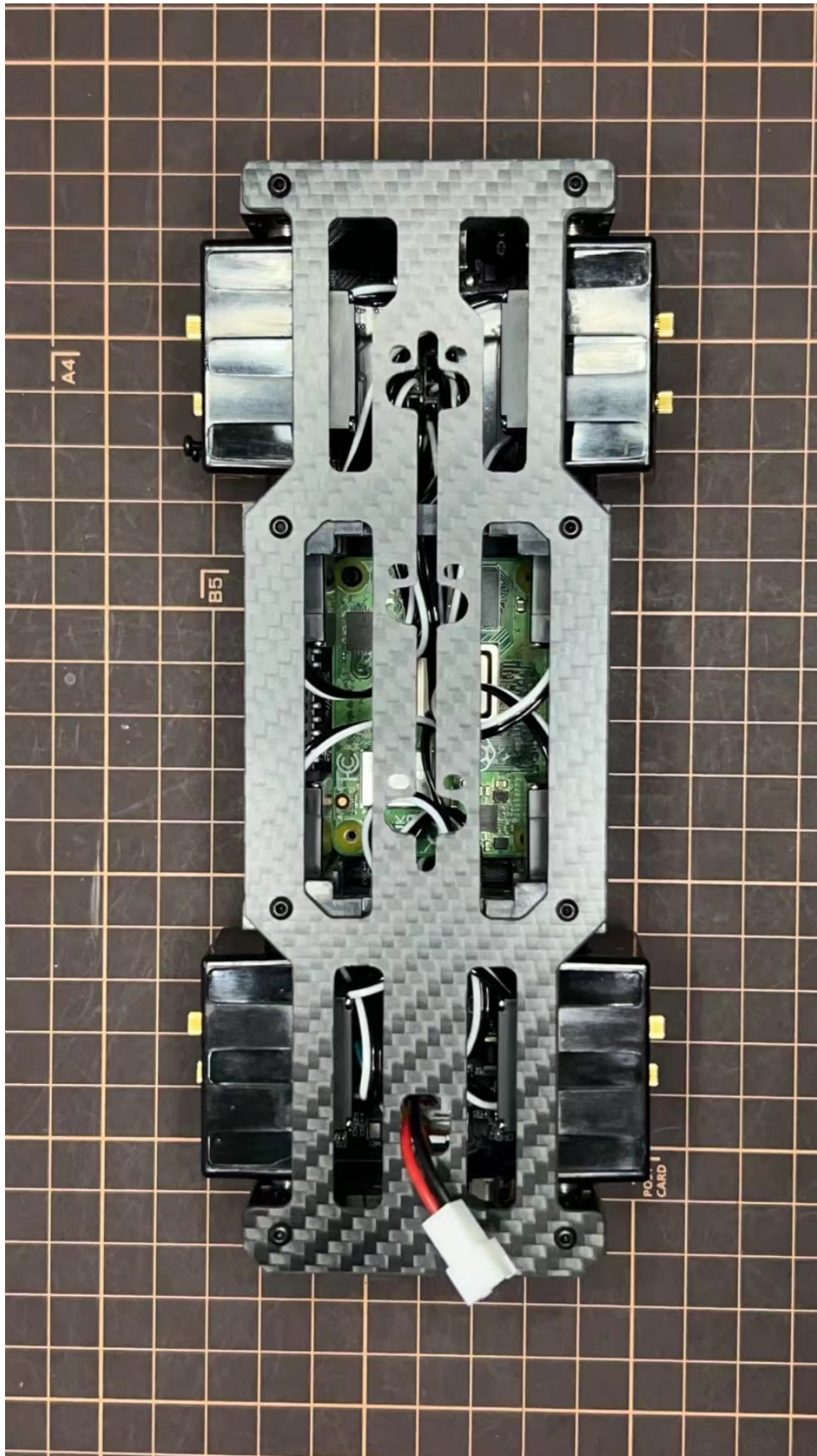




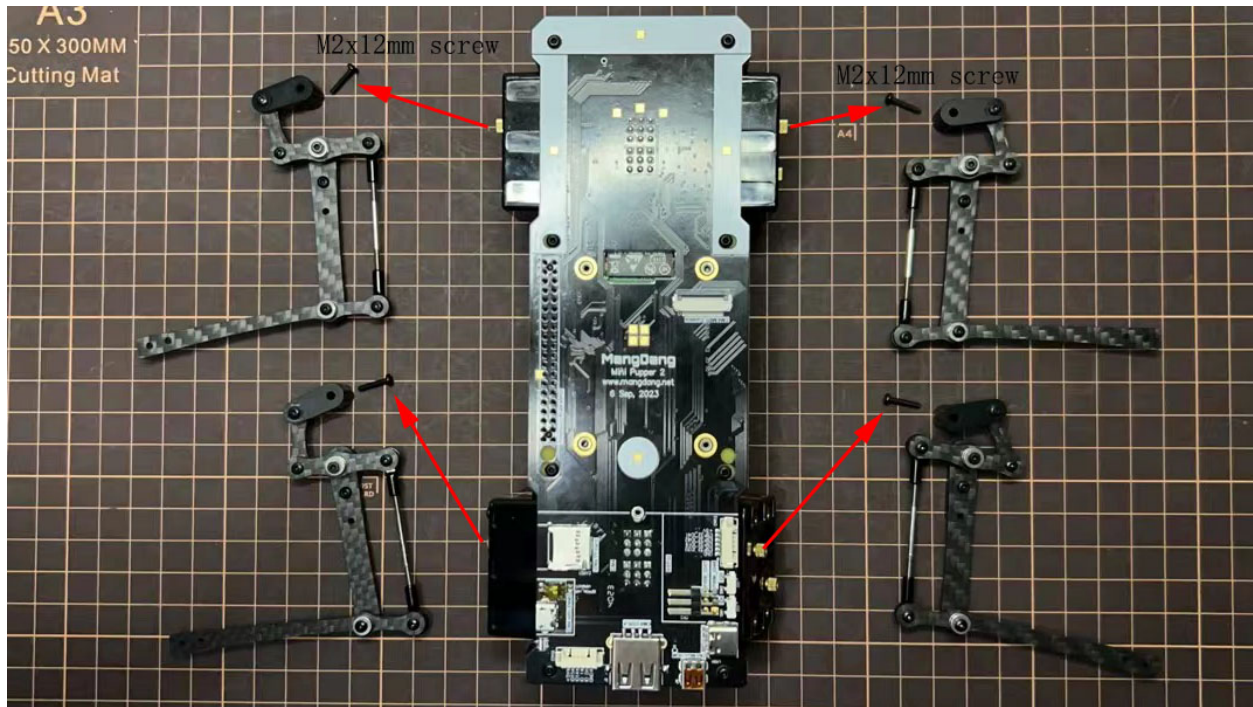
Fix the top and bottom boards.



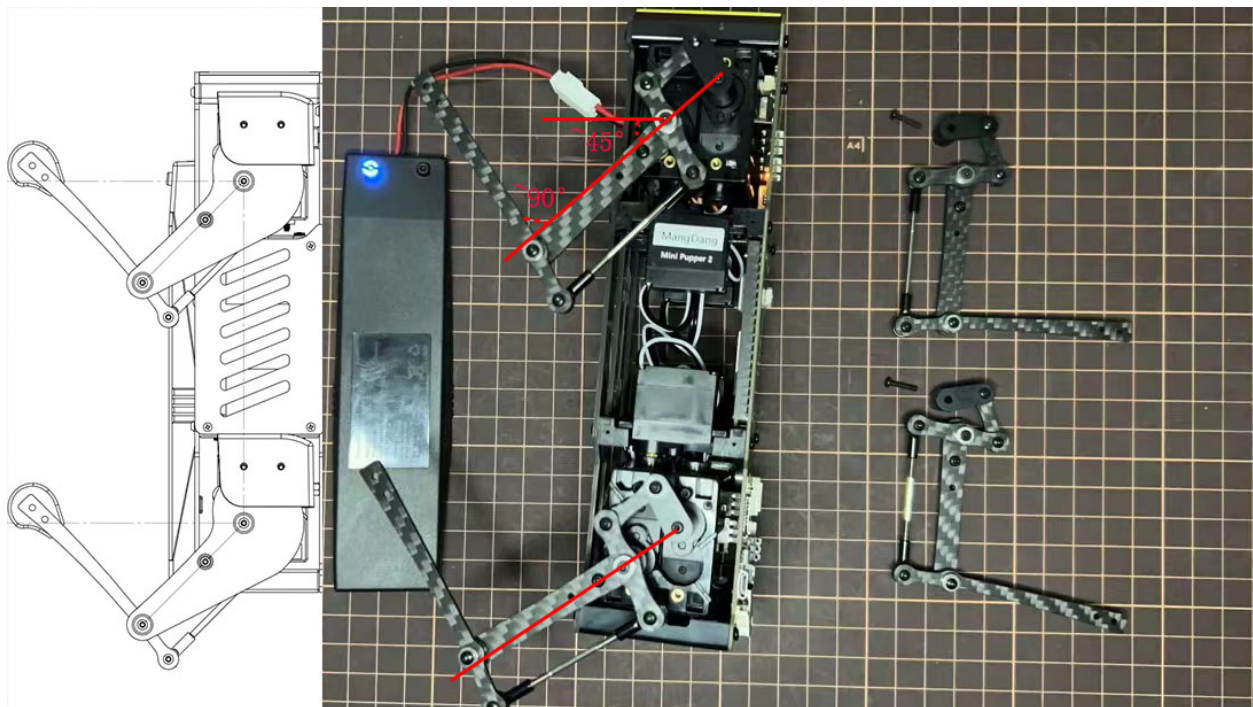


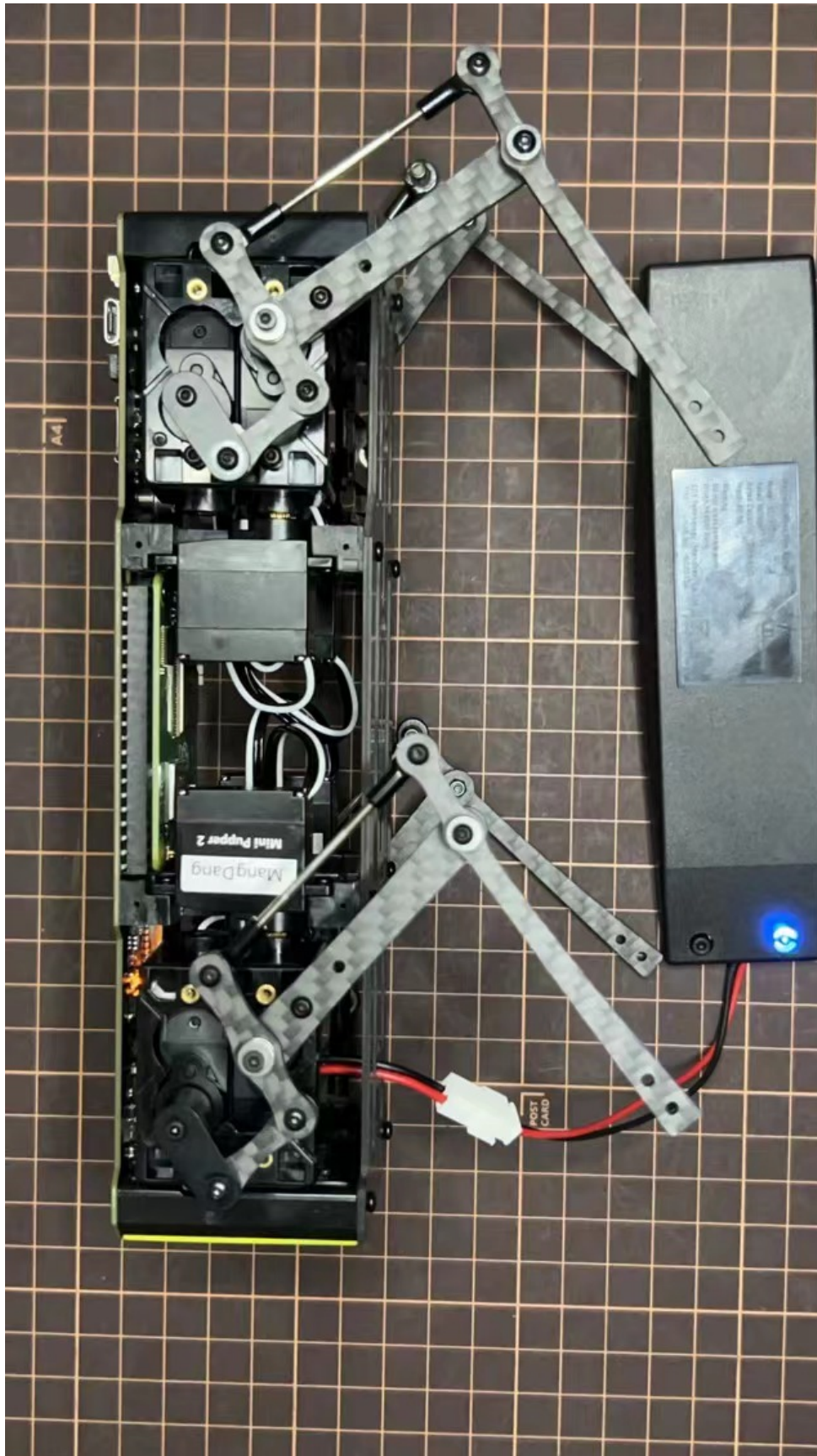


Step 5.4 Assemble four legs to the body

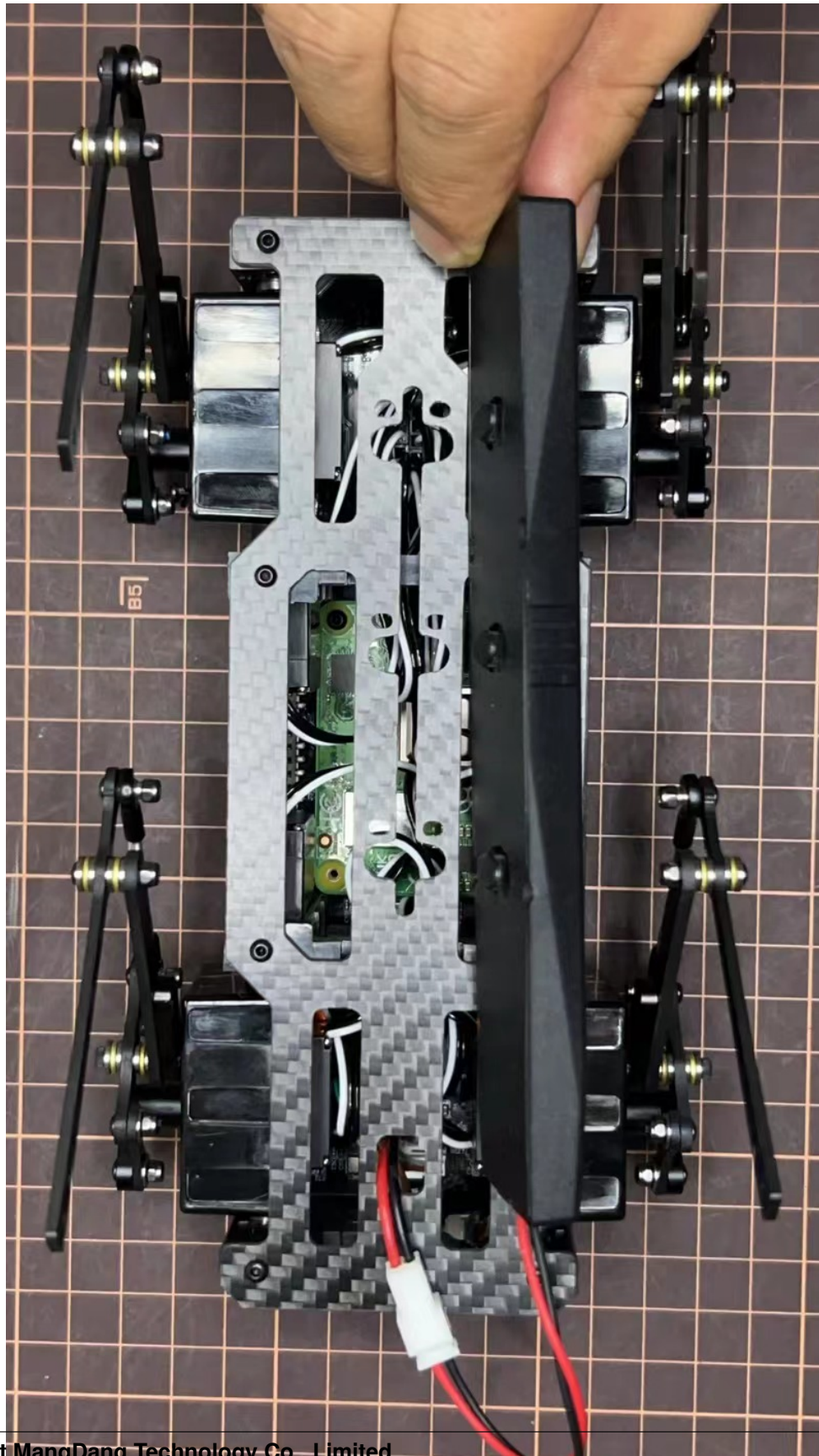


Pay attention to the theoretically best angles, it's better to meet the theoretically best angles as much as possible. But don't worry, we'll use the software to calibrate the angles later.

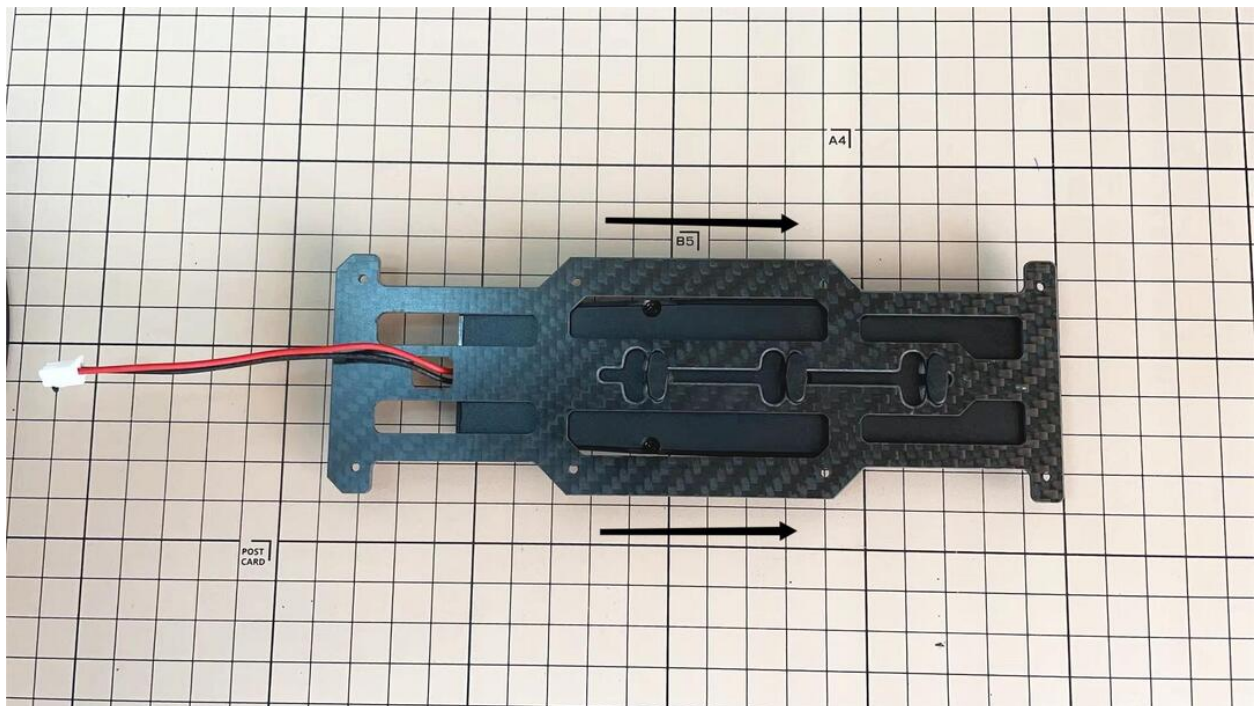
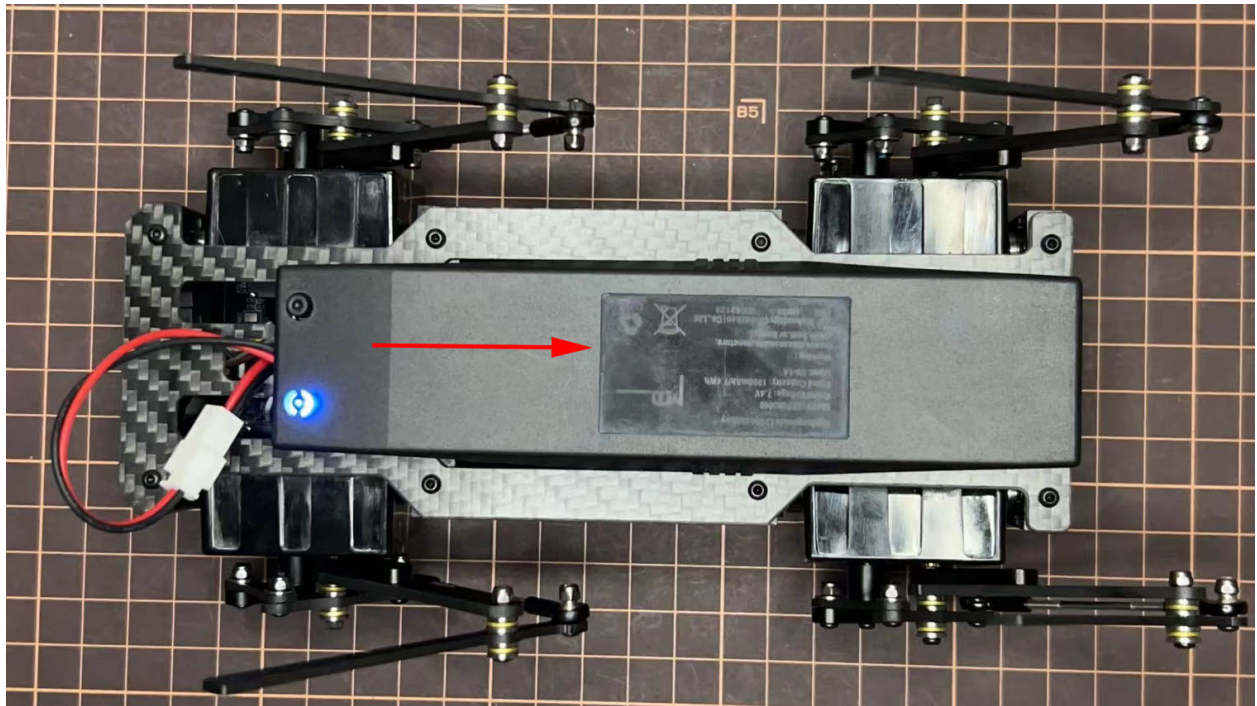


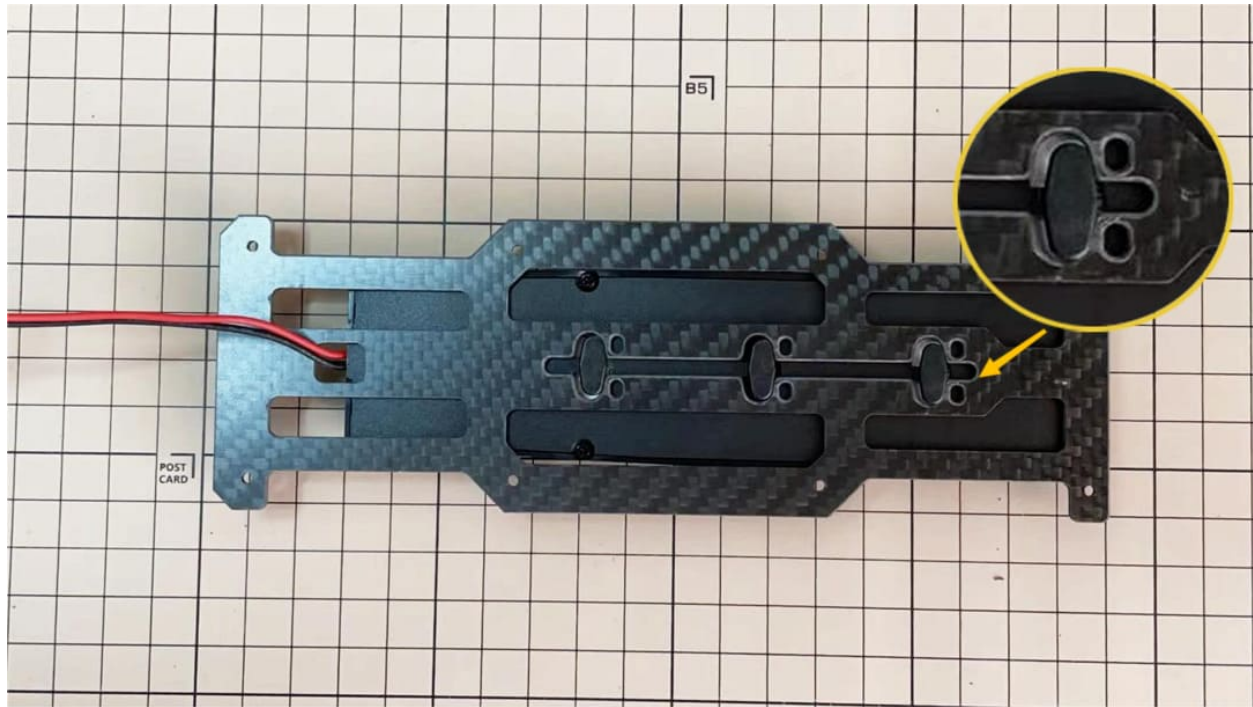


Step 5.5 Assemble the battery to the body

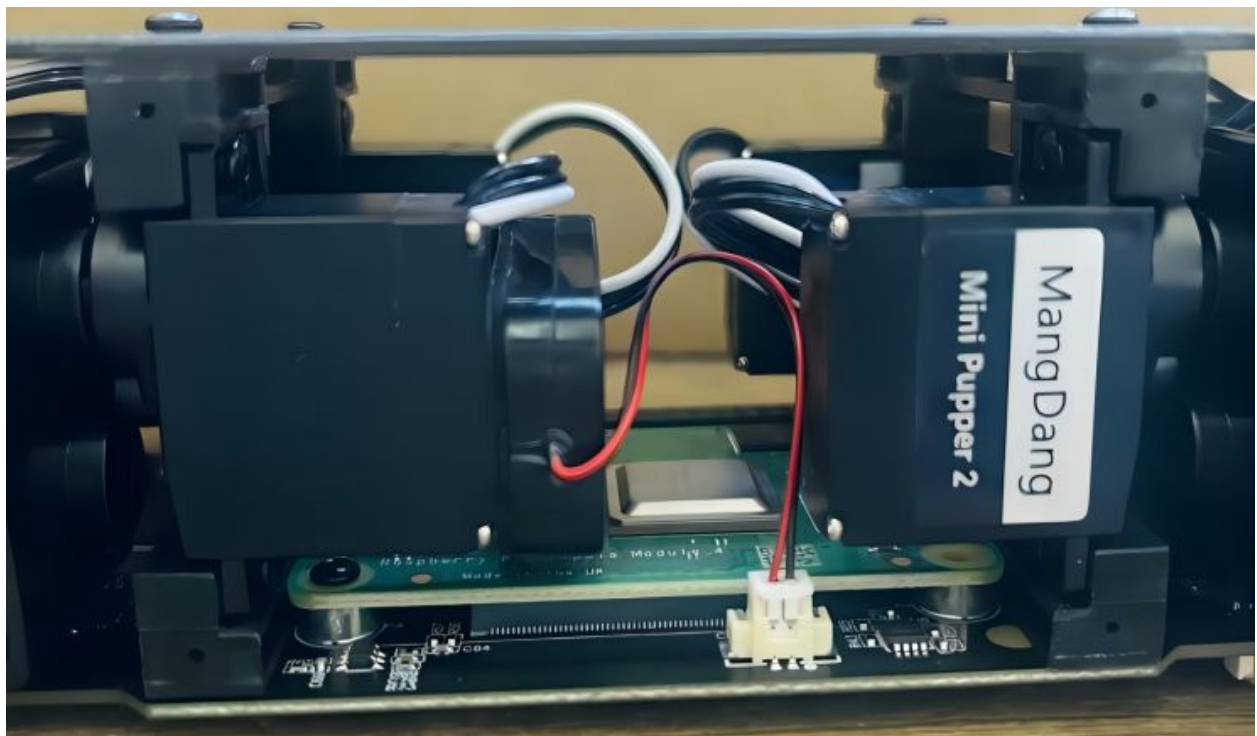
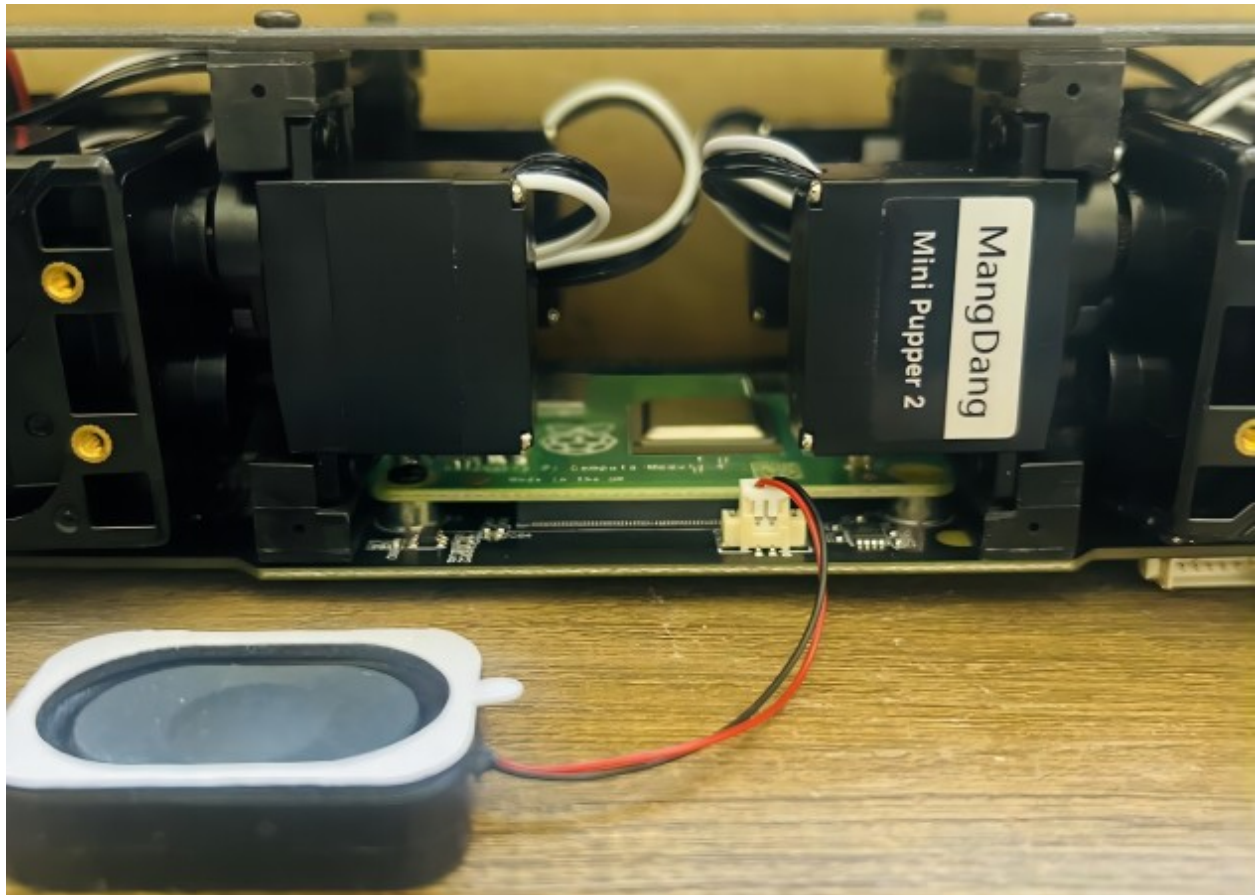


Slide the battery backward and secure it.





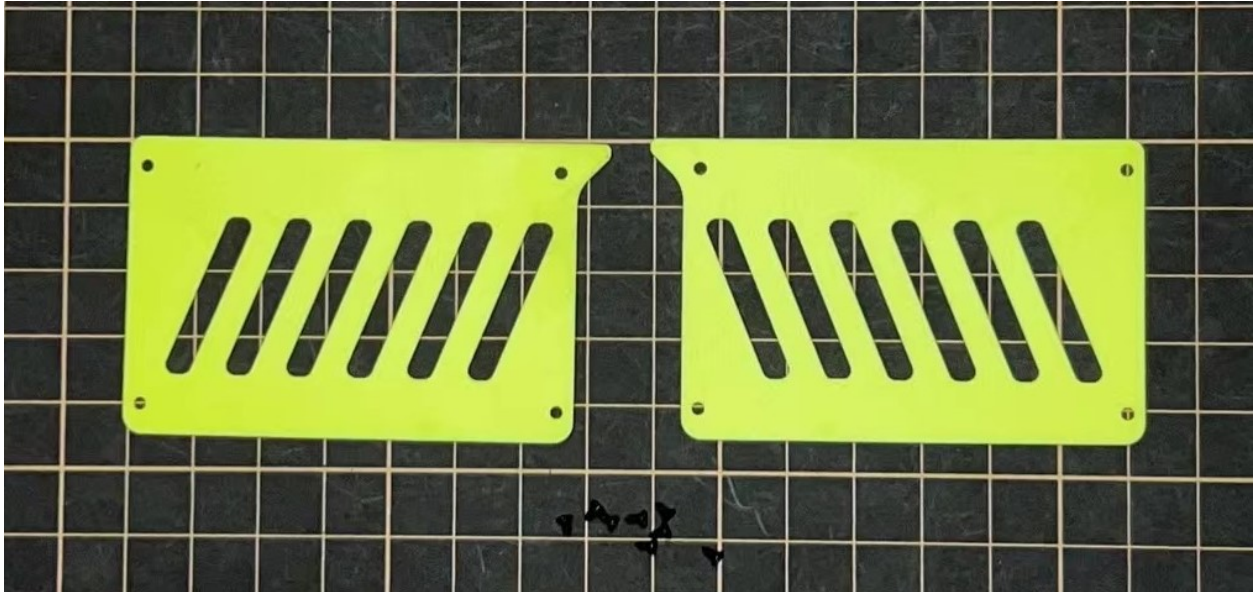
Step 5.6 Assemble the speaker



6. Cover Assembly

Please refer to the below video clip.

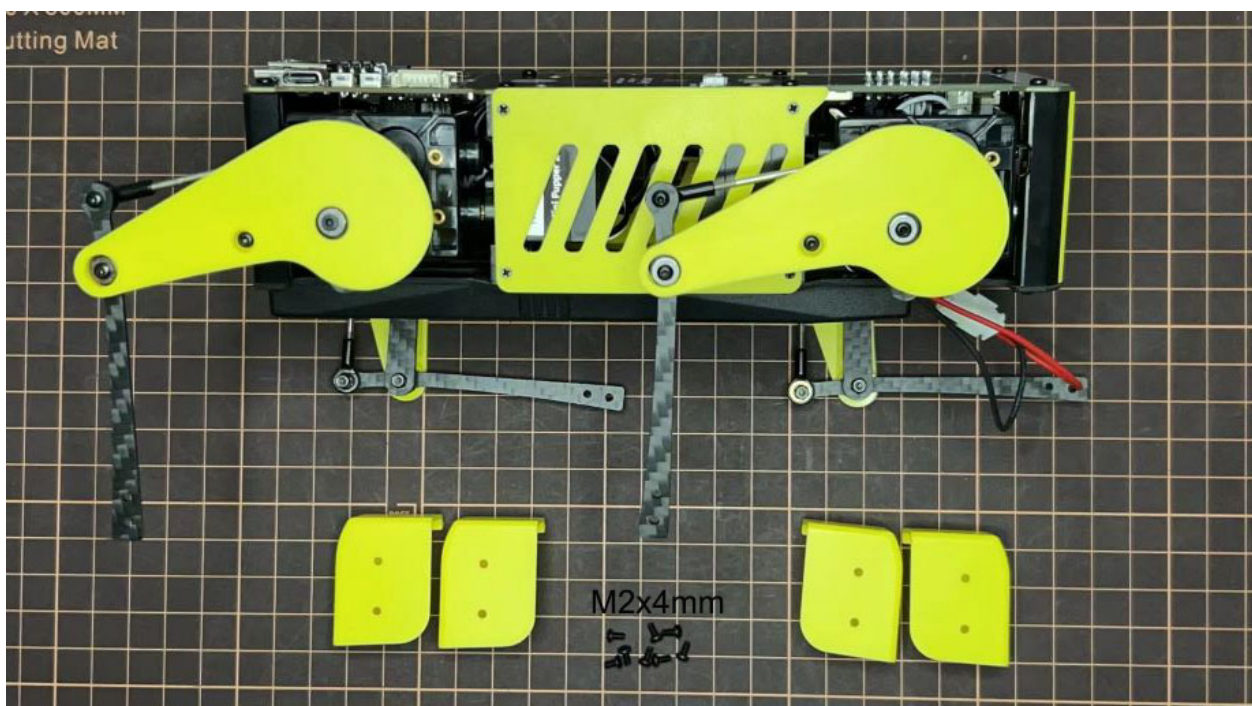
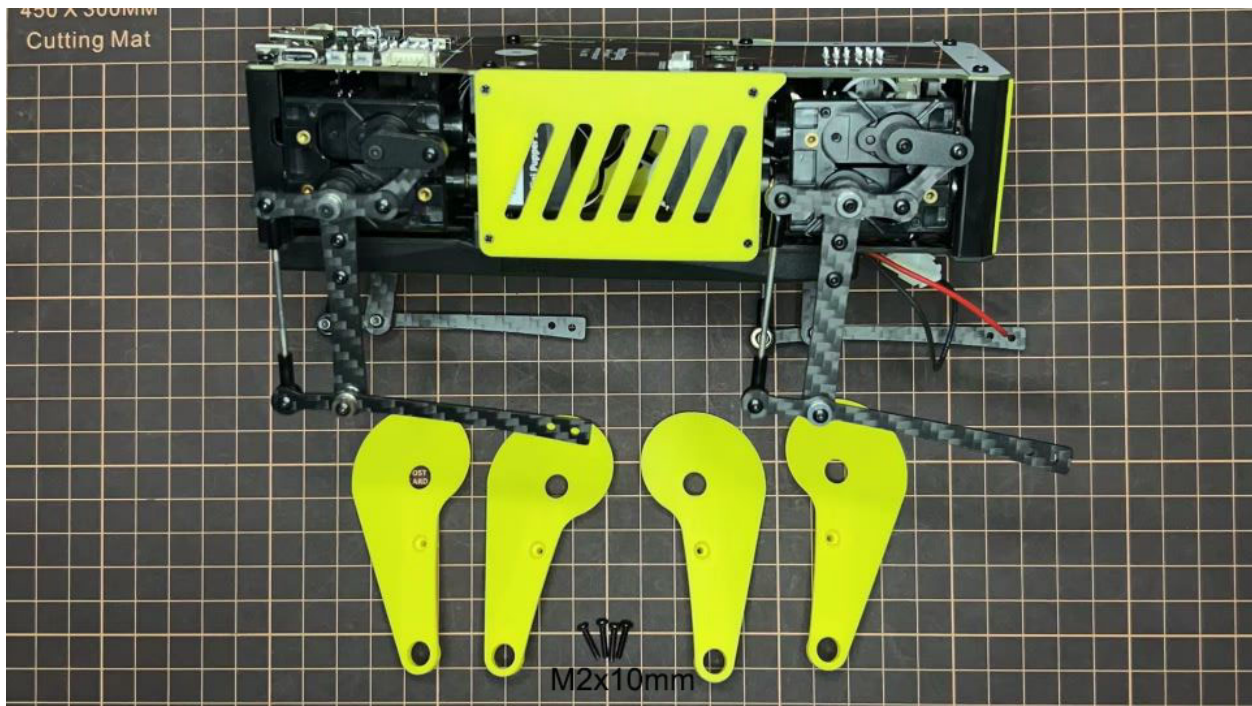
Step 6.1 Side panels





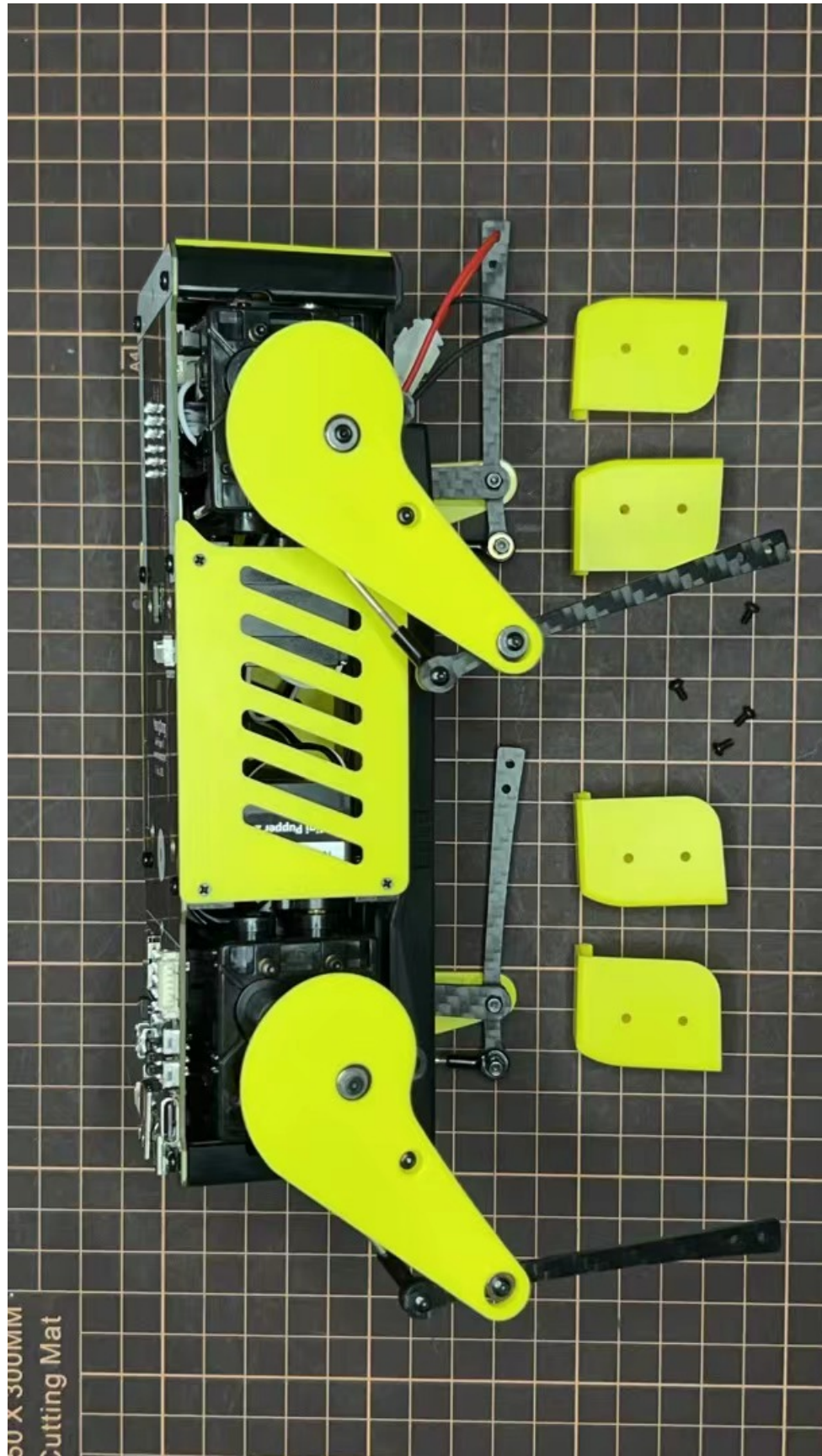
Step 6.2 Shin guards

- Use four M2x10mm countersunk screws.

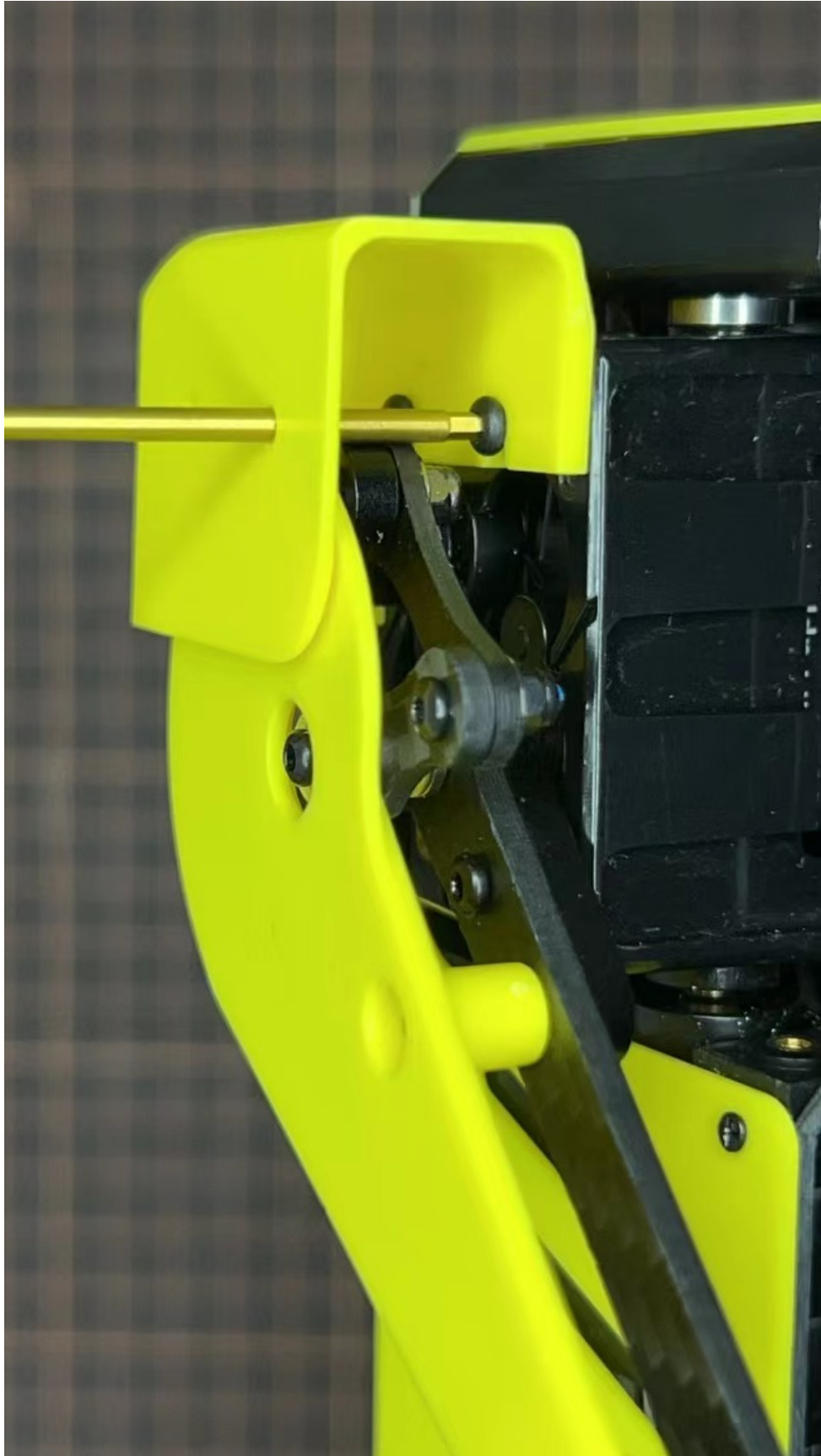


Step 6.3 Shoulders

- Insert only the screws first and then insert the shoulder parts into the gap. Insert the 2 mm hex driver into the hole in the shoulder part and tighten the screws.









Step 6.4 Shoes

- Put on 4 shoes.



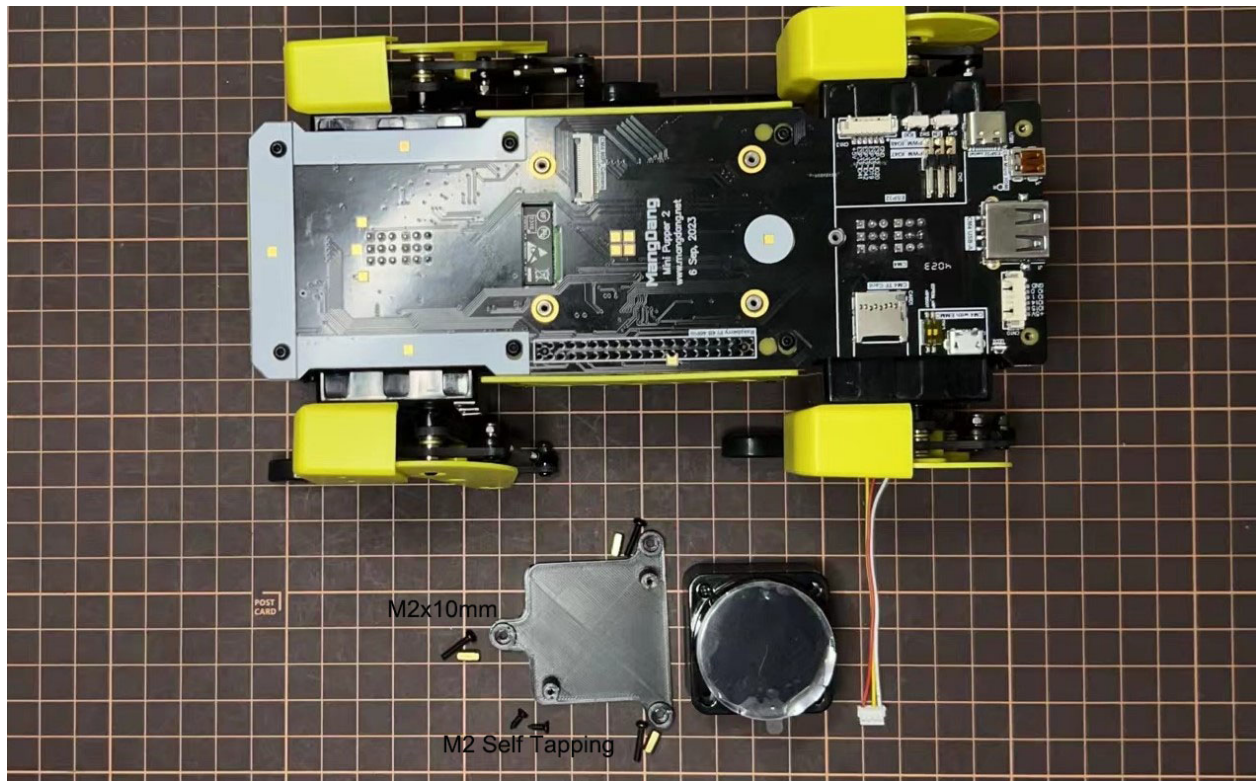


Complete!

7. Add-On Assembly

Step 7.1 Lidar

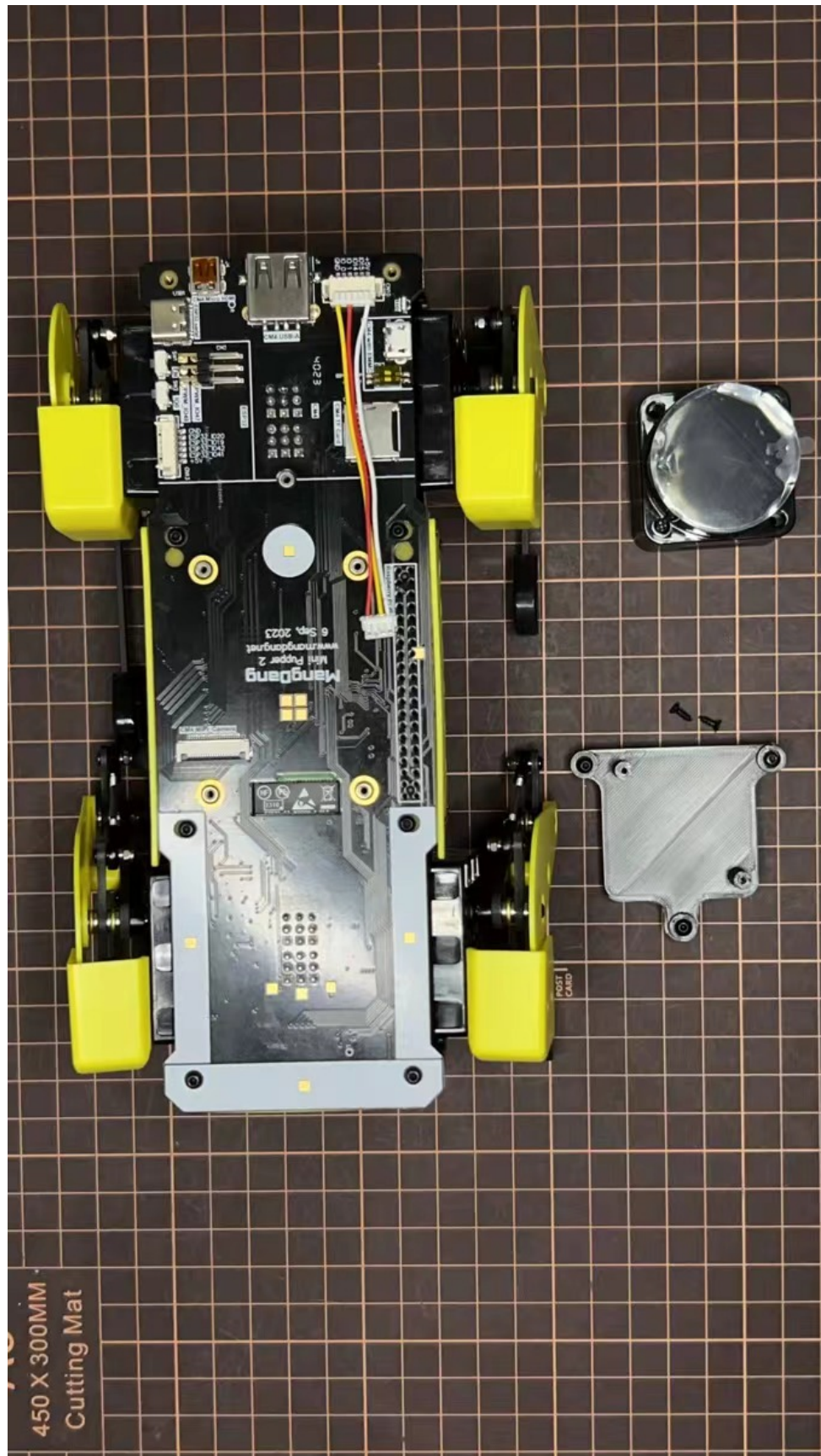
If you order the Lidar, the 3D-printed Lidar holder and custom cable will be shipped together. You can also print the holder by yourself using the [Mini Pupper 2 STL files](#)



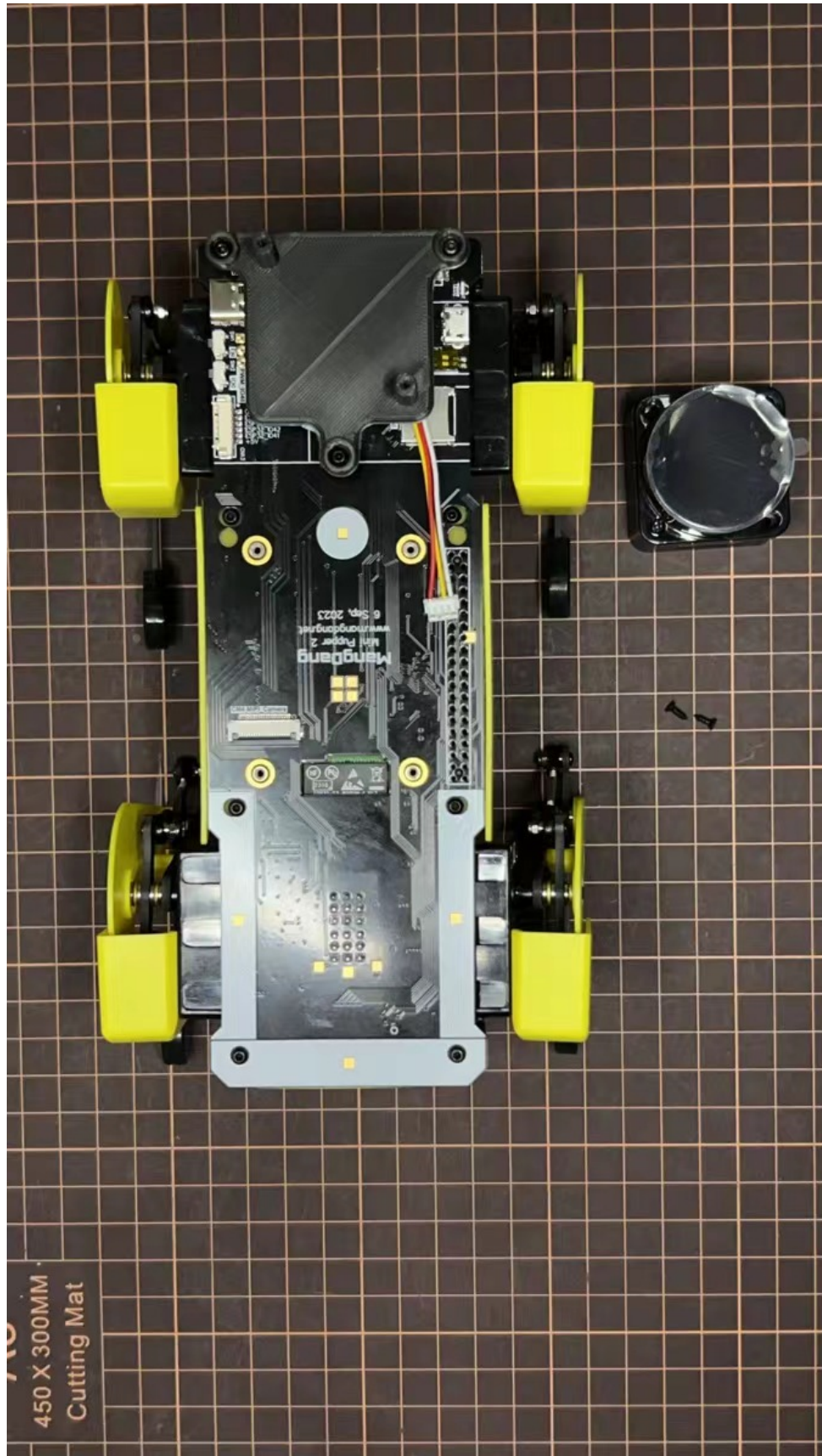
Connect the 3 holders to the 3D-printed part.



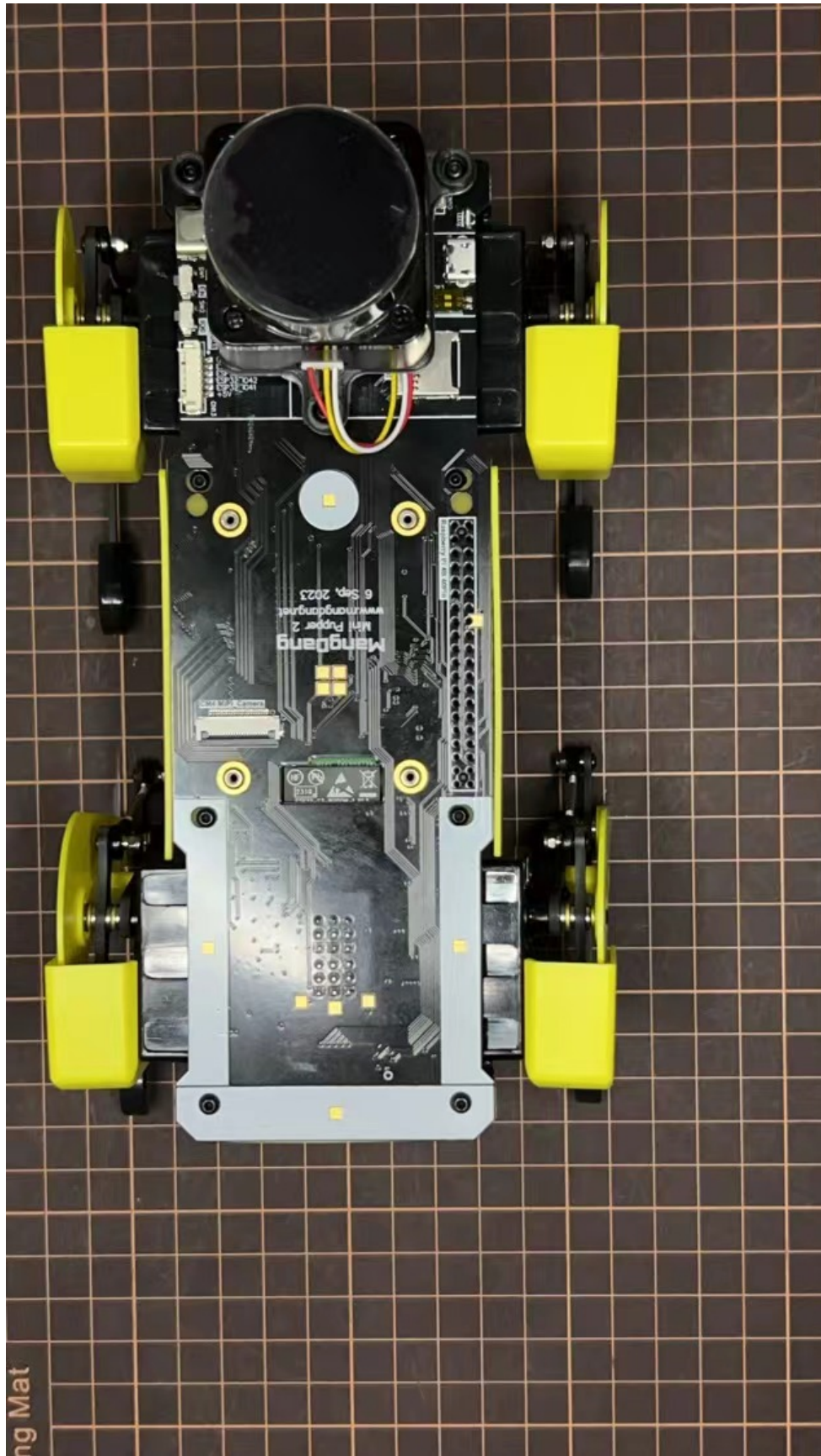
Connect the custom cable to the Lidar connector on the PCB board.



Fix the 3D-printed part on the PCB board.

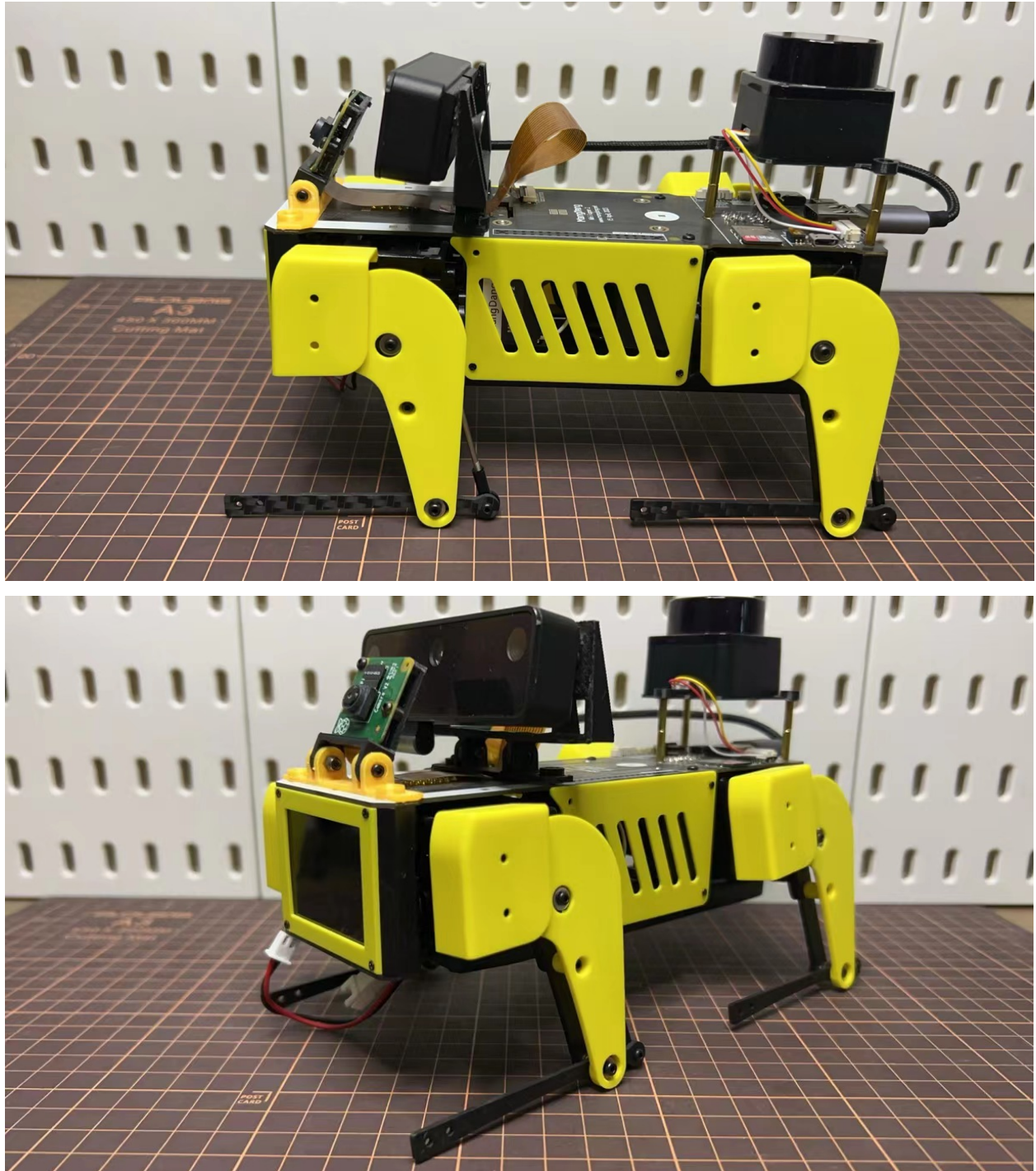


Connect the custom cable to the Lidar module and fix it using the self-tapping screws.



Step 7.2 Camera

Mini Pupper 2 also supports the single Pi camera or OpenCV OAK-D-Lite camera module. You can also print the holder by yourself using the [Mini Pupper 2 STL files](#)





1.2.6 Assemble Mini Pupper 2 Pro

Contents

- *Assemble Mini Pupper 2 Pro*
 - 1. Write the pre-built image into microSD
 - 2. Position of the screws
 - 3. Legs Assembly
 - 4. Display and Frame of face
 - 5. Body Frame and Hips Assembly
 - 6. Cover Assembly
 - 7. Add-On Assembly

* General DIY process:

- Assemble → Calibration → Run

* Attention:

- The MCU(ESP32 and AT32) software are both pre-installed, you don't need to flash any MCU image.
- You don't need to set each servo number as Mini Pupper 2 because the servo number is fixed by the hardware design, please follow the guide to put the servo to the right positions.

Please refer to Mini Pupper 2 Fusion 360 CAD model for your reference: <https://a360.co/485n8mP>

1. Write the pre-built image into microSD

Tools

In addition to the tools included in the kit, the following items are required for assembly.

- USB keyboard
- USB mouse
- PC
- microSD card reader
- HDMI Display
- micro HDMI cable
- USB charger

Step 1.1 Charging the battery

- The battery is charged via USB, see picture for USB socket, and can also be charged while attached to the Mini Pupper body.

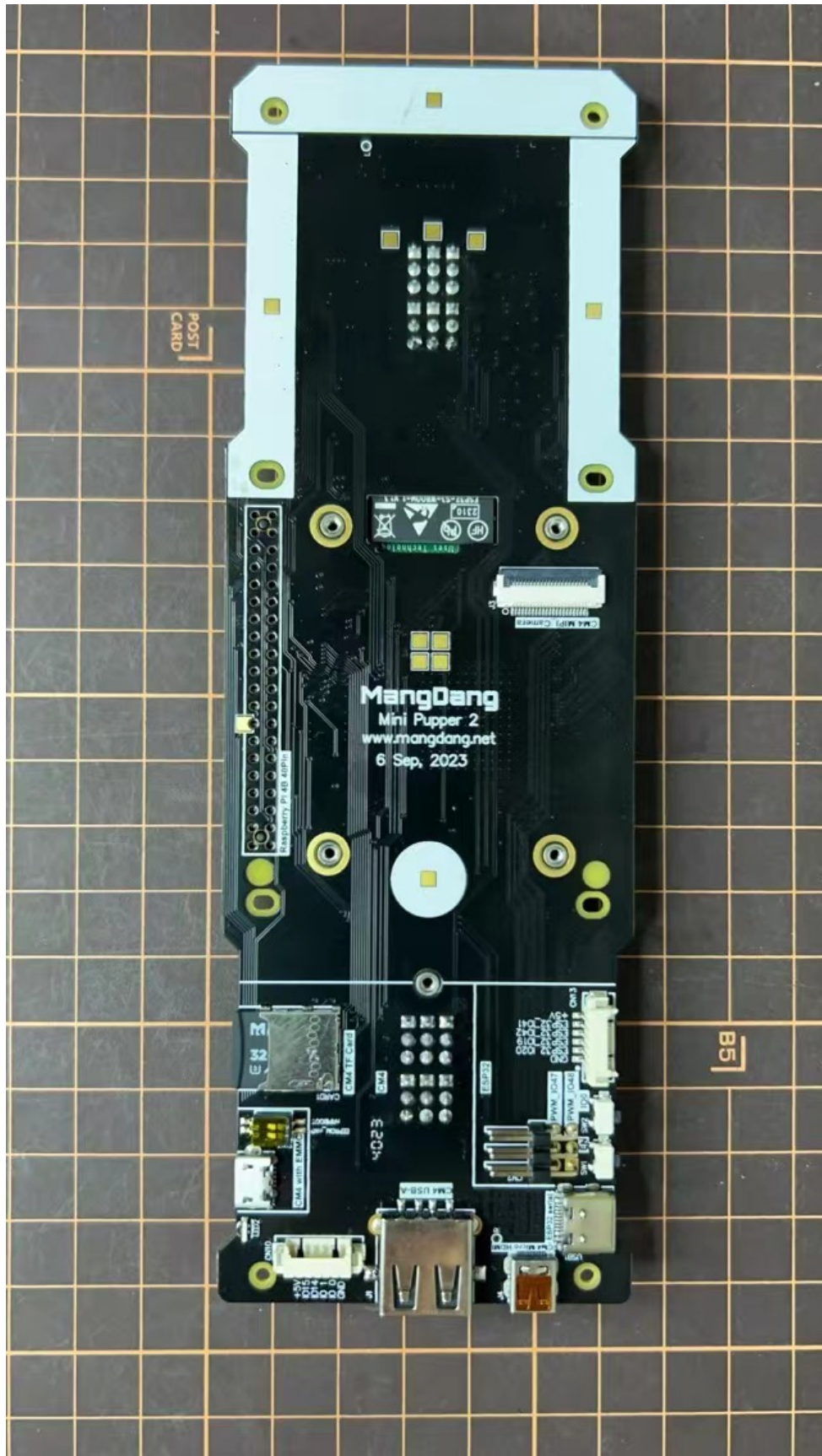
※ LED light: Green means there is enough power, and Red means you need to charge it.

※ We recommend 5V/1A adapter, if you use 5V/2A adapter, the battery IC will change it to 1A. It needs about 1 hour to charge 80% and the light will become green, and an additional 1 hour to 100%, anyway, you can use it when the light becomes green.



Step 1.2 Download the image

- You can download the pre-built image files from [Mini Pupper pre-built images](#)
- ※ “v2Pro_stanford**.img” means the image is for Ubuntu 22.04 version.
- The picture below is the custom carry board.

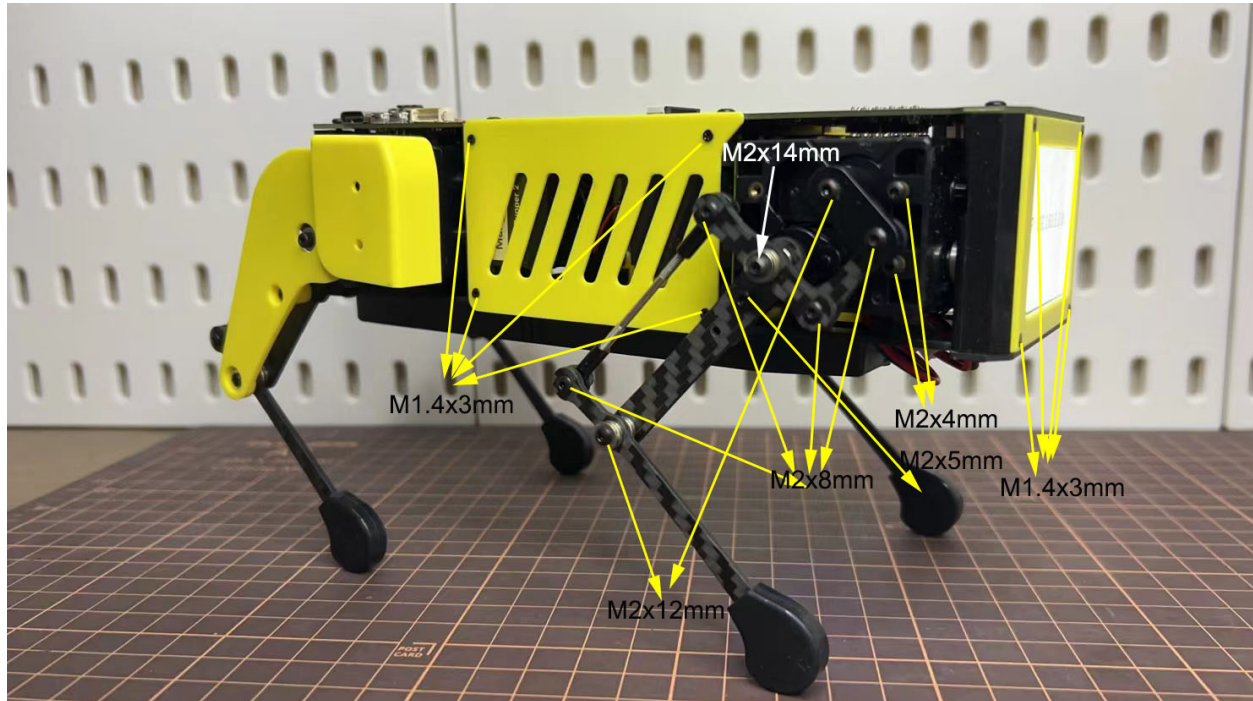


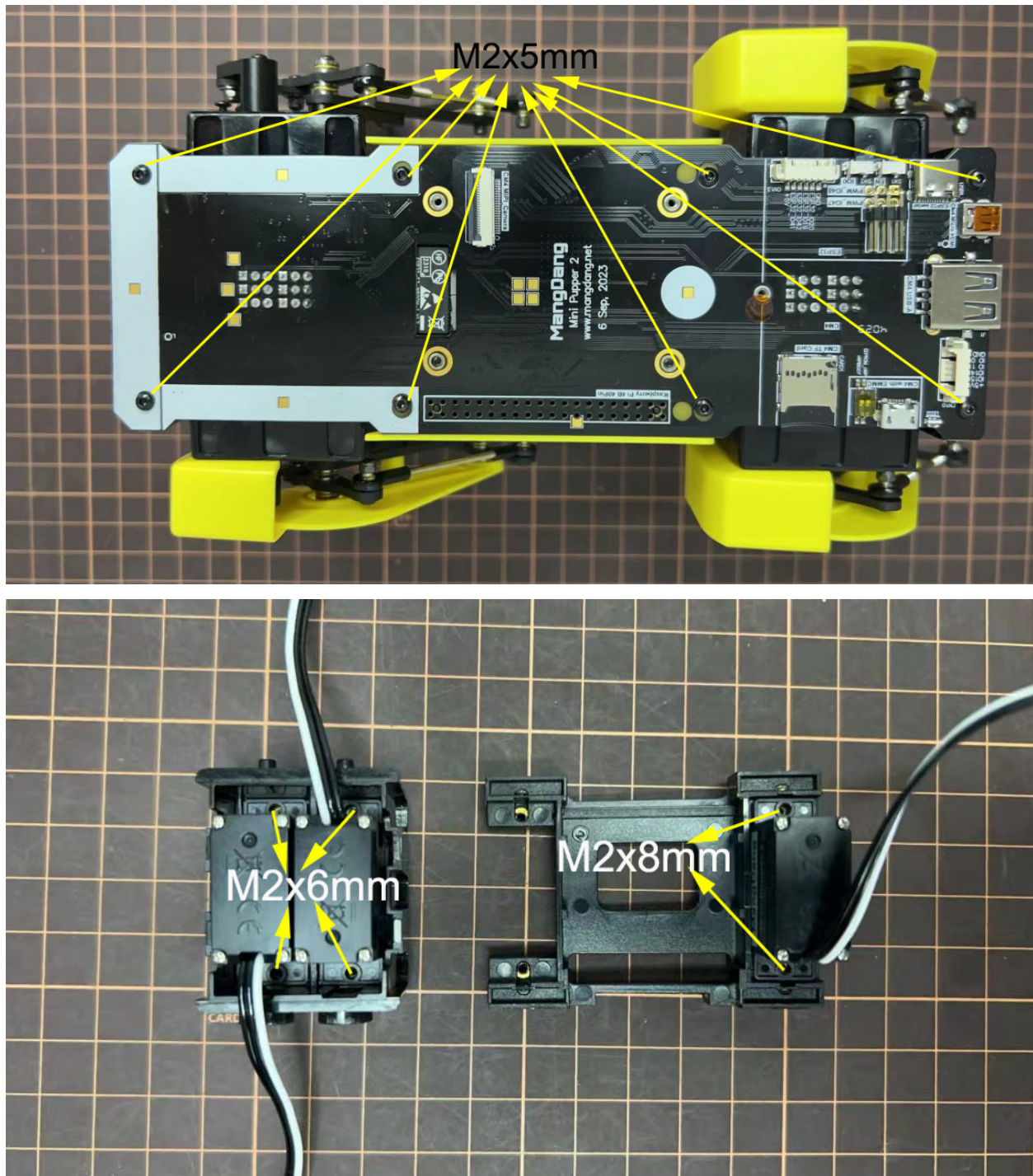
Step 1.3 Write the image into a microSD card

- Insert the microSD card into your PC's SD card reader and write the image. We recommend the image creation tool balenaEtcher or Win32DiskImager as it is easy and reliable. Please take a look at the official manual. It may take a while to complete.

2. Position of the screws

- The pictures show the position of the screws briefly.





3. Legs Assembly

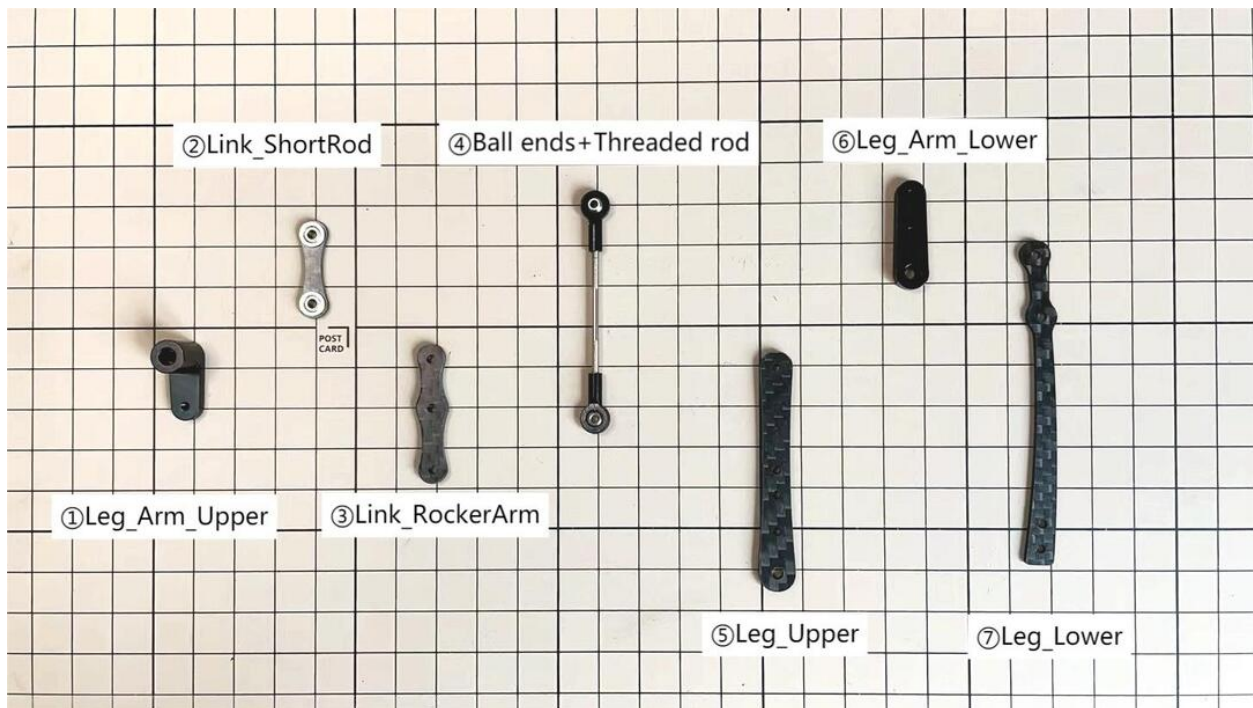
Please refer to the below video clip.

Bolt to use

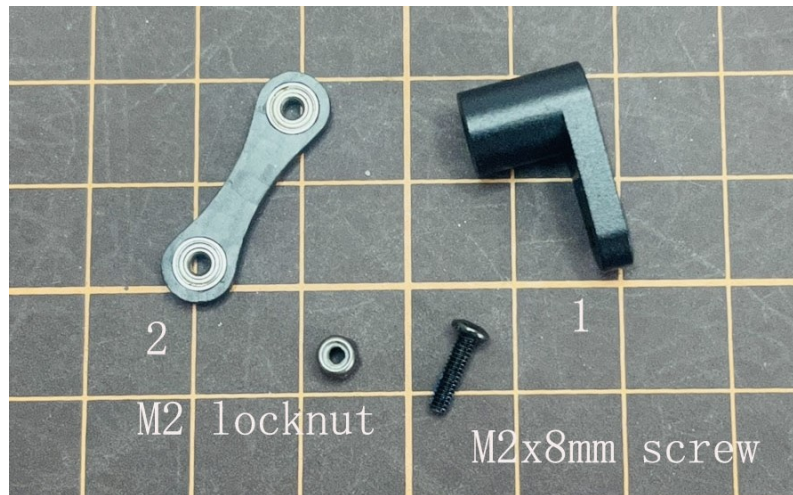
- M2x5mm 2x4=8 +, +
- M2x8mm 3x4=12 +, +, +
- M2x12mm 1x4=4 +
- M2x14mm 1x4=4 +

Step 3.1 Single leg

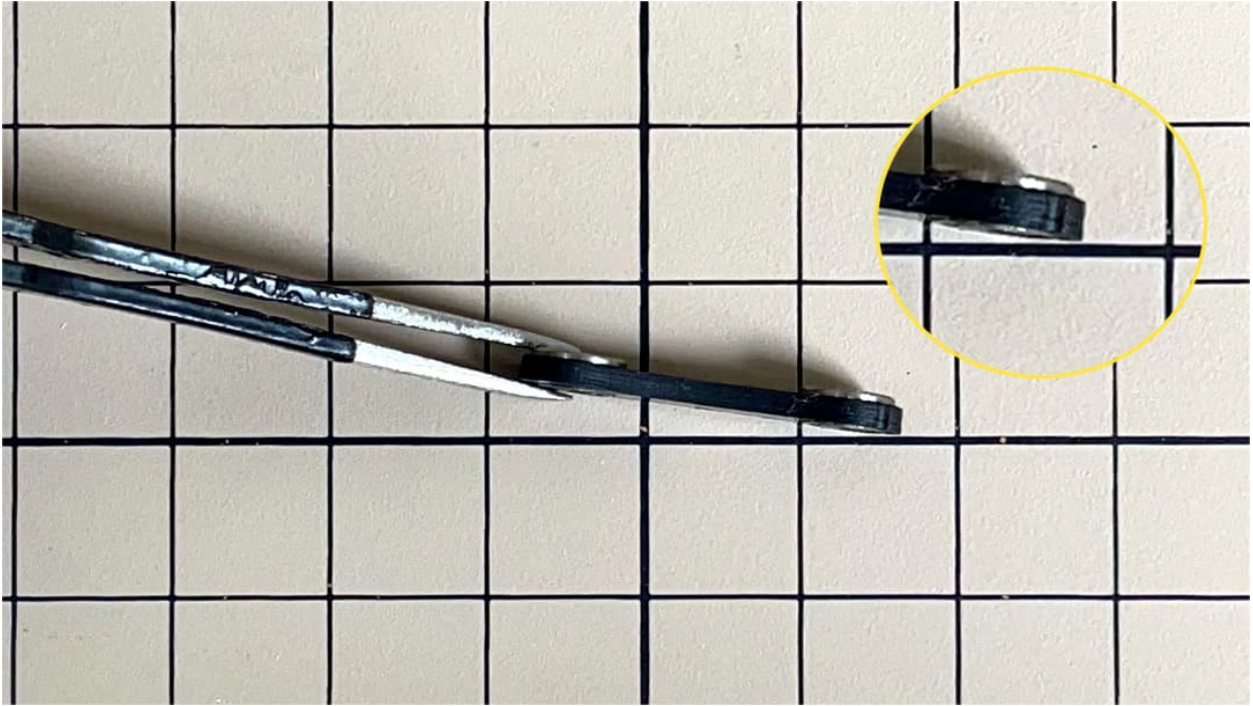
- Assemble the four legs. The front and back of the right side are the same, and so are the front and back of the left side. Show you how to assemble the right side.
- Video Instructions, please refer to the link <https://youtu.be/Ut7UnS3CTZs>
- The parts are numbered as follows to explain.



Assemble and

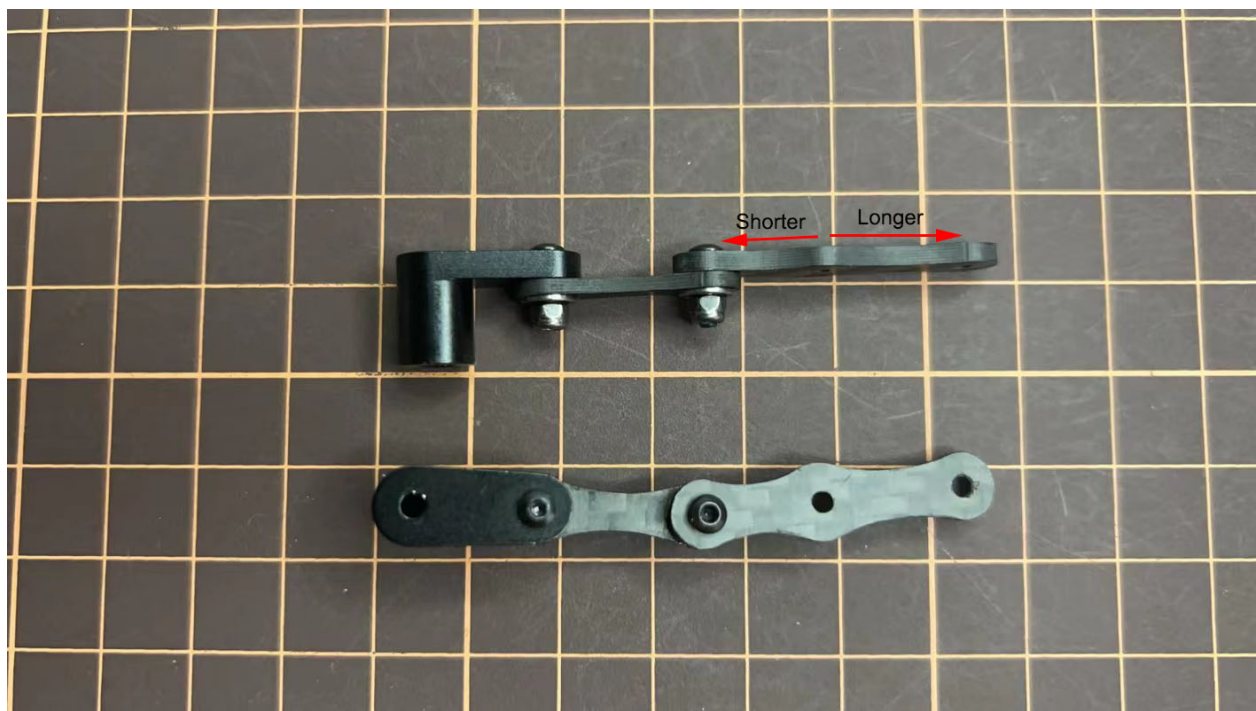
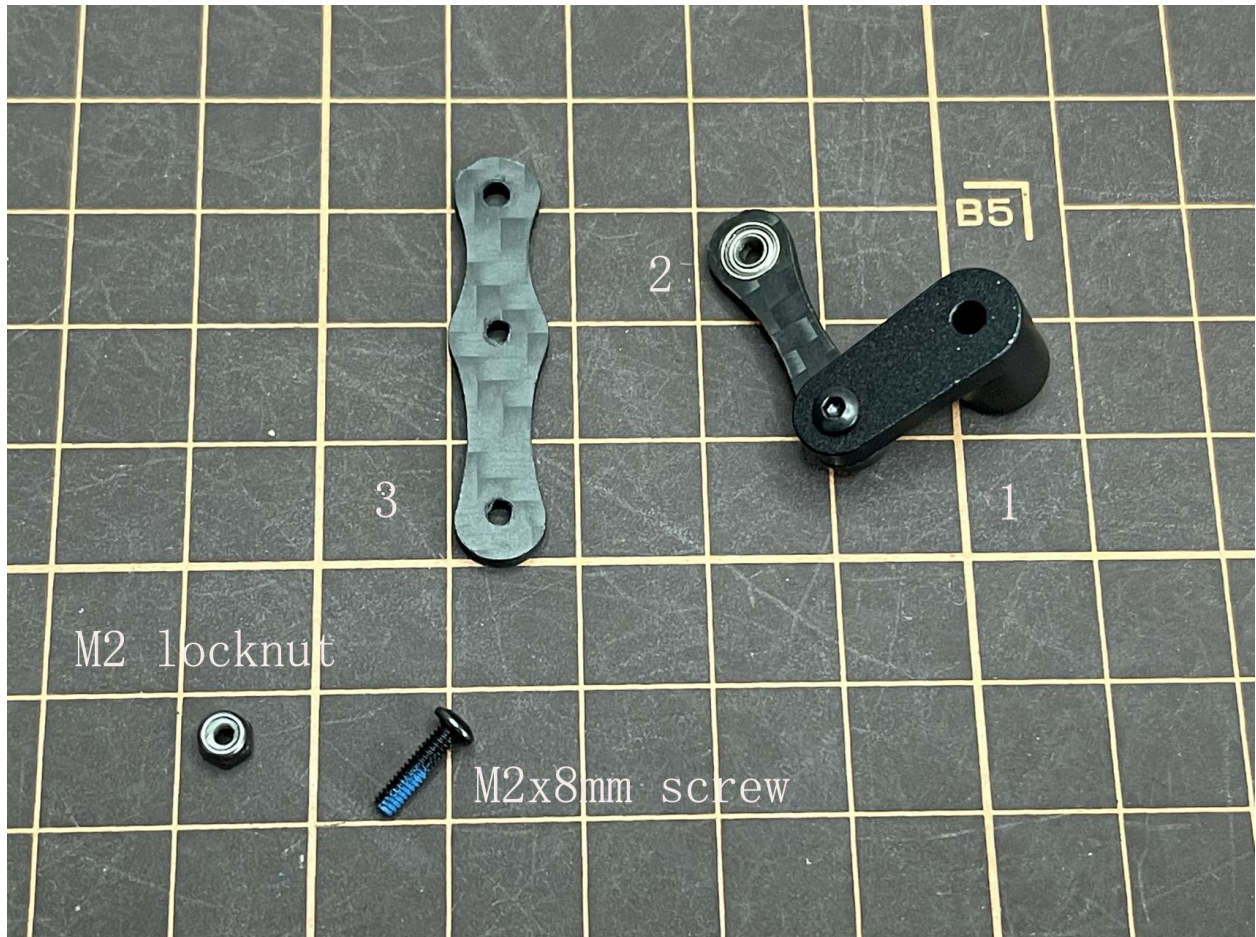


- The two sides of bearings inside are different.



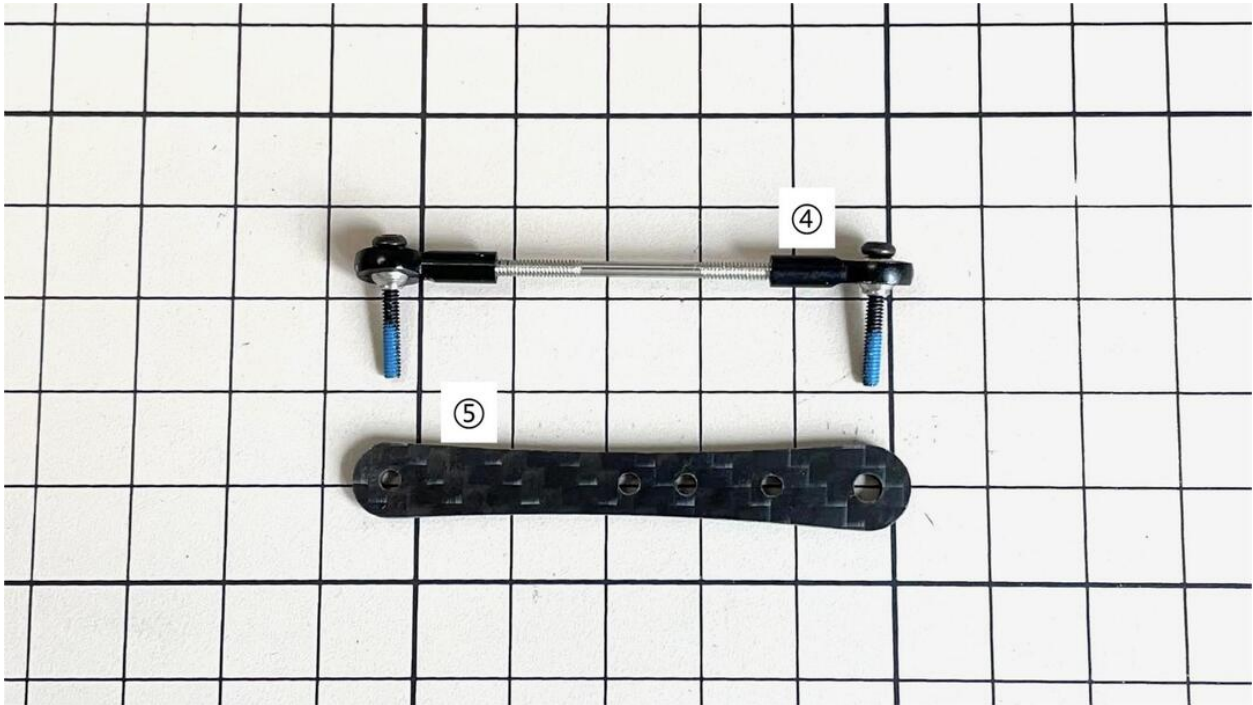
Assemble and

- Use an M2x8mm screw and an M2 locknut. Insert the screw from the bottom to the top of , pass through and tighten with the nut. It is important to pay attention to the orientation of . Look carefully at the position of the hole in the middle.

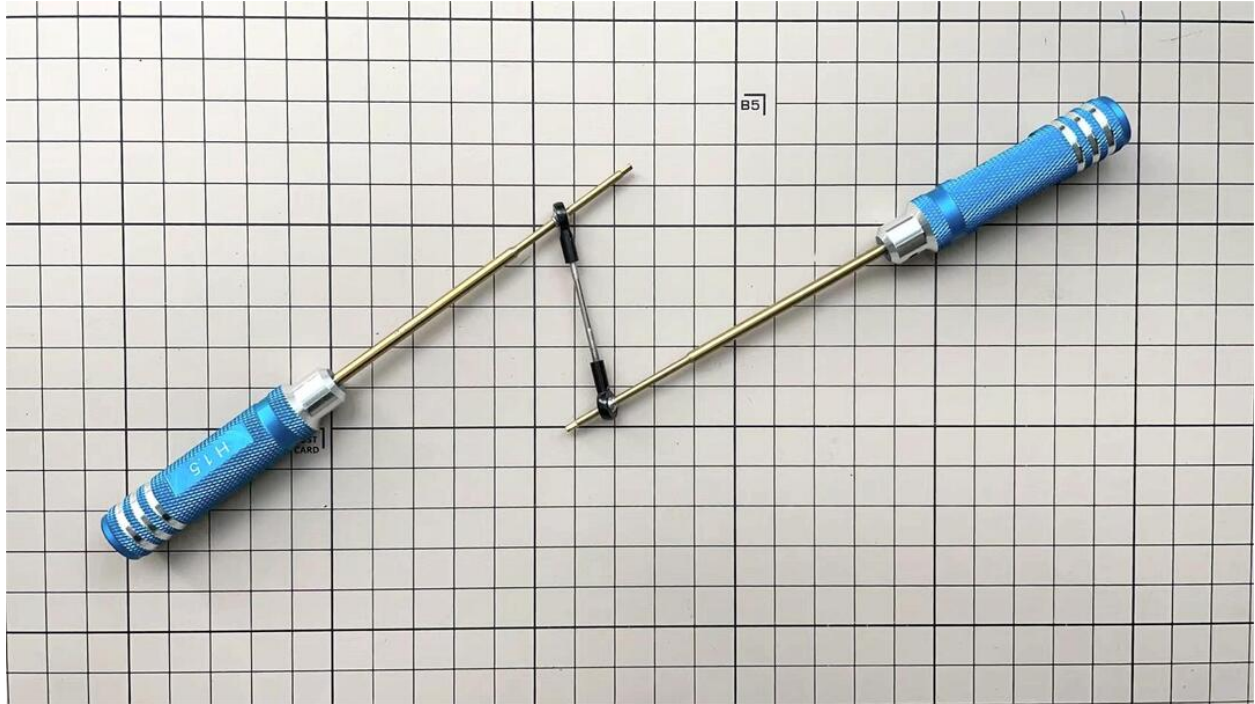


Adjustment of the length of

- The length of must match the length of . When adjusting the length, it is easier to use two long screws to make sure that the lengths match. Once the lengths have been adjusted, take apart all.

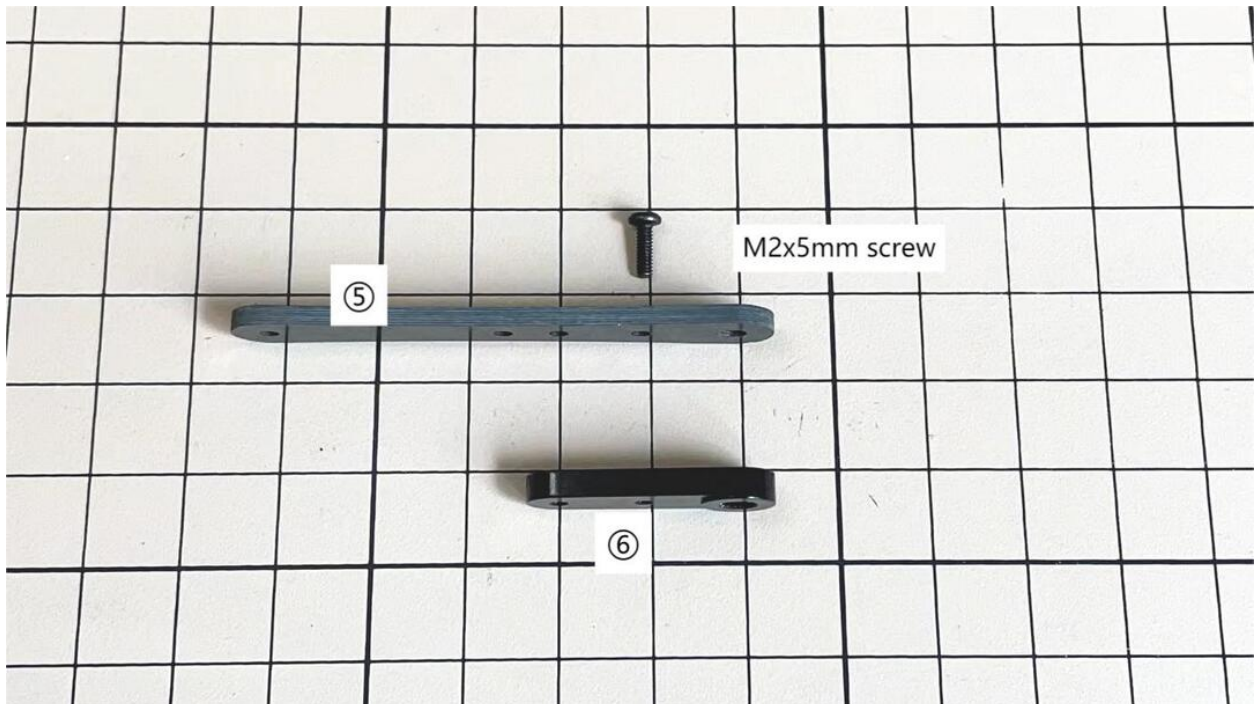


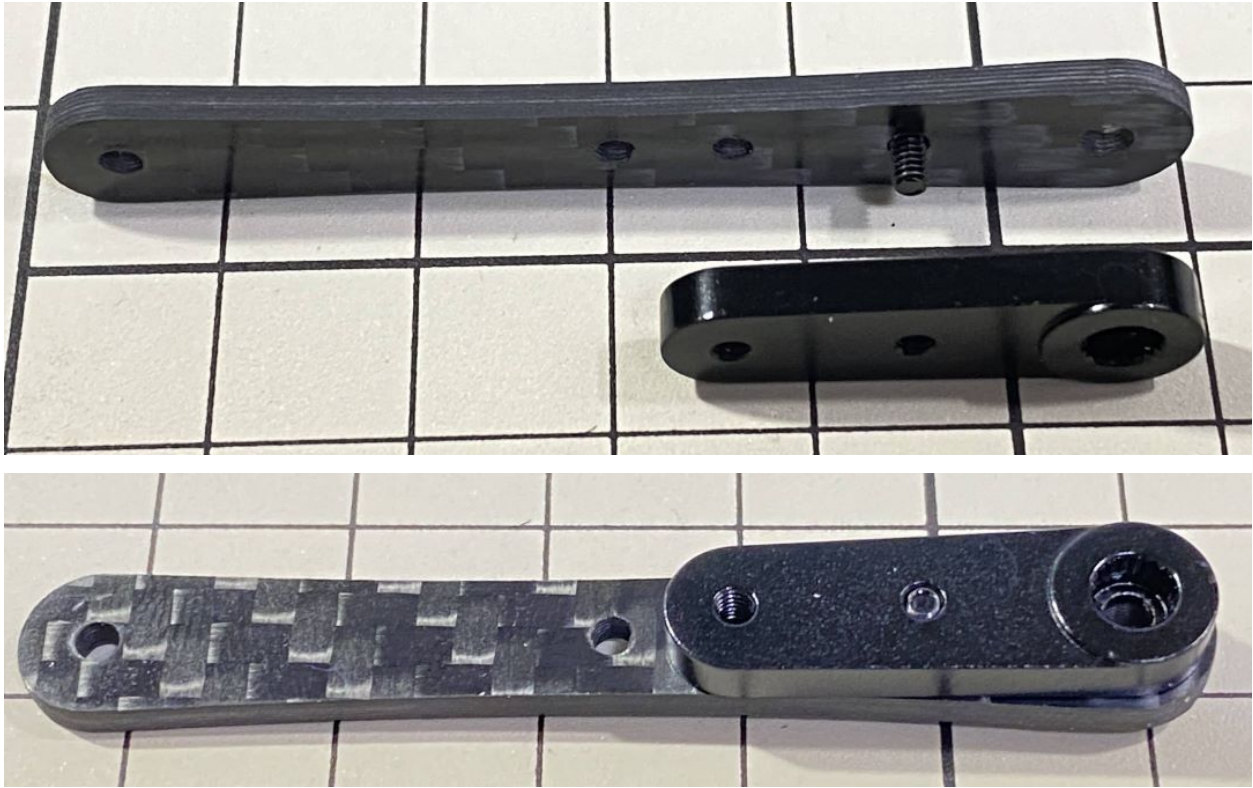
- If it's hard to twist, you can use two screwdrivers to assist.



Assemble and

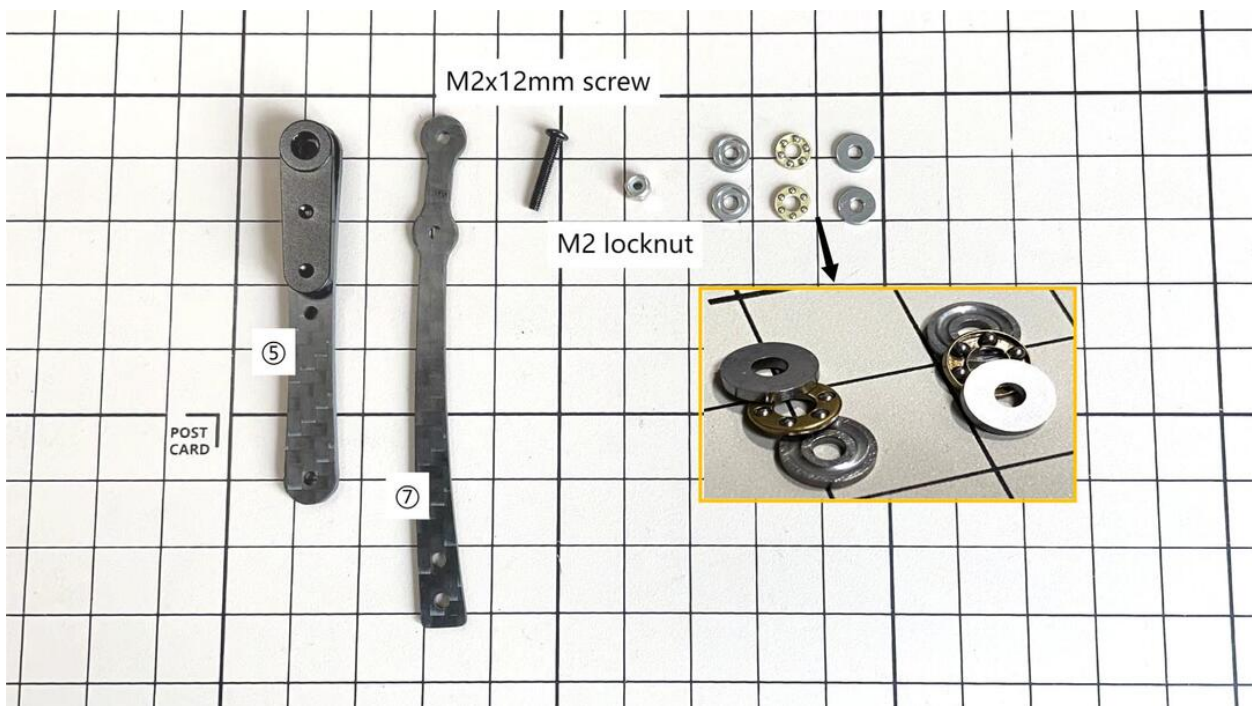
- Use one M2x5mm screw. Insert the screws into first, insert them into the holes of , and tighten them. The large hole in should be facing the surface.

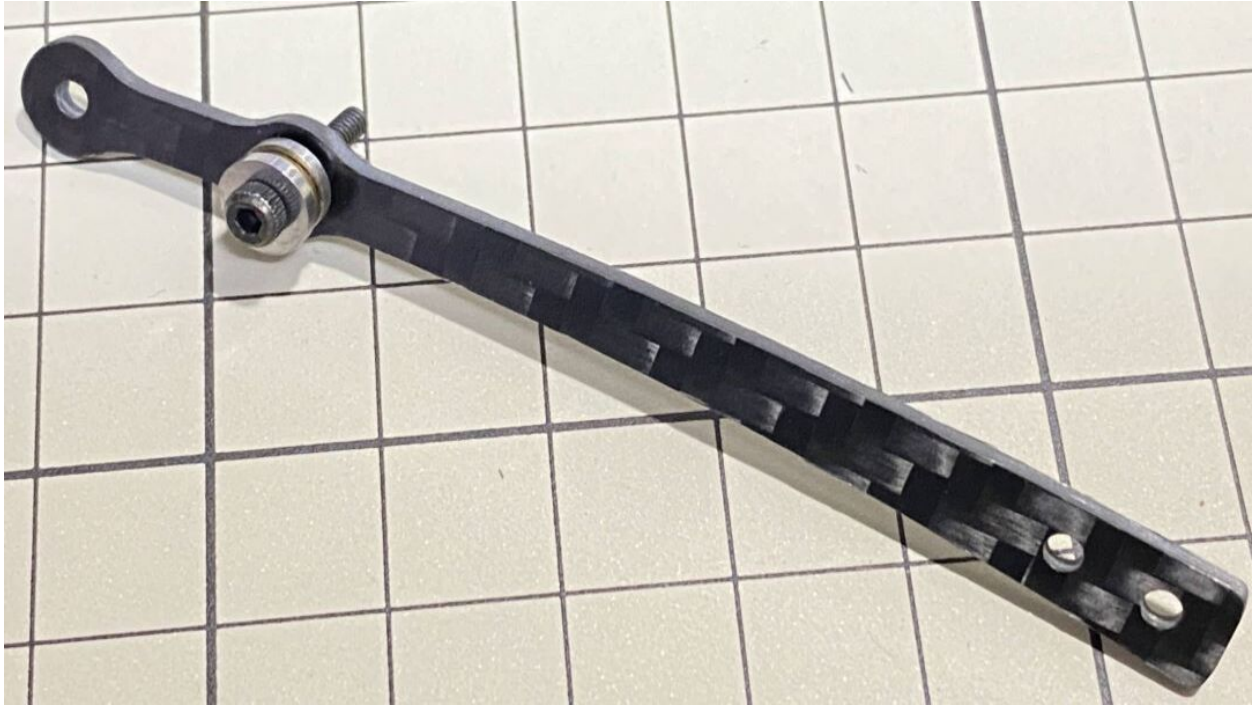


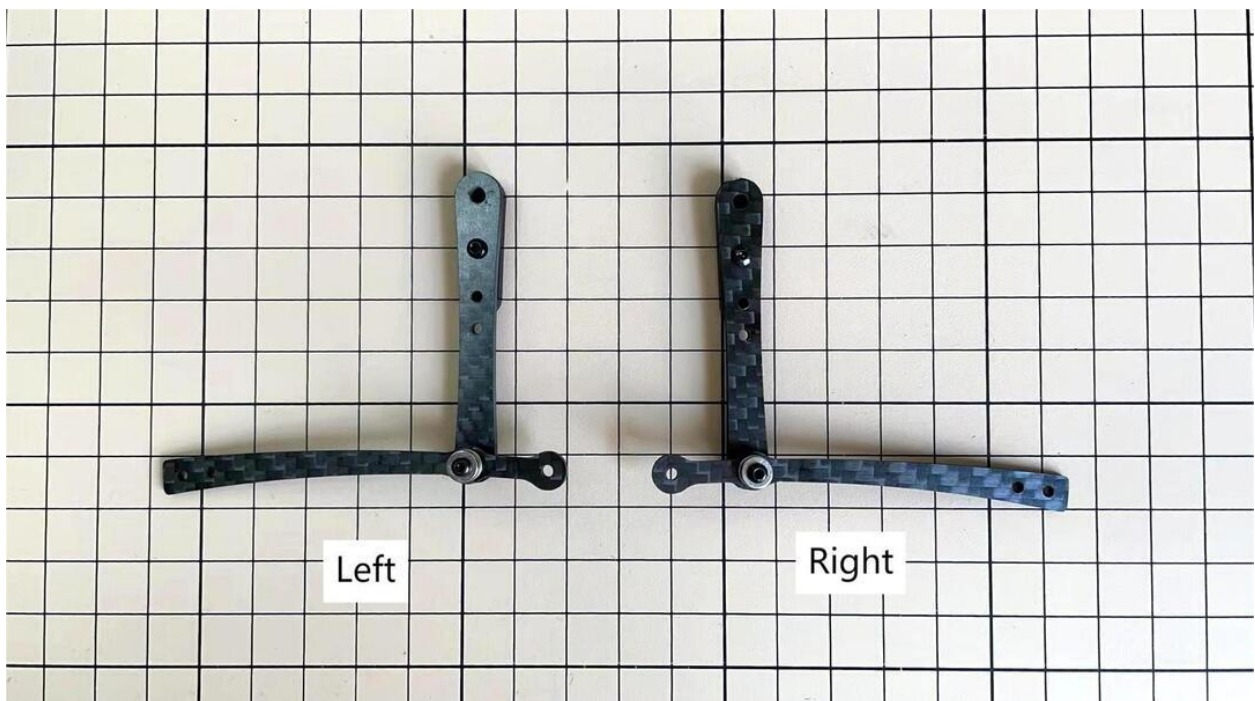
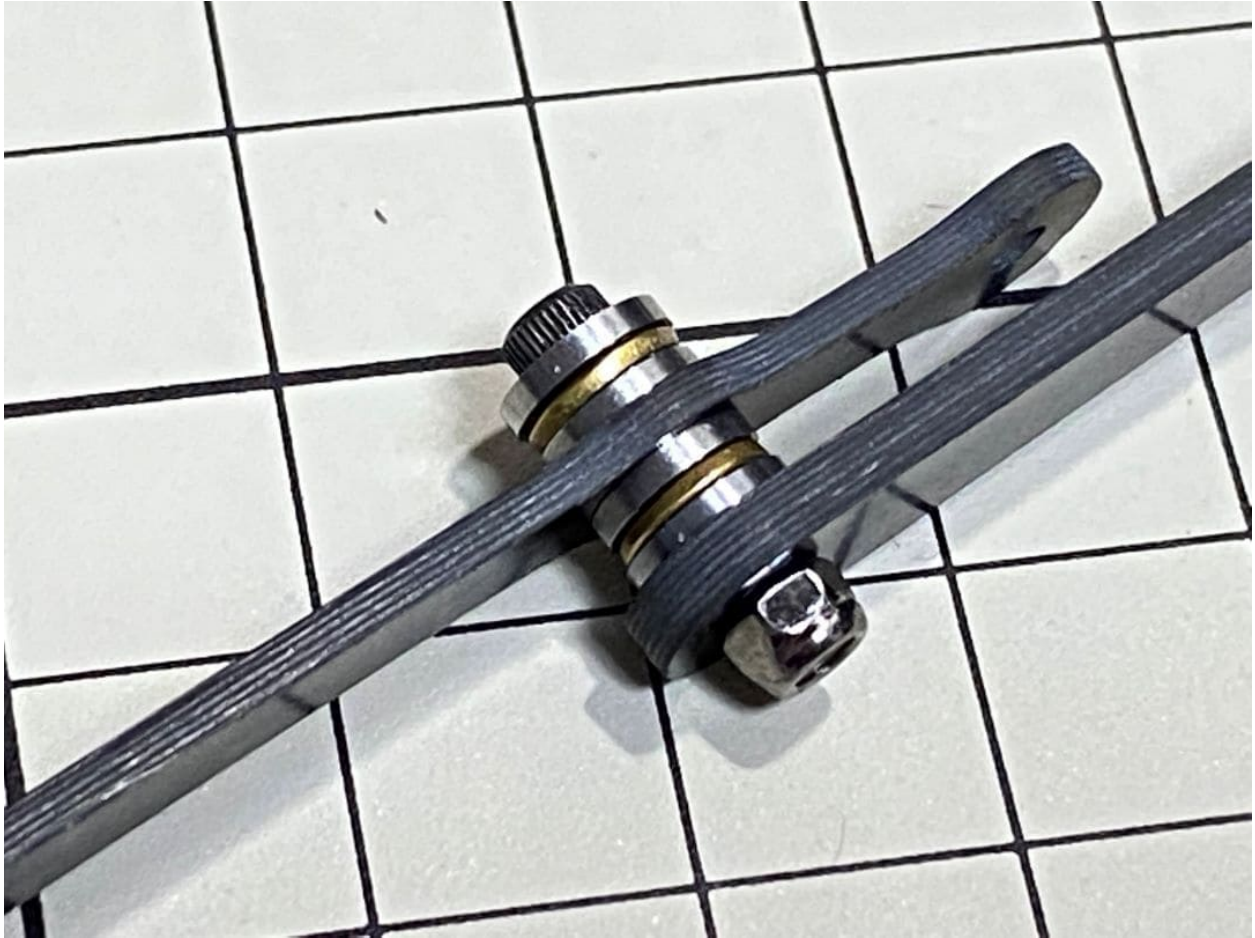


Assemble and

- Use an M2x12mm screw, an M2 locknut and two sets of ball bearings. Each ball bearing is made up of three parts, the top and bottom parts with the grooved side facing inwards. Insert a screw into a set of ball bearing. Then insert the screw into the hole. Taking care to look at the warped side of to make sure it is facing the right way. Now screw in the another set of ball bearing. Finally, insert screw into and tighten it with the nut.



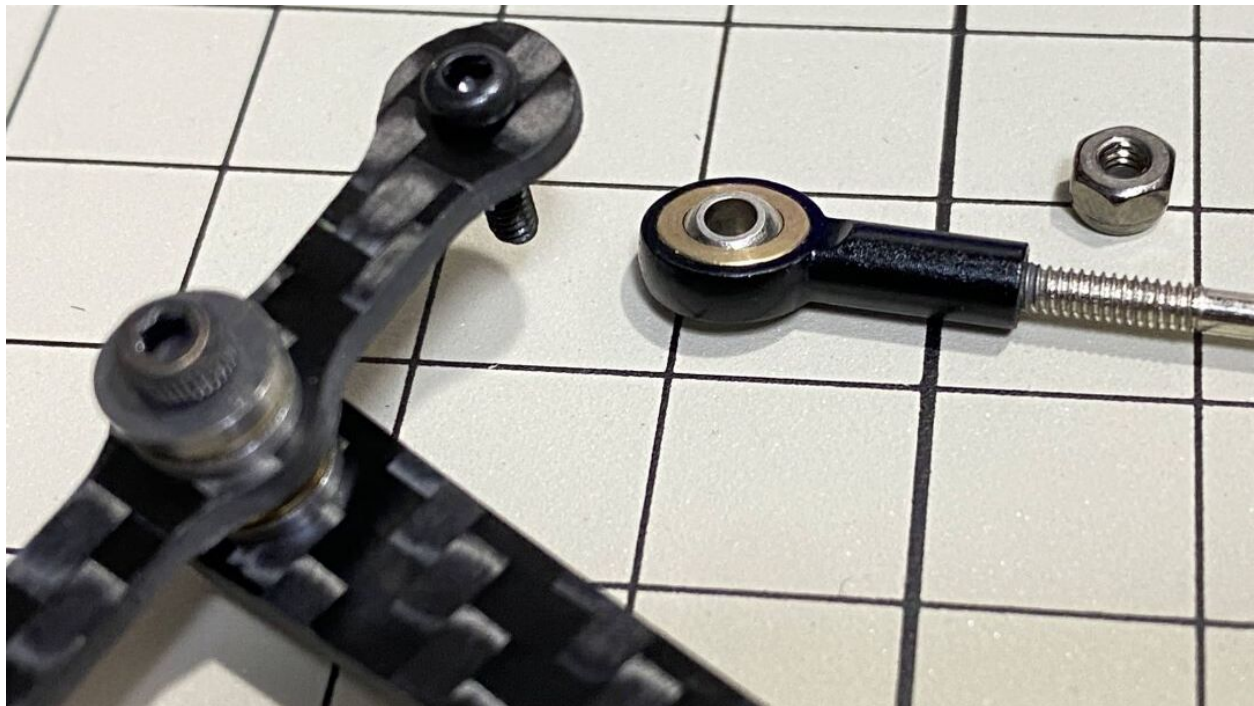
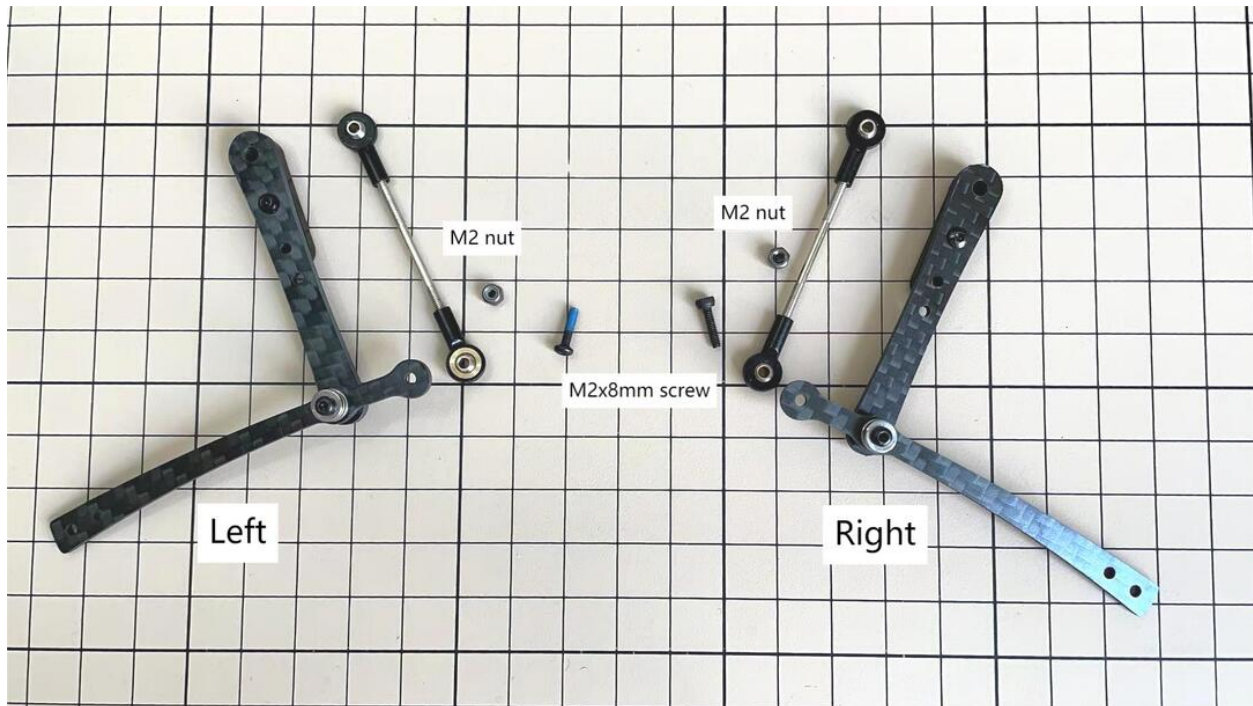


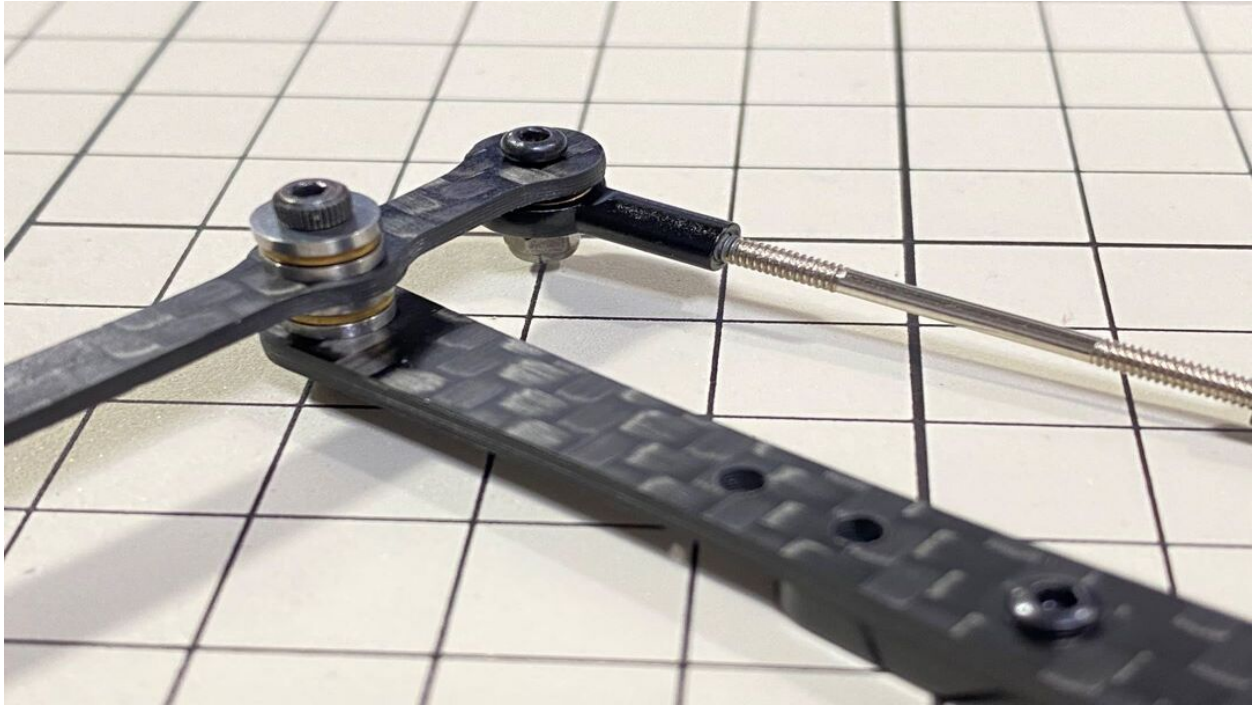


Assemble and

- Use an M2x8mm screw and an M2 nut. Insert the screw into and put through, then tighten it with the nut. The direction of the front and back of can be either.

Left and right leg

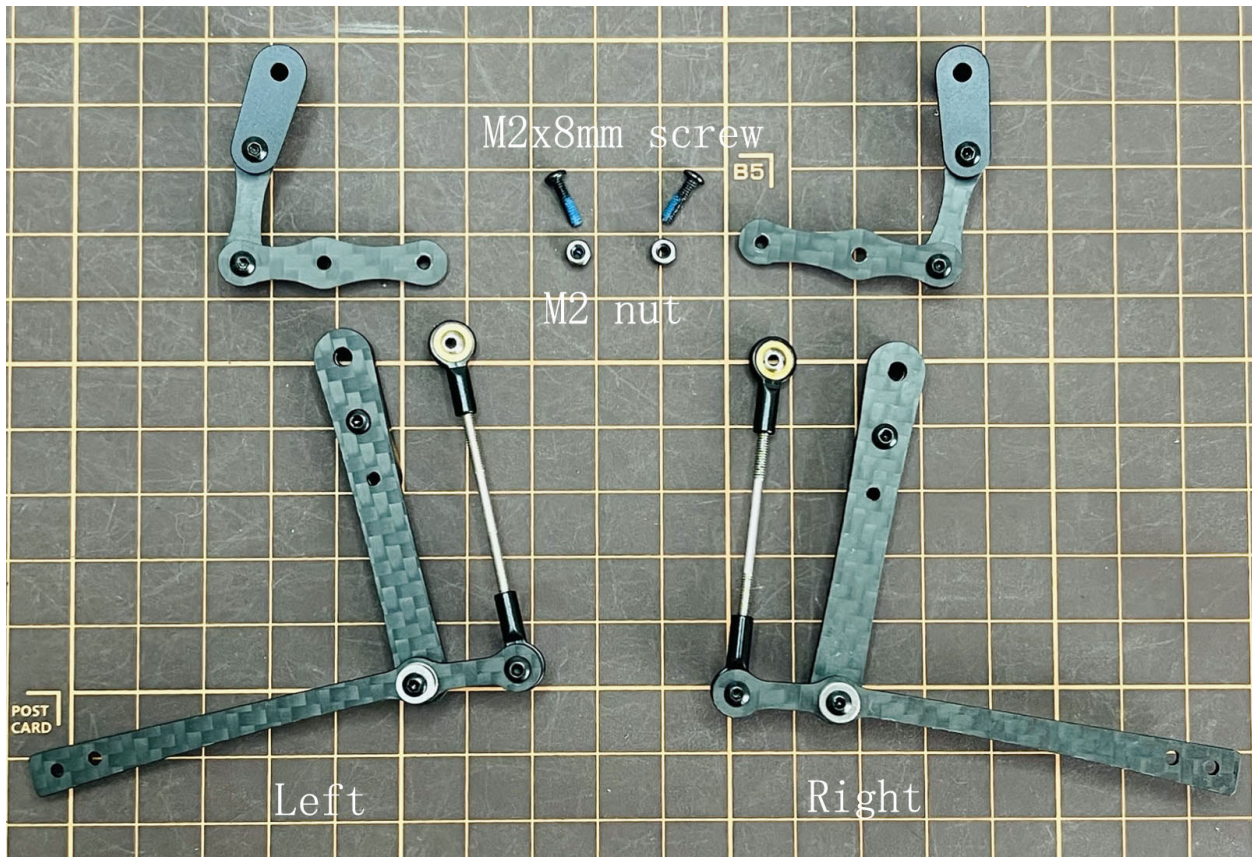




Assemble and

- Use an M2x8mm screw and an M2 nut. Insert the screw into and put through, then tighten it with the nut.

Left and right leg

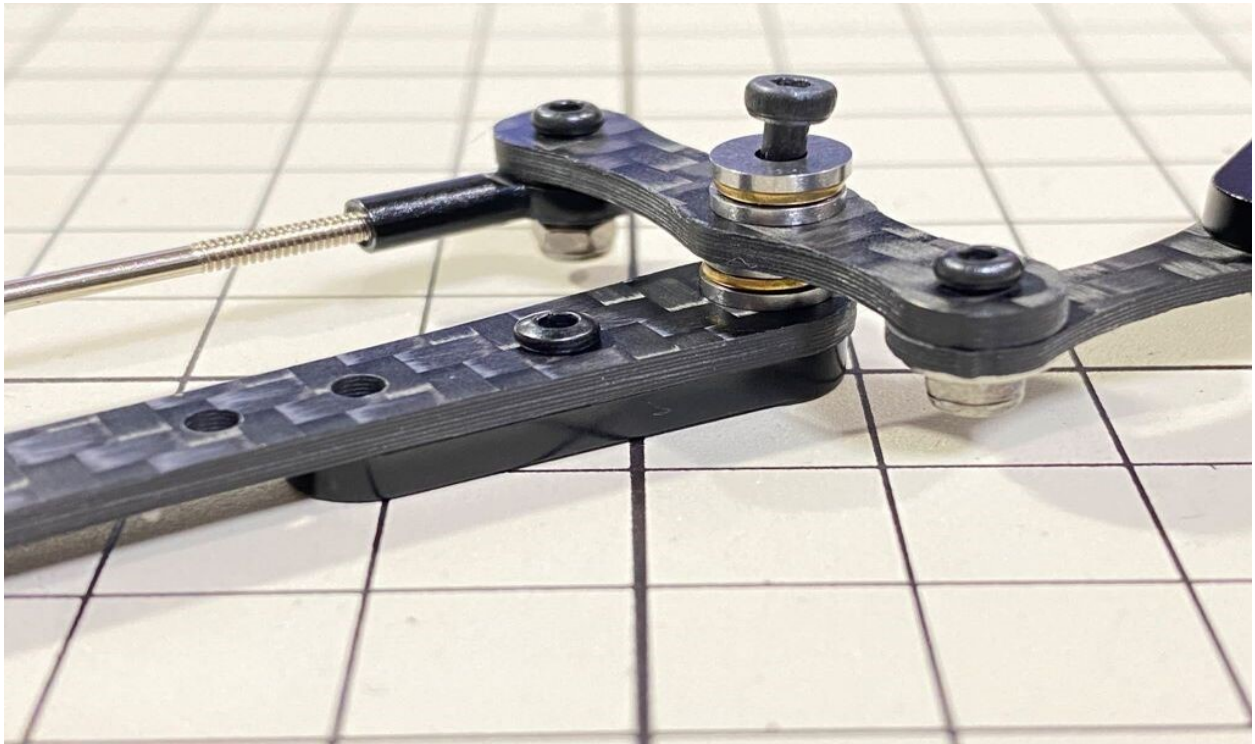
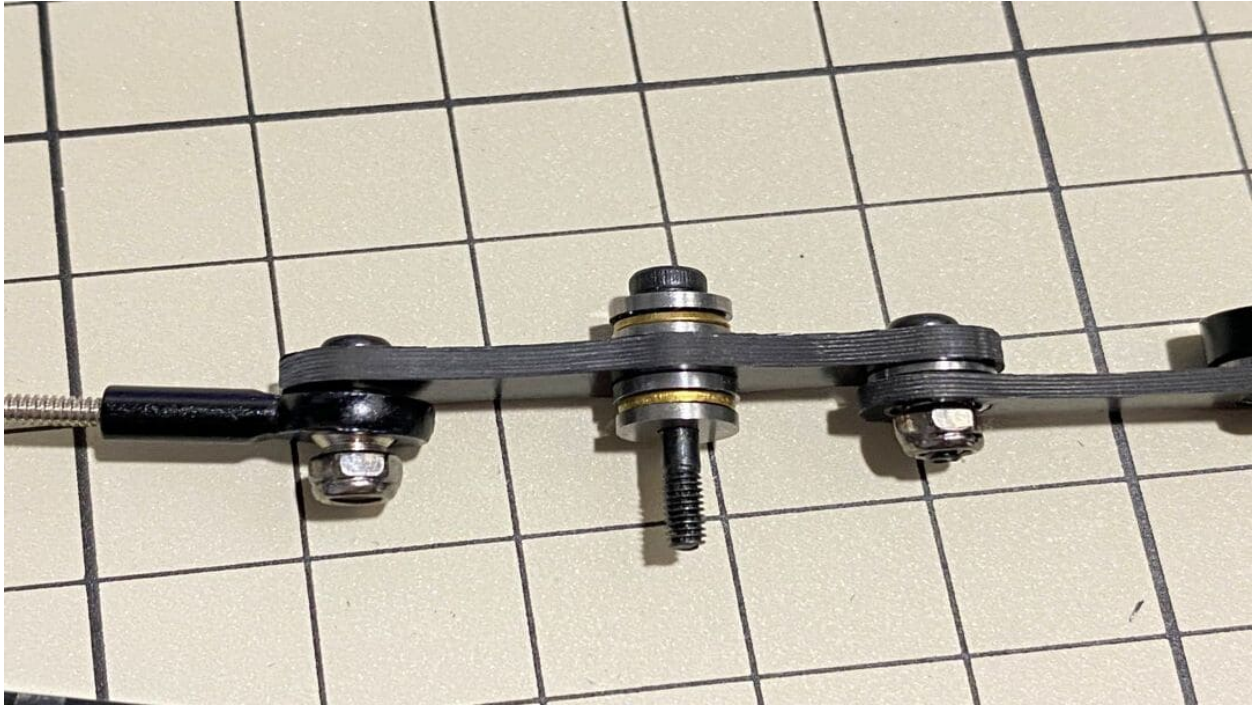




Assemble and

- Use M2x14mm screws and two sets of ball bearings. Thread the screws through the bearings, , bearings, , in that order. The screws are not fixed, but you will tighten them when you mount the servo in the next step.

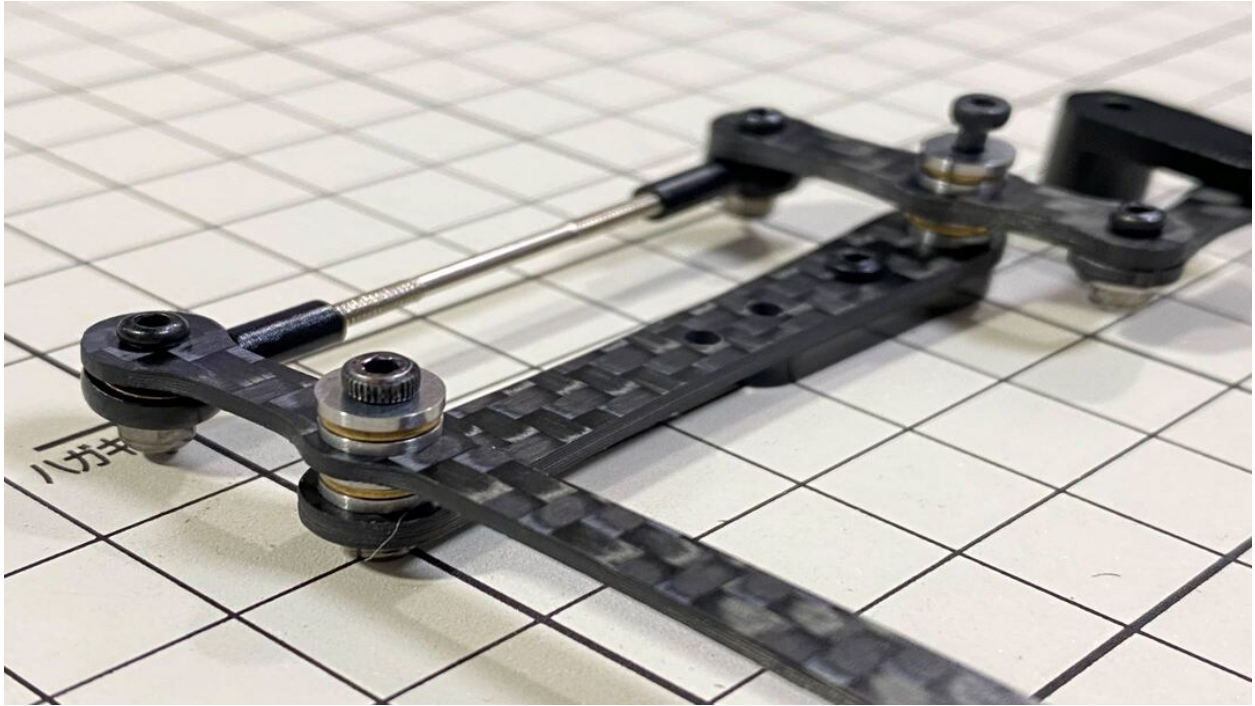




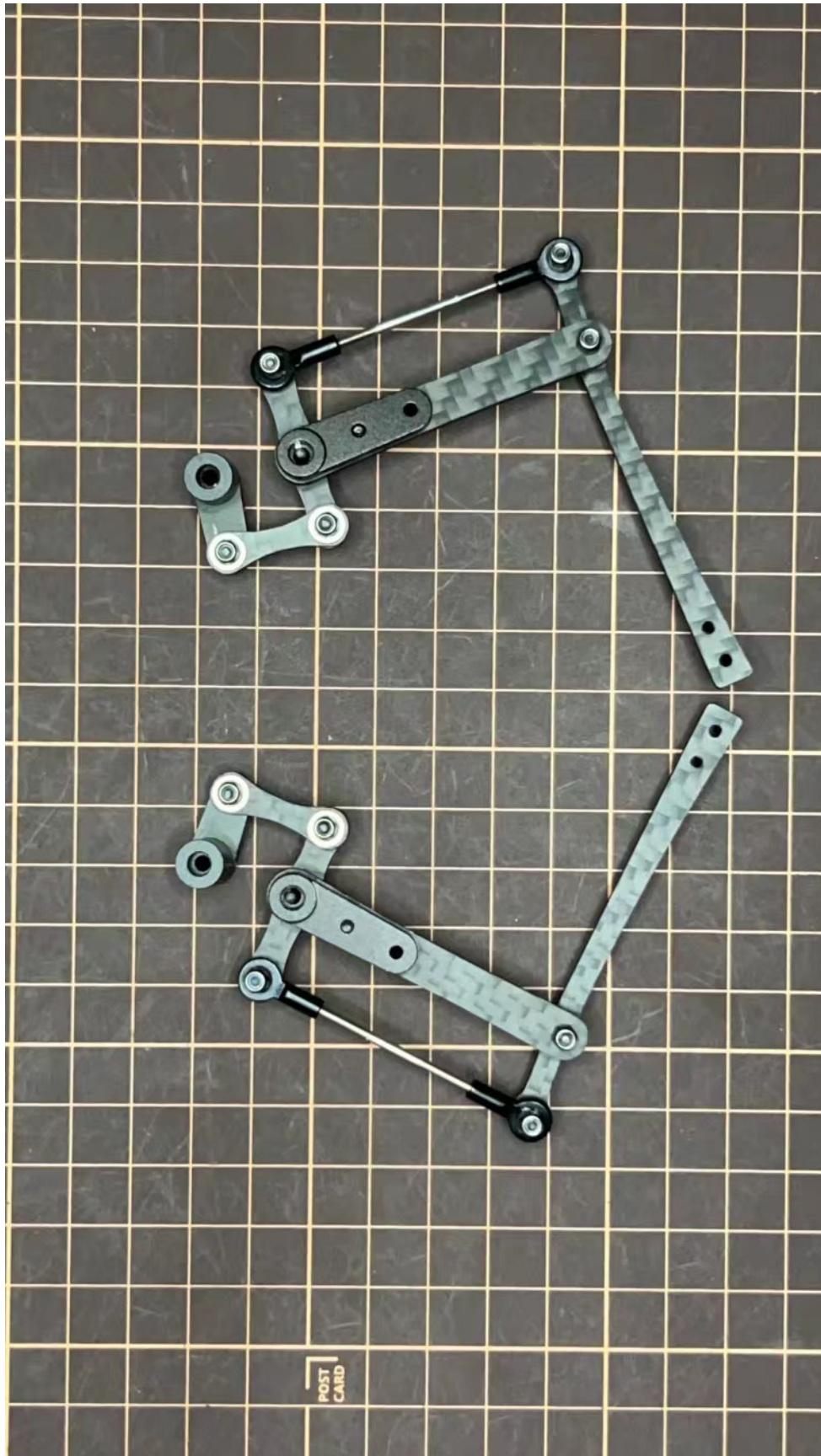
Completion of a right leg

- Now we have one leg on the right side. Here are some pictures so you can see it from different angles. The left leg should be symmetrical with the right one.

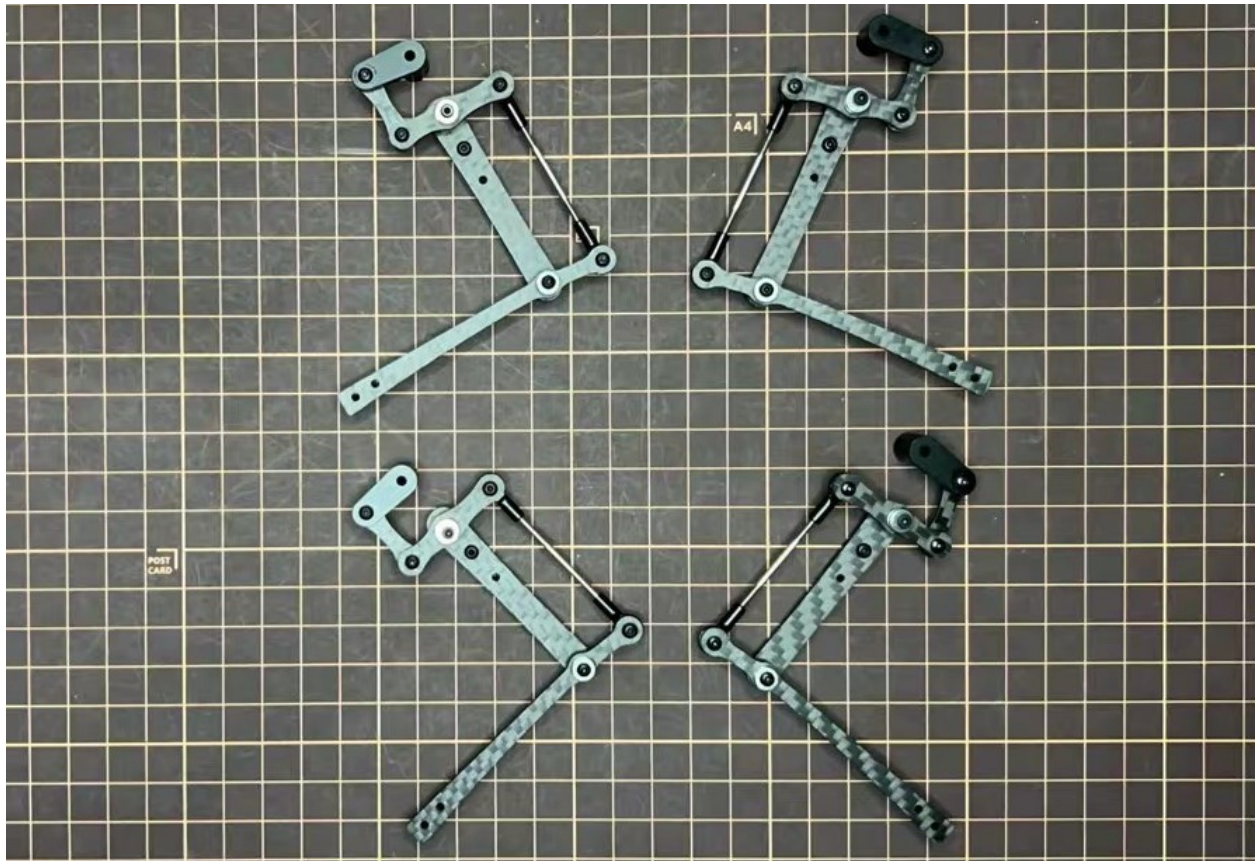




opposite side



Step 3.2 Four legs

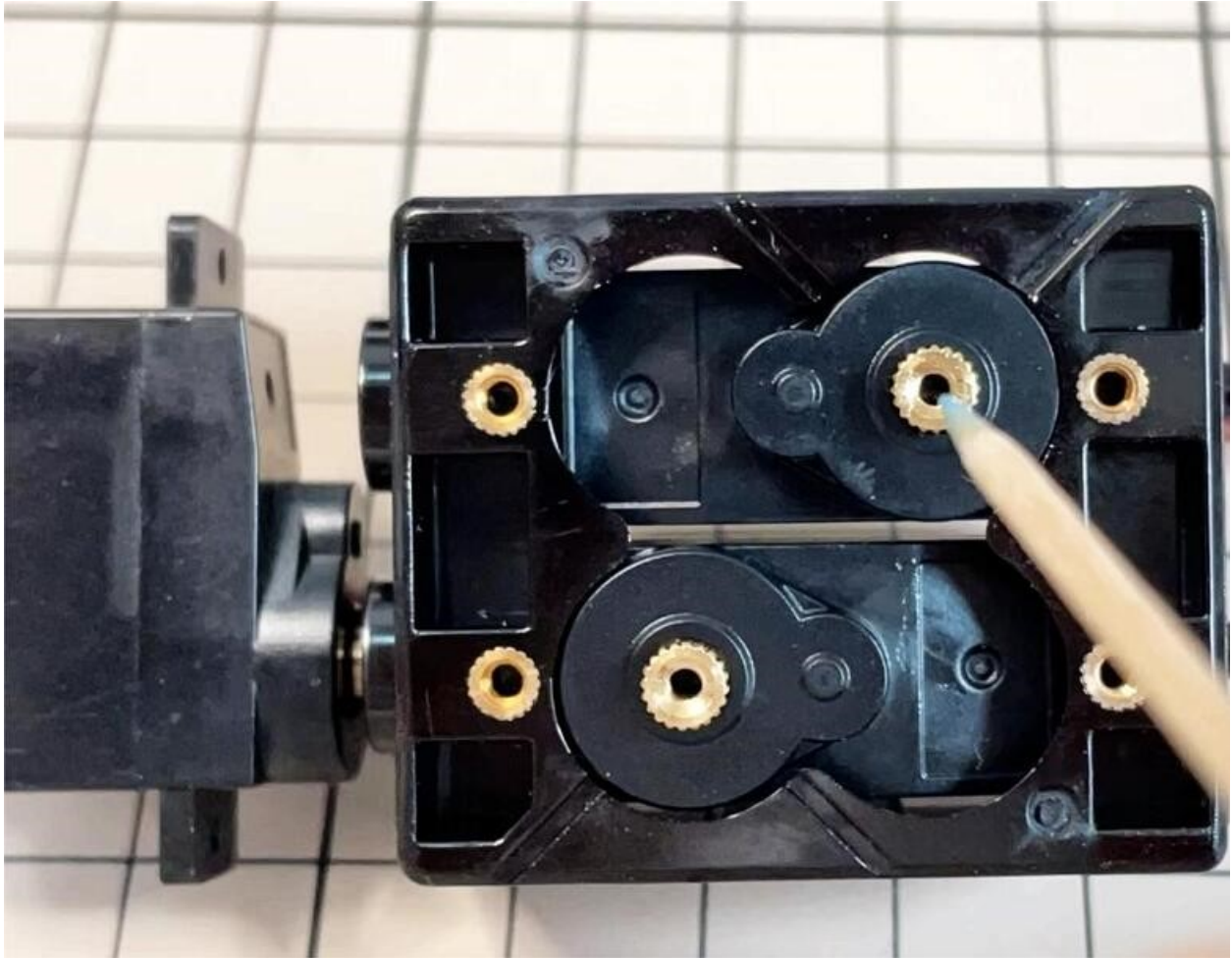


Step 3.3 Loctite

After Mini Pupper run sometime, some screws or nuts will loose, you have to check and tighten them if needed. It's helpful to understand how it works.

- * We don't recommend new users to use the Loctite at first, you can use it after you have much background.
- * Loctite prevents the nut from loosening, but it is not essential, as it can be tightened only when looseness is noticed.



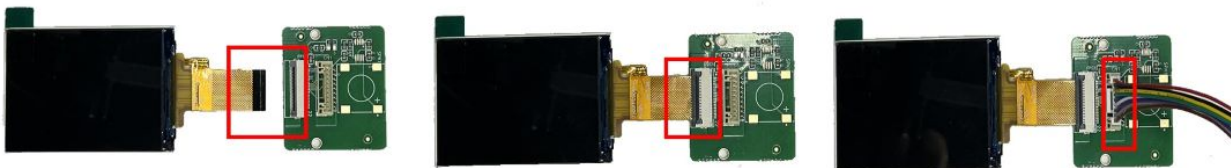


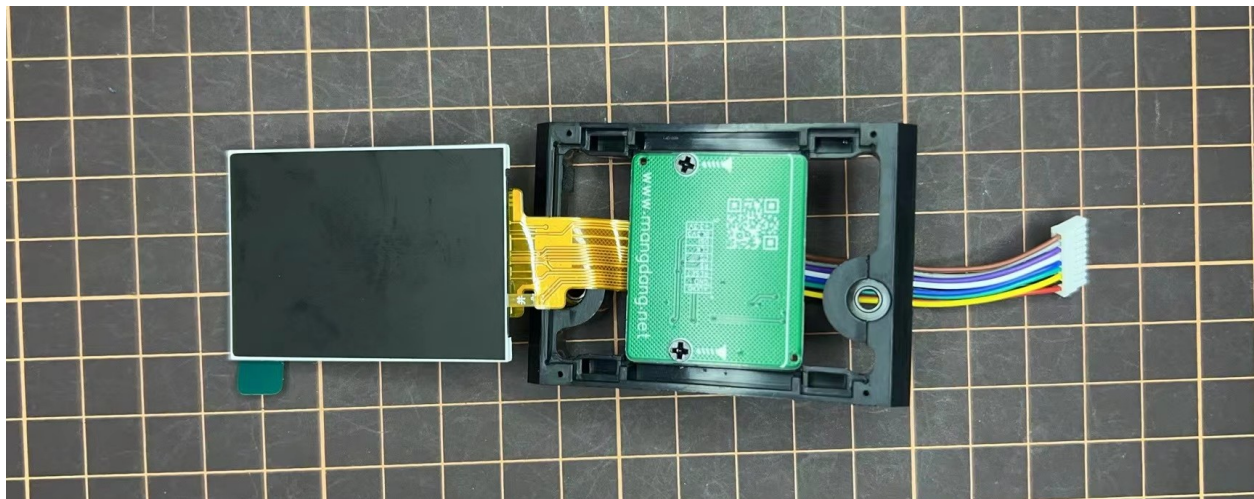
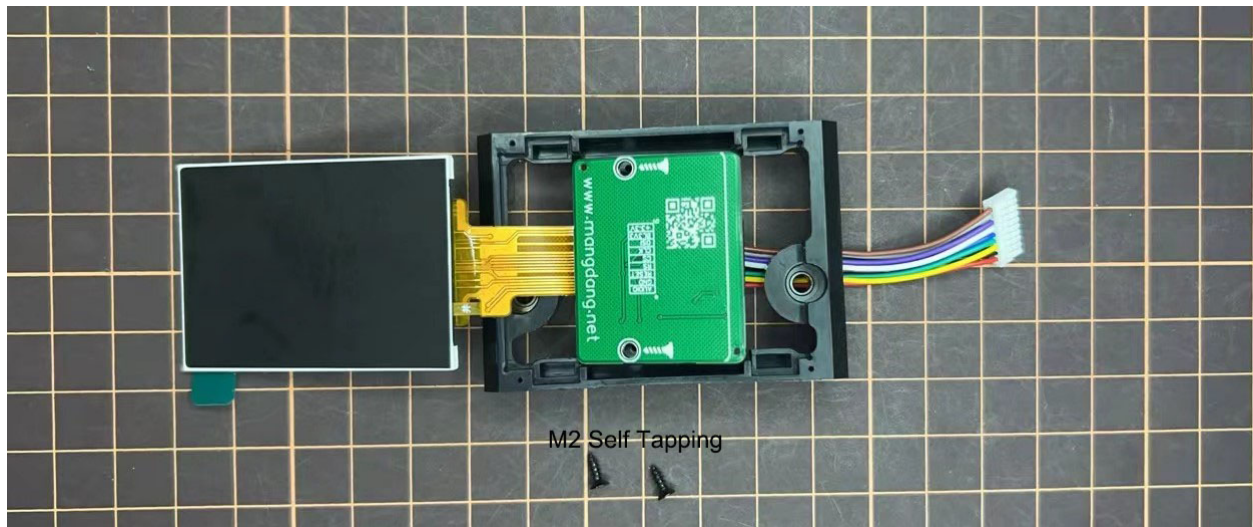
- Some screws are also secured with glue as the below picture shows.

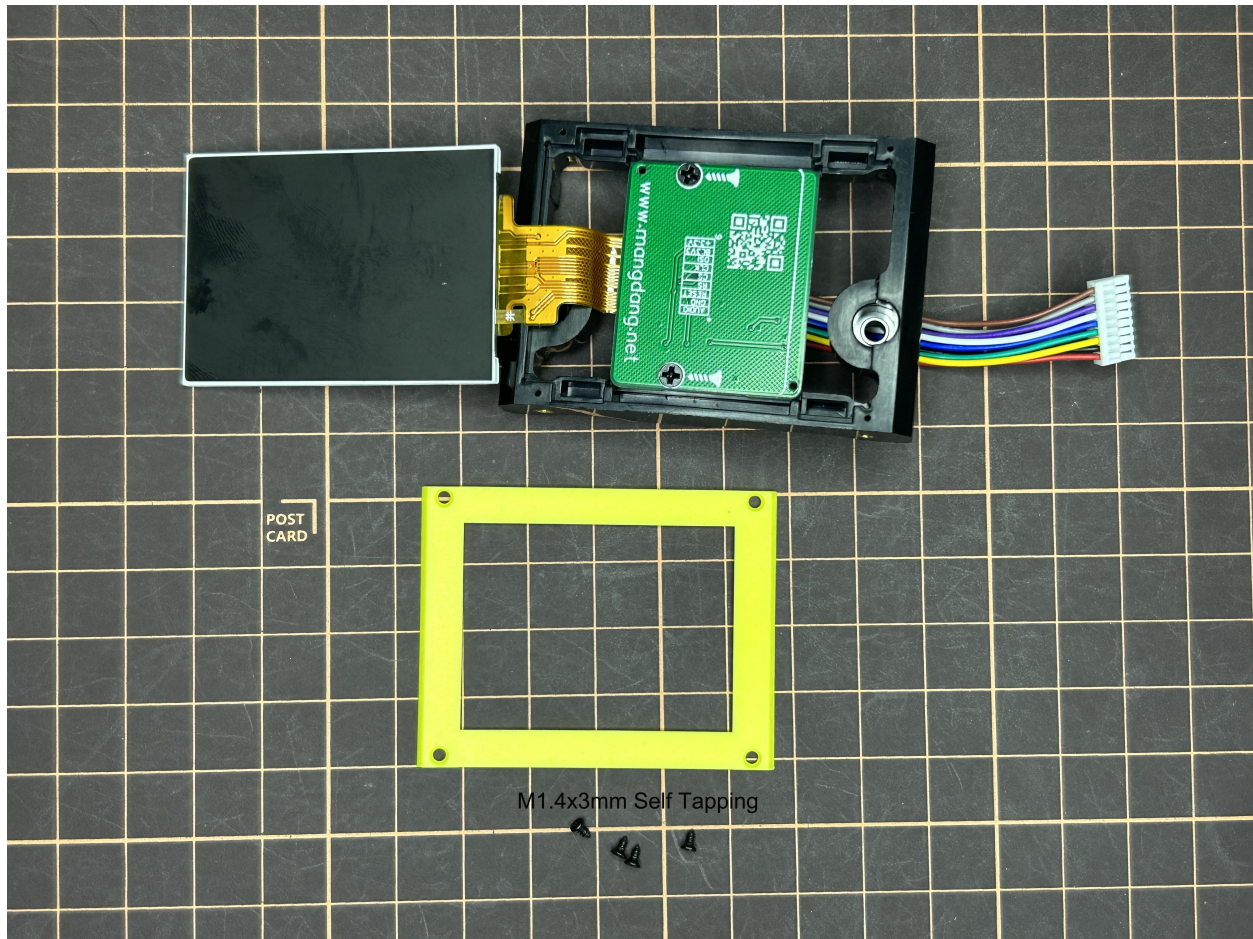


4. Display and Frame of face

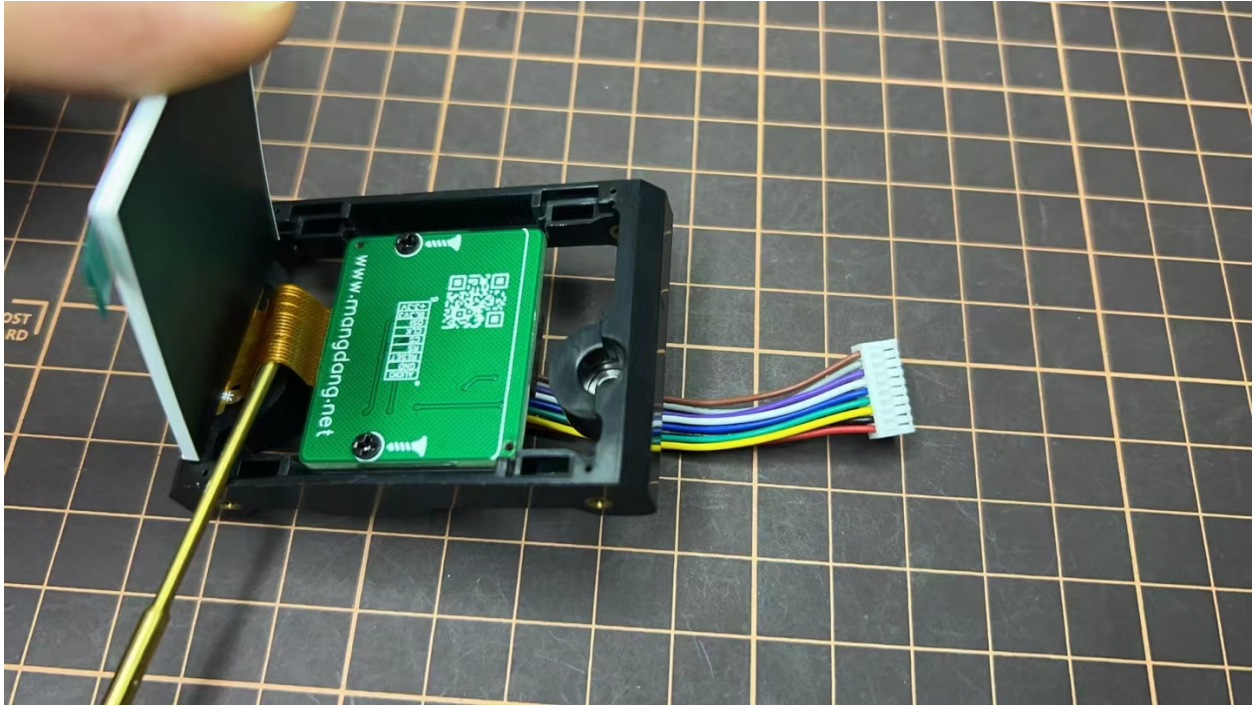
Remove the protective sheet for the display. Fold the thin flexible cable at the edge of the display. Attach the board and the display to the main unit.







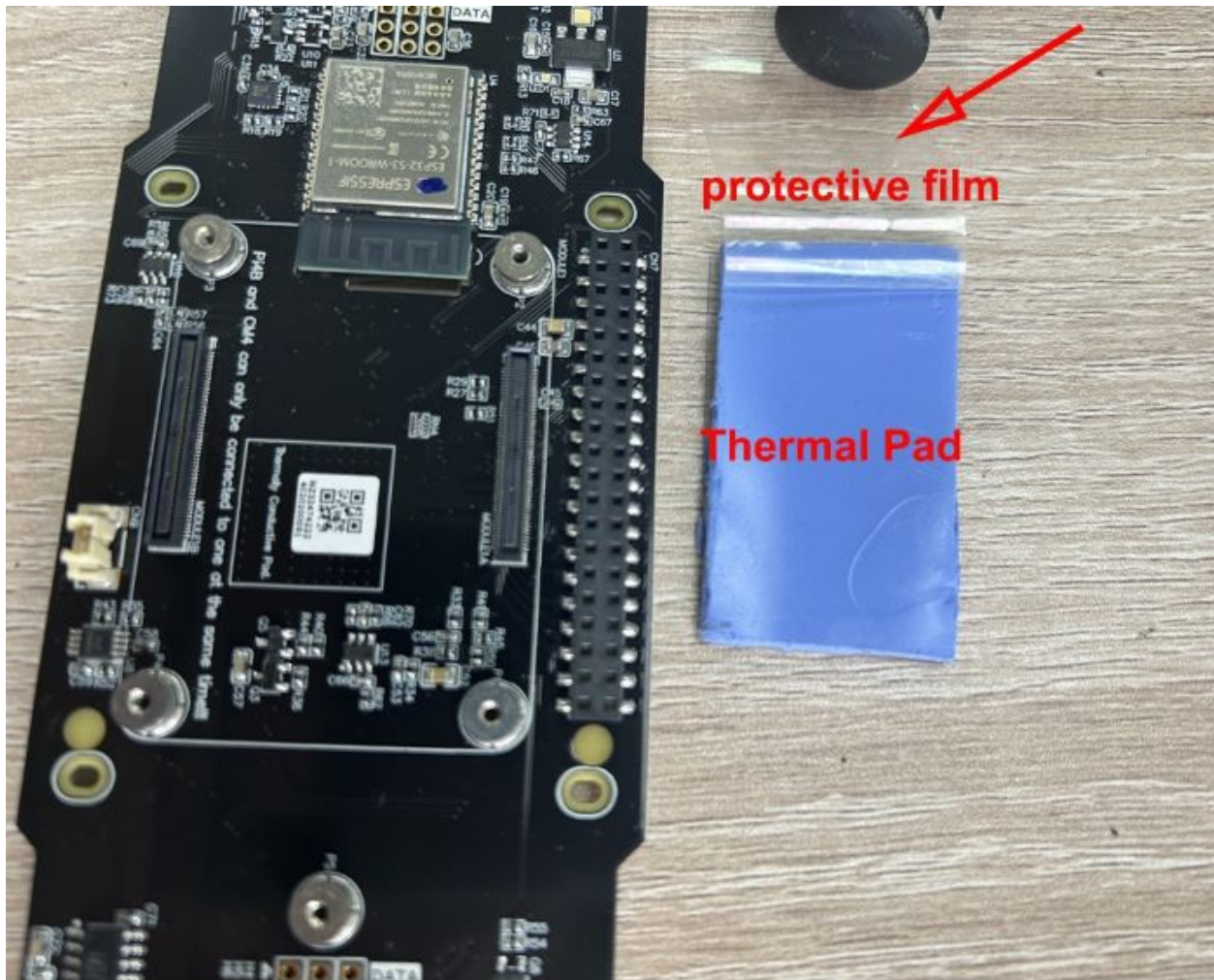
- When attaching the display, you can use a stick to gently push the flexible FPC cable, so that it goes as far back as possible. Don't bend this FPC cable at 180 degrees.



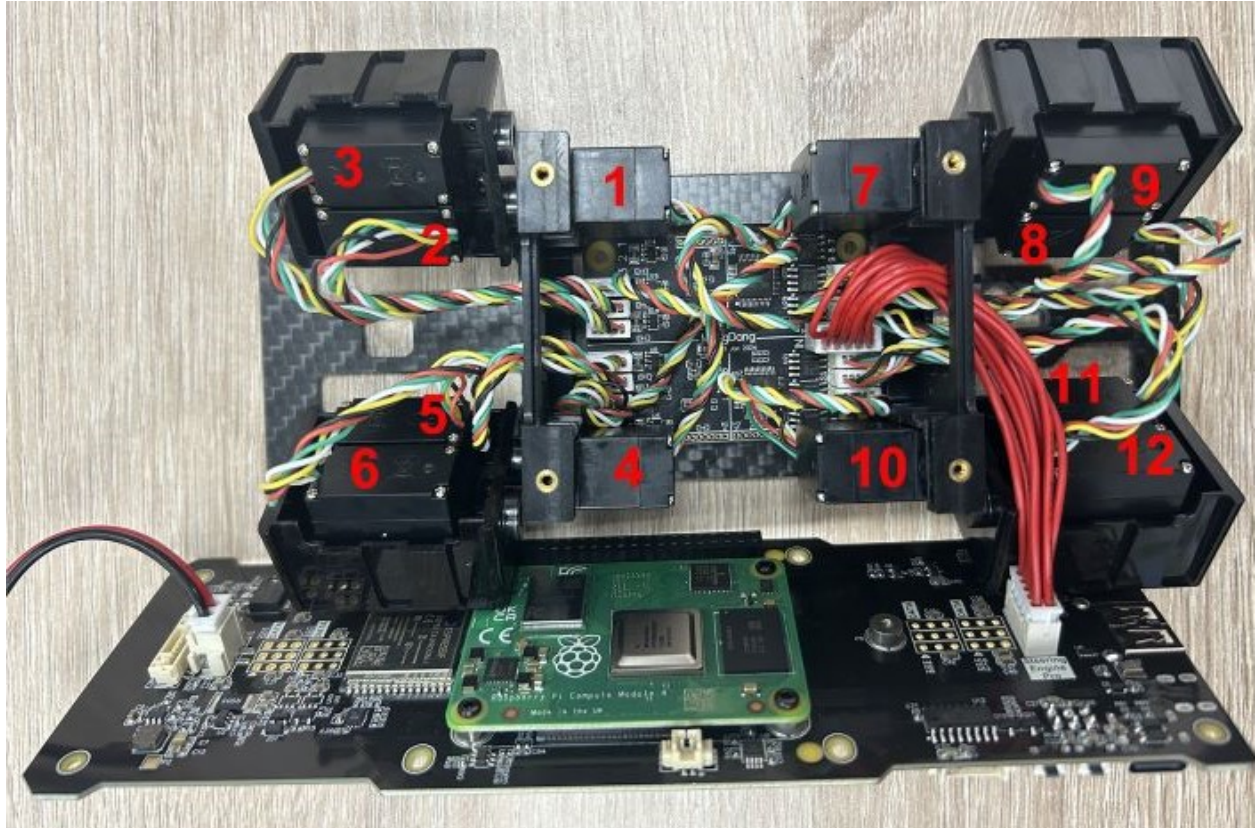


5. Body Frame and Hips Assembly

- Before you connect the CM4 module to the carry board, please make sure to remove the protective film on the Thermal Pad.



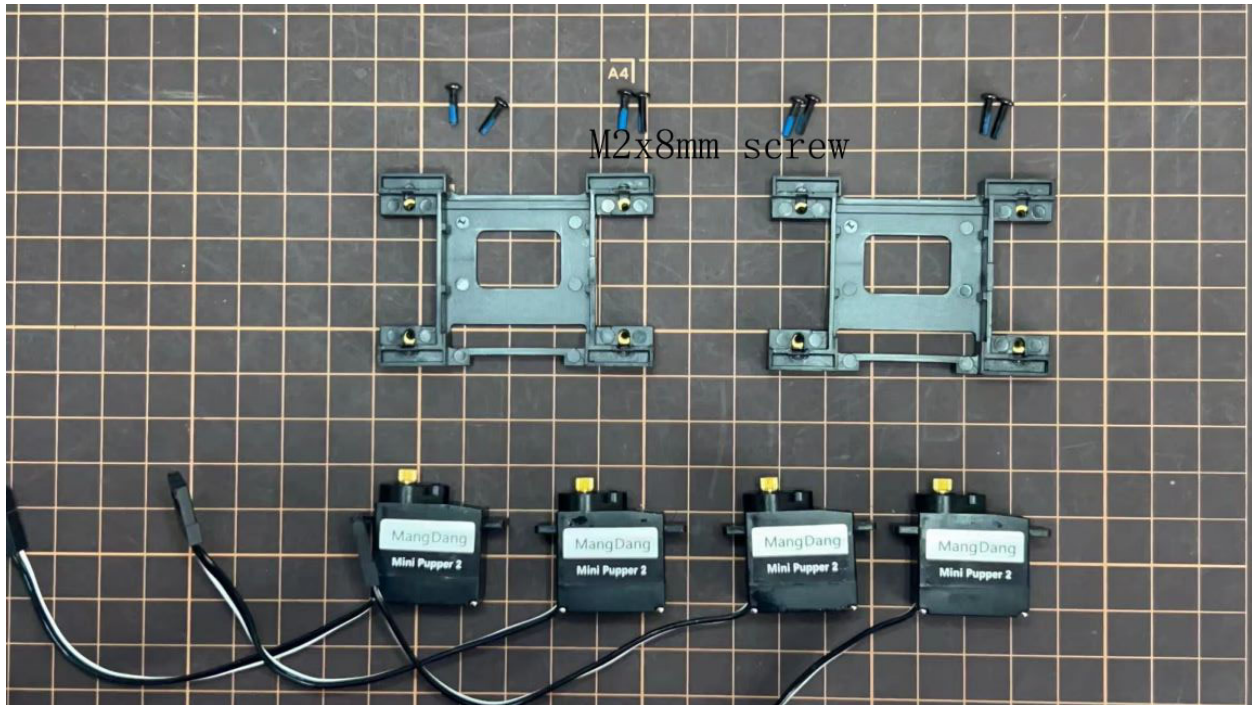
- Don't need to set servo ID for v2 pro version, the servo ID is fixed by hardware design.
- For the position of each servo, please refer to the below picture.



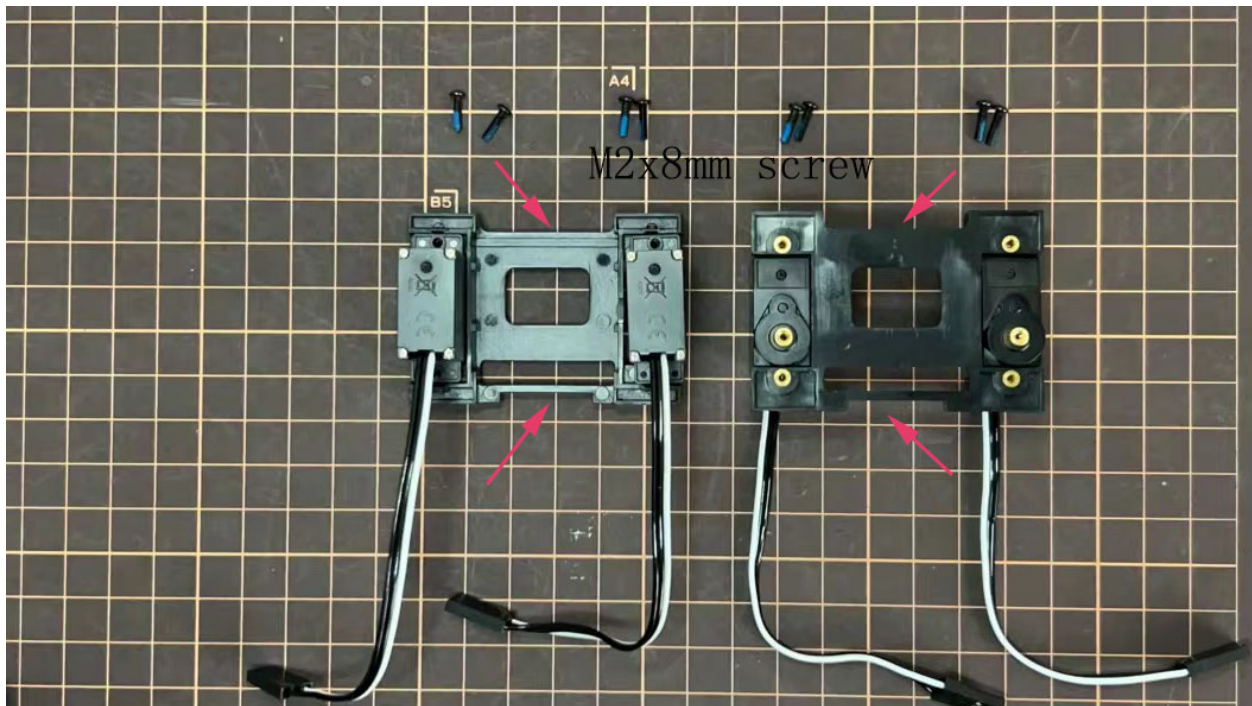
Step 5.1 Body center parts

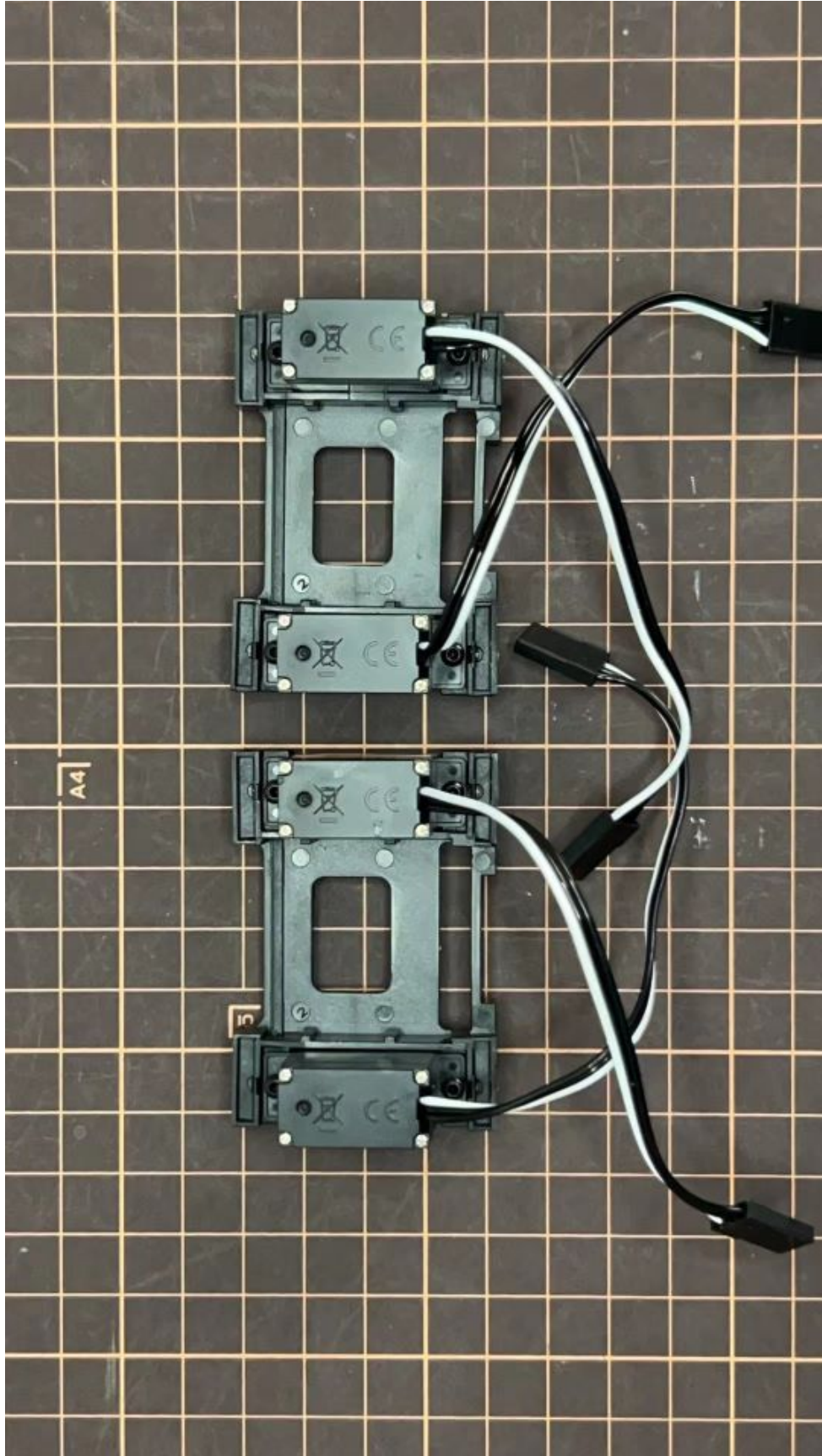
Connect the No.1, 4, 7, 10 servos to the body center parts.

- It is useful to put masking tape on the cables and write the number of servos during this process to make it easier later.



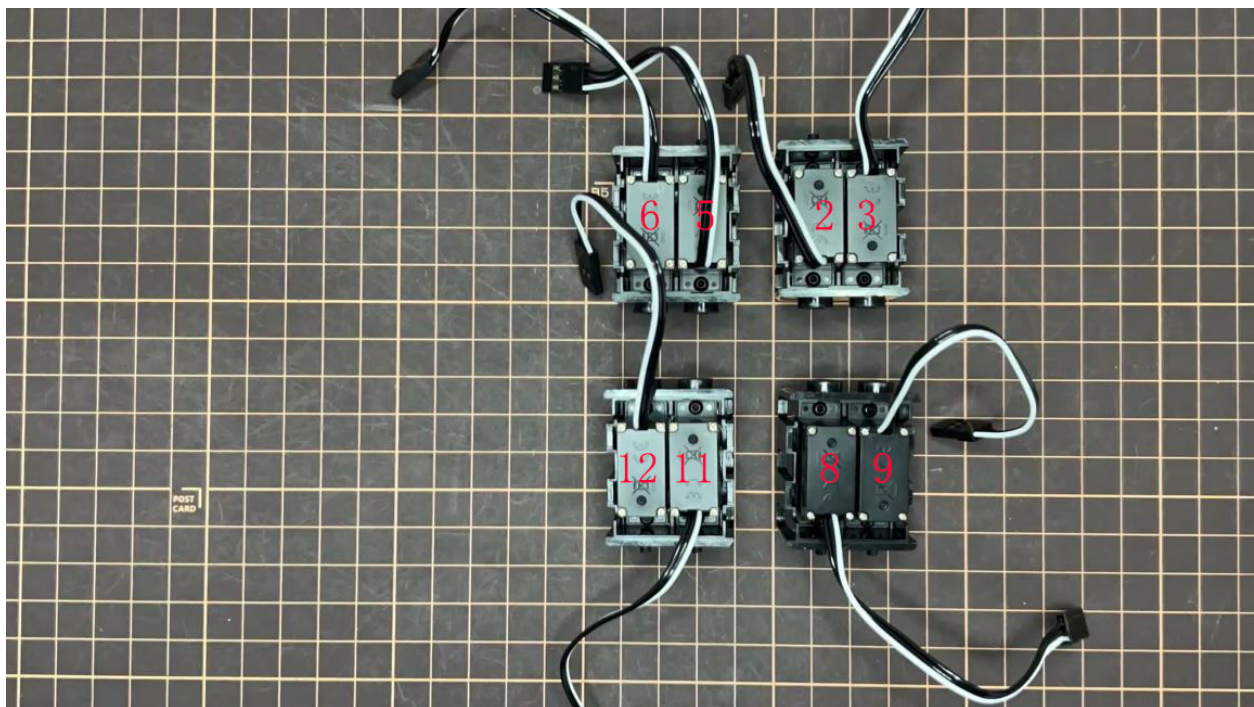
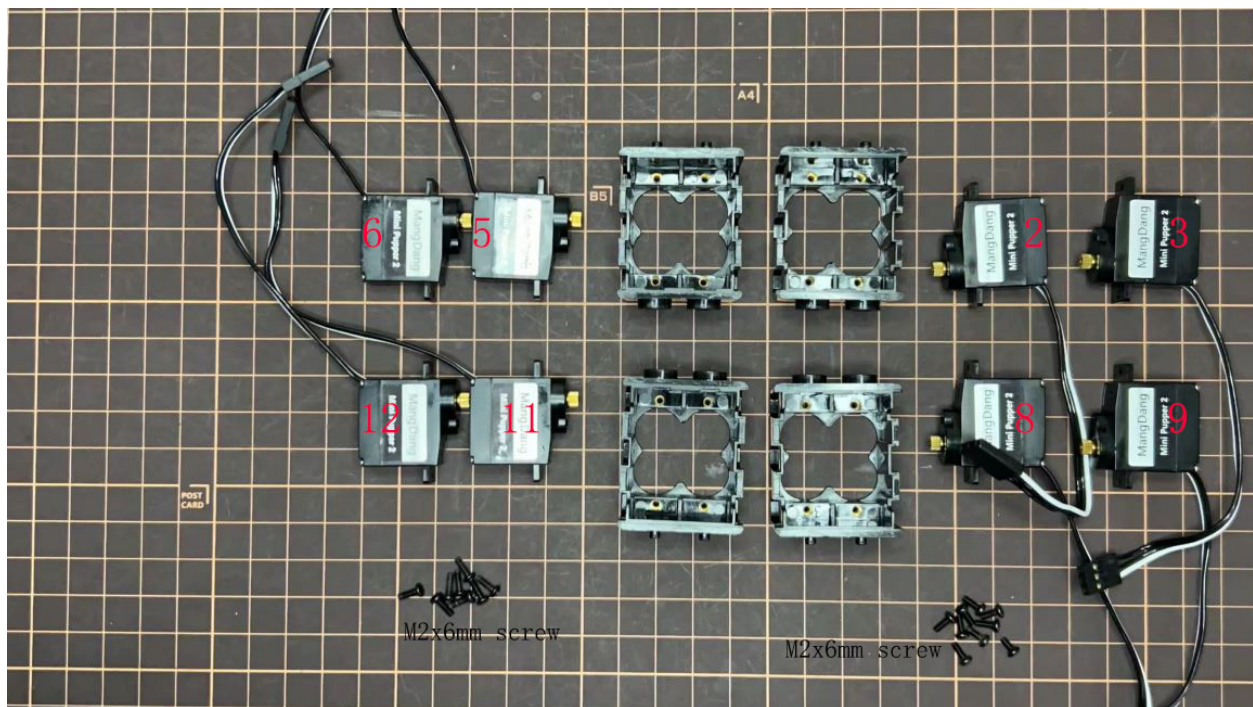
- Pay attention to the center part direction.



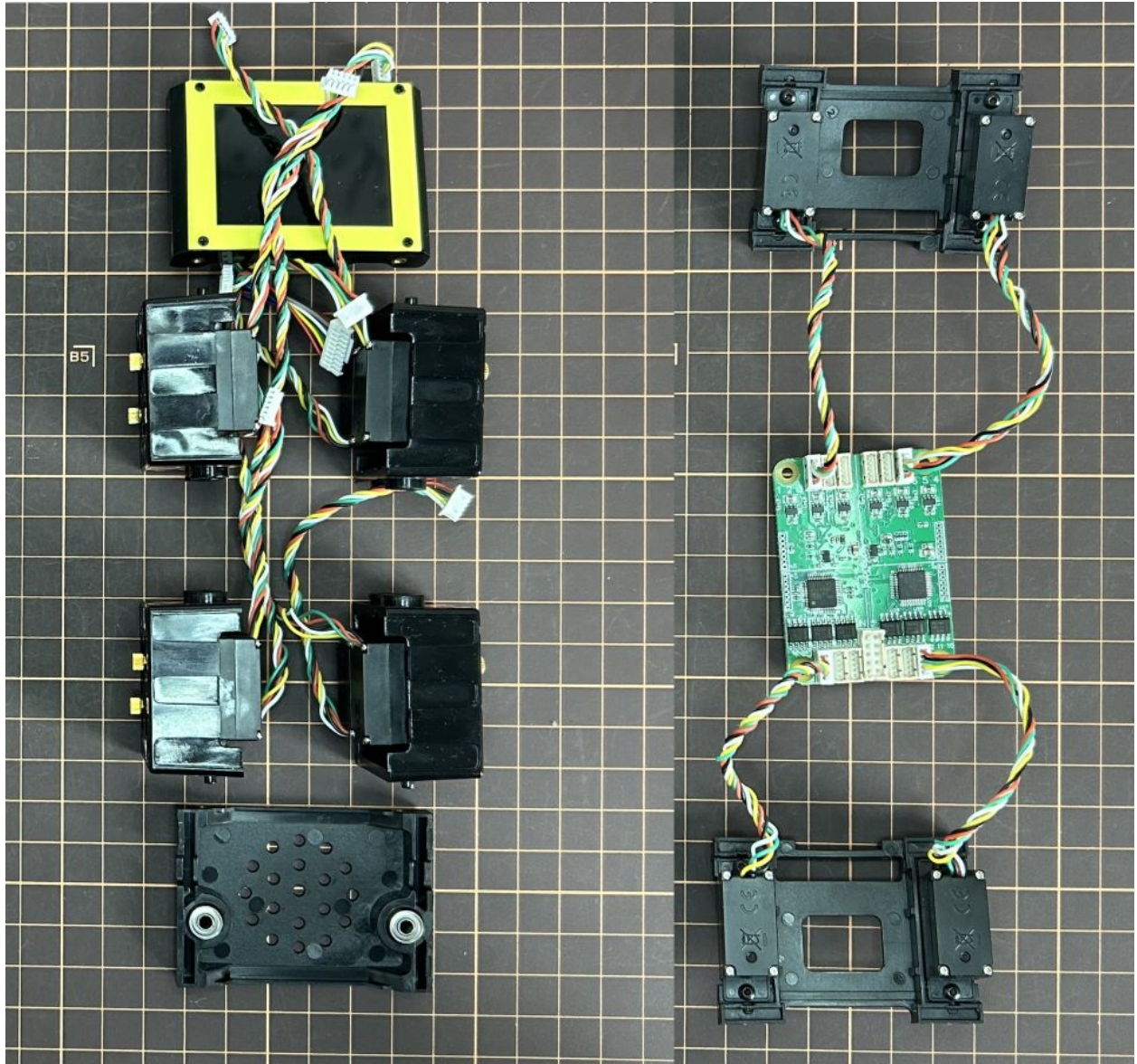


Step 5.2 Hip parts

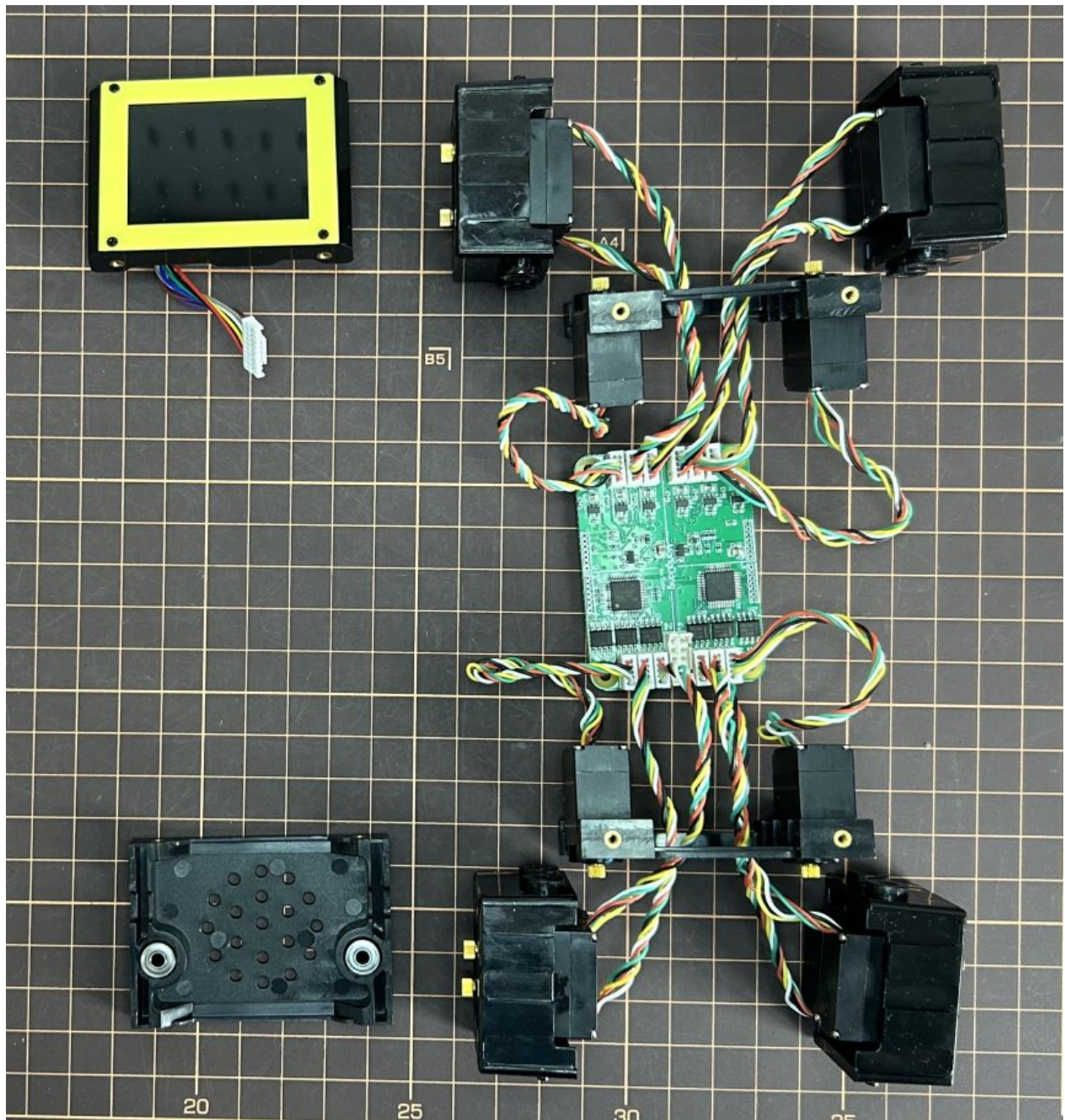
Assemble four hip parts, please refer to the servo positions.



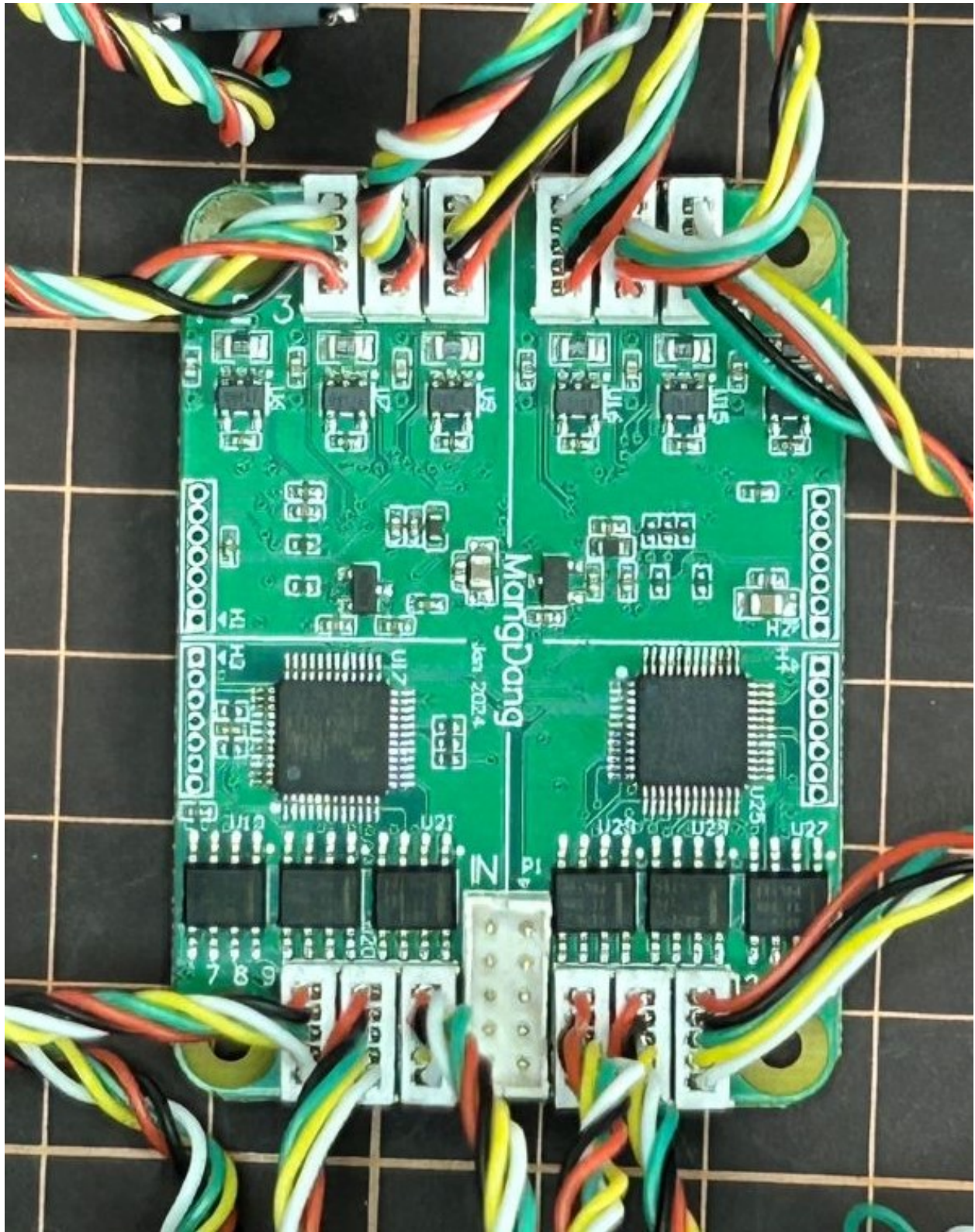
- Connect the No.1, 4, 7, 10 servos to the servo MCU PCB board.



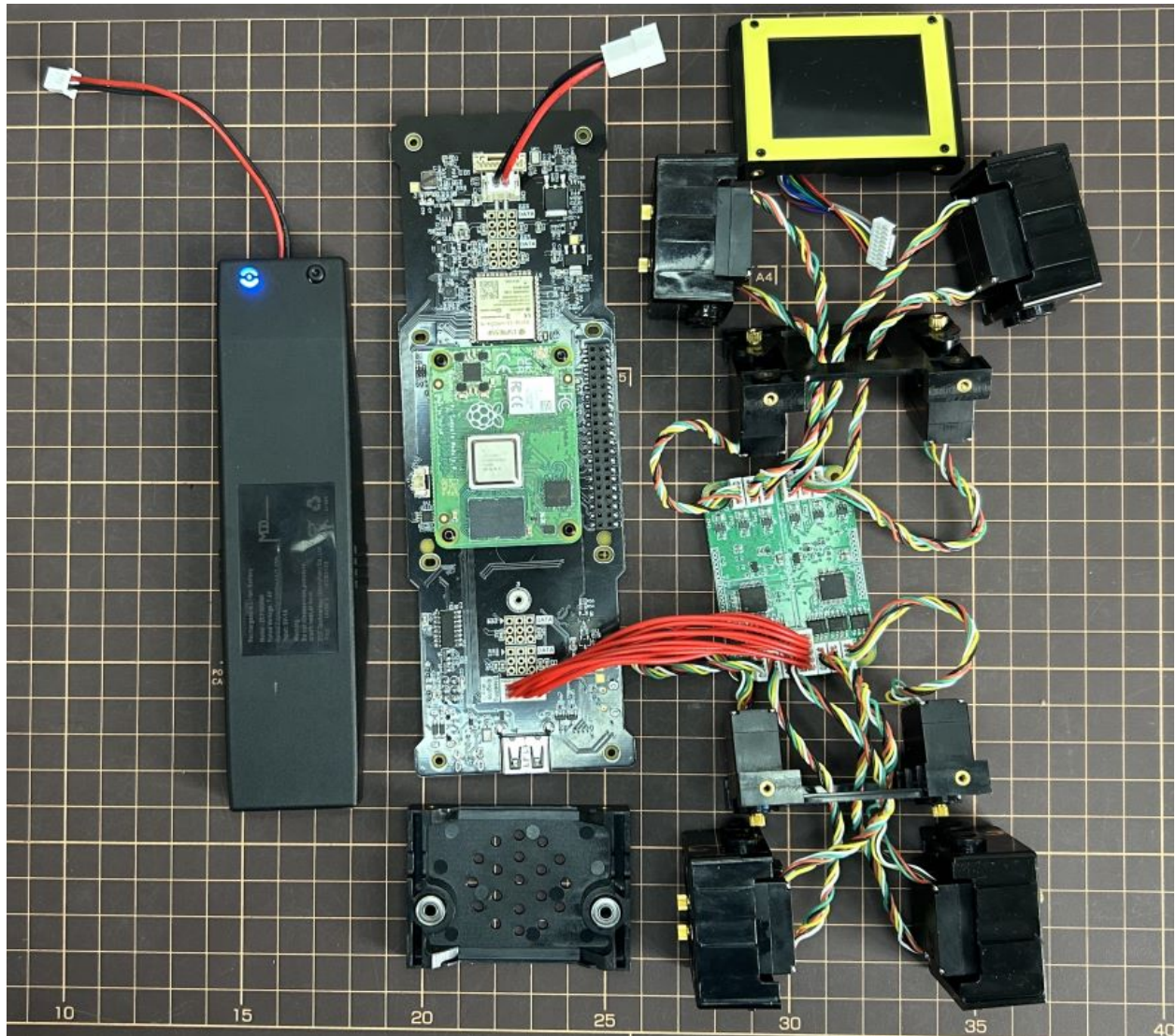
- Connect the rest servos to the servo MCU PCB board.



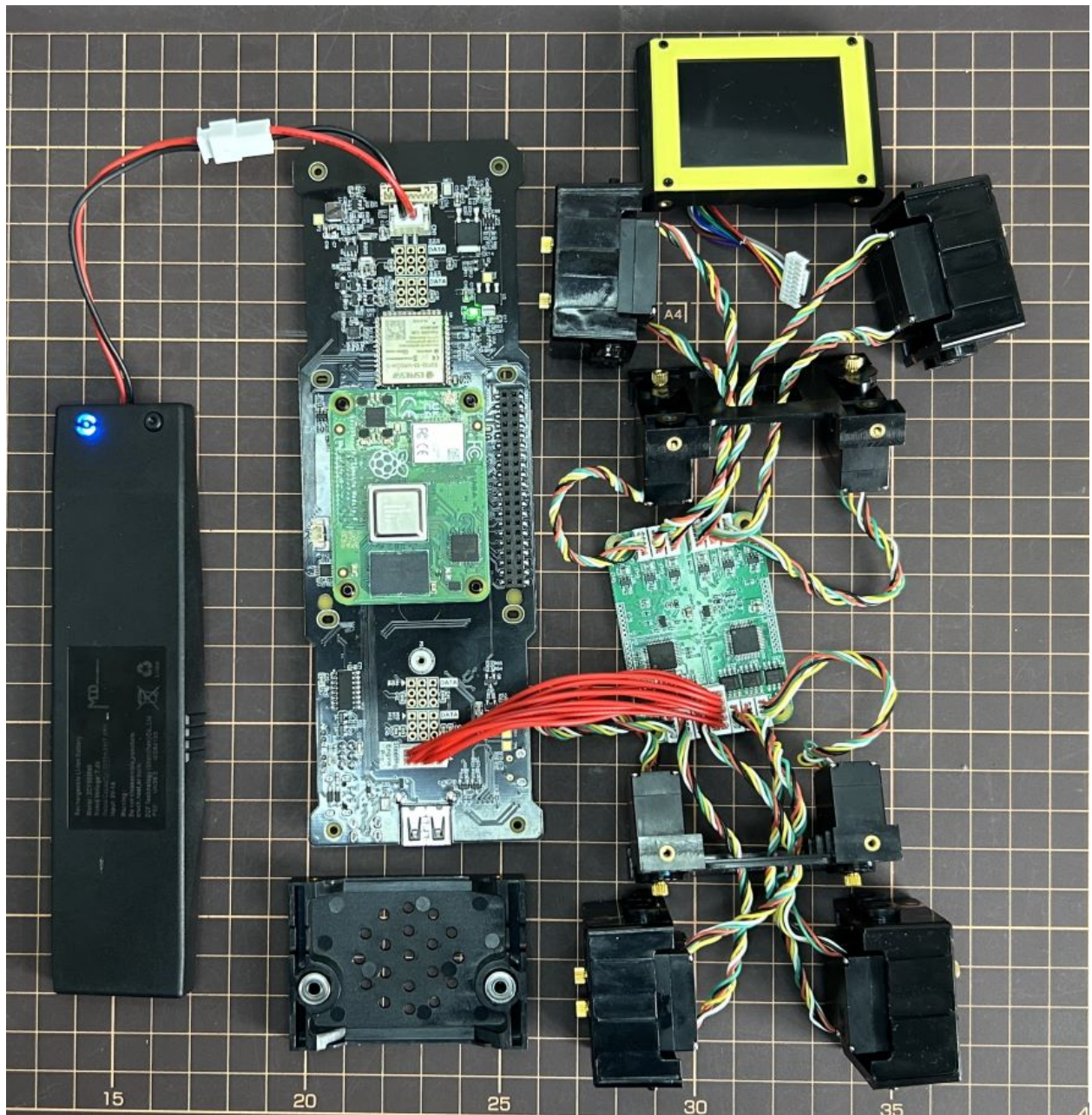
Pay attention to the servo cable connectors' directions.



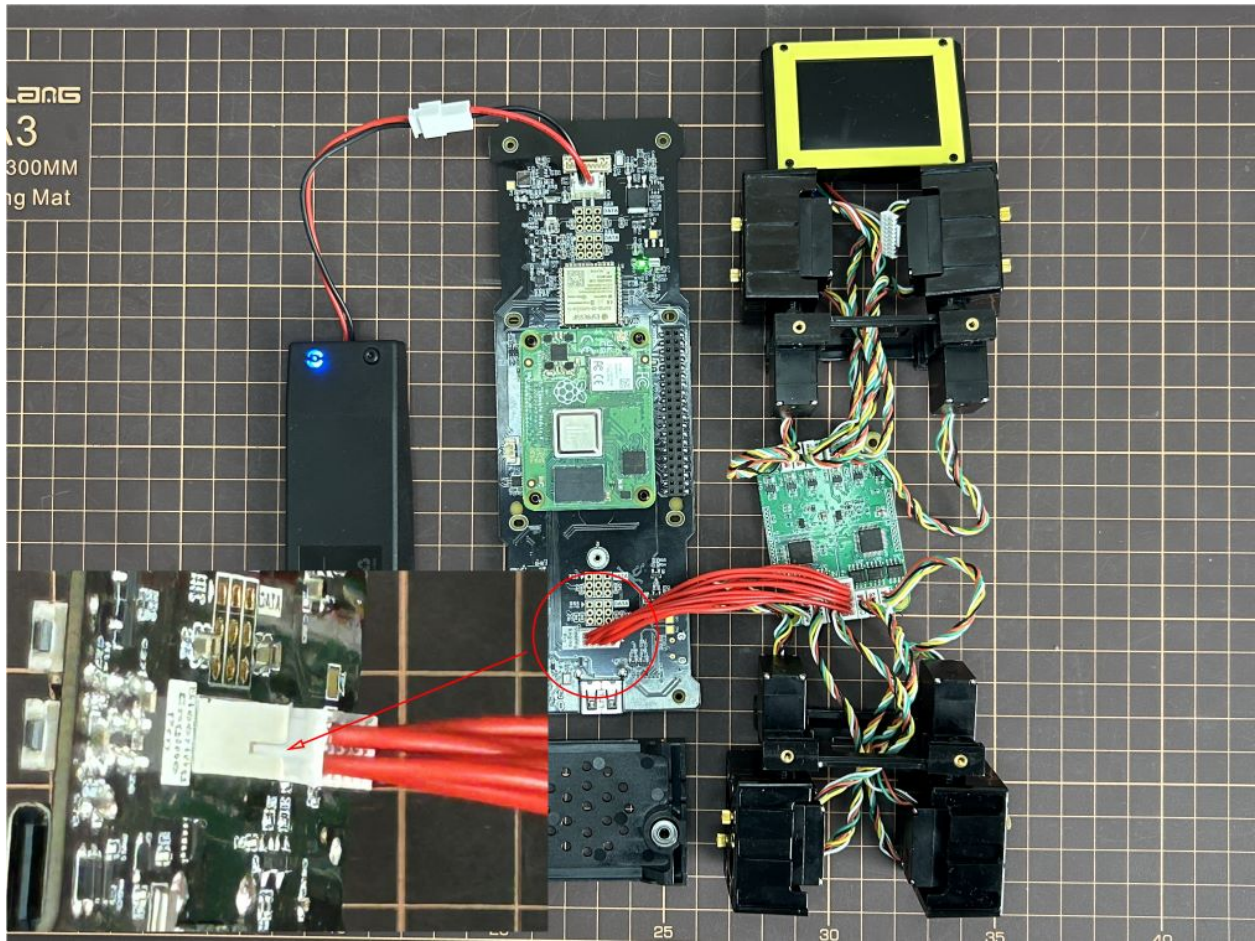
- Use the DIY cable to connect the top PCB board to the servo MCU PCB board.



- Power on the battery and connect to the top PCB board.



- Connect the four black hip parts to the relative servos(No. 1,4,7,10).

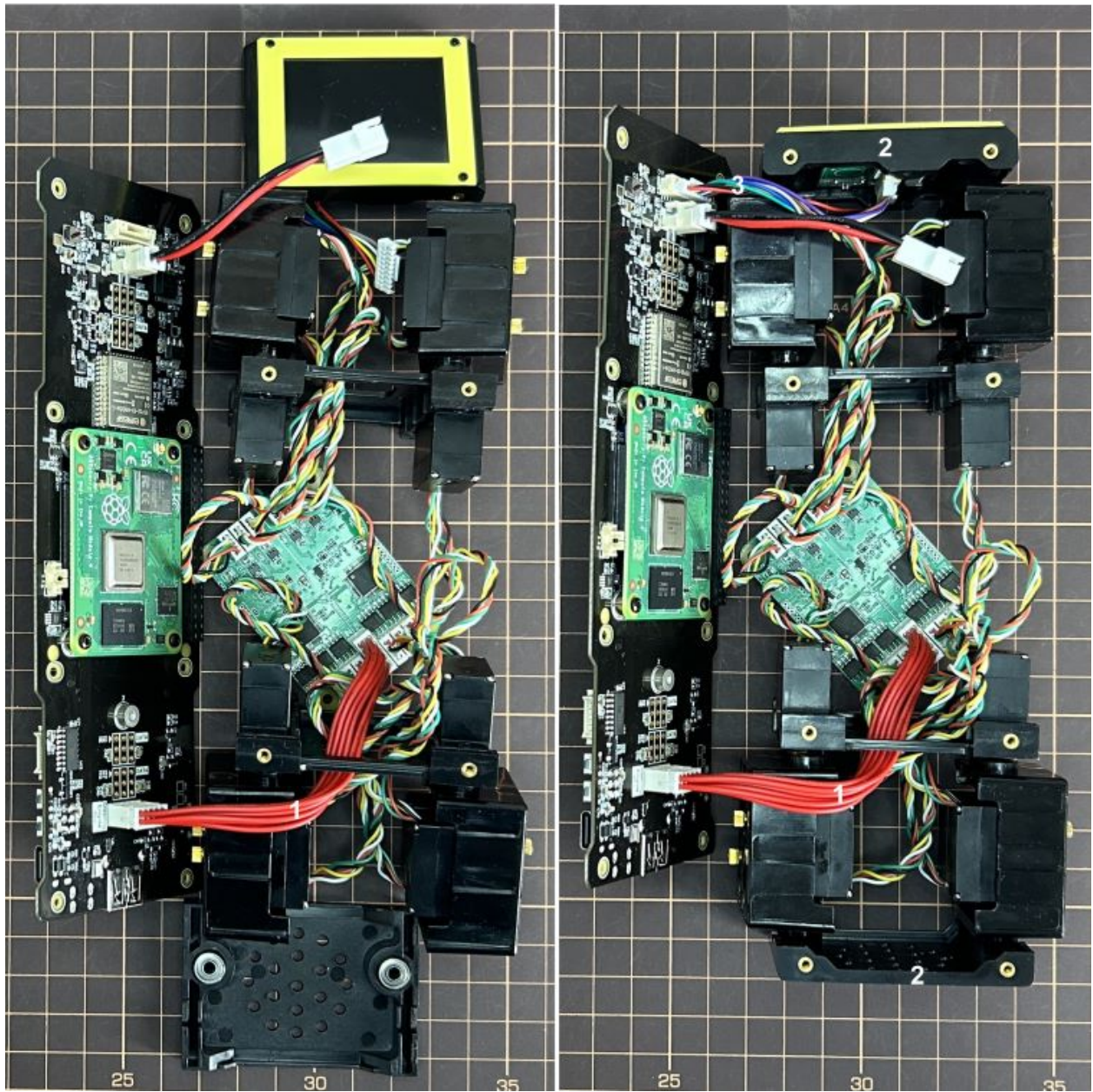


Connect the four hip parts to the body, please pay attention.

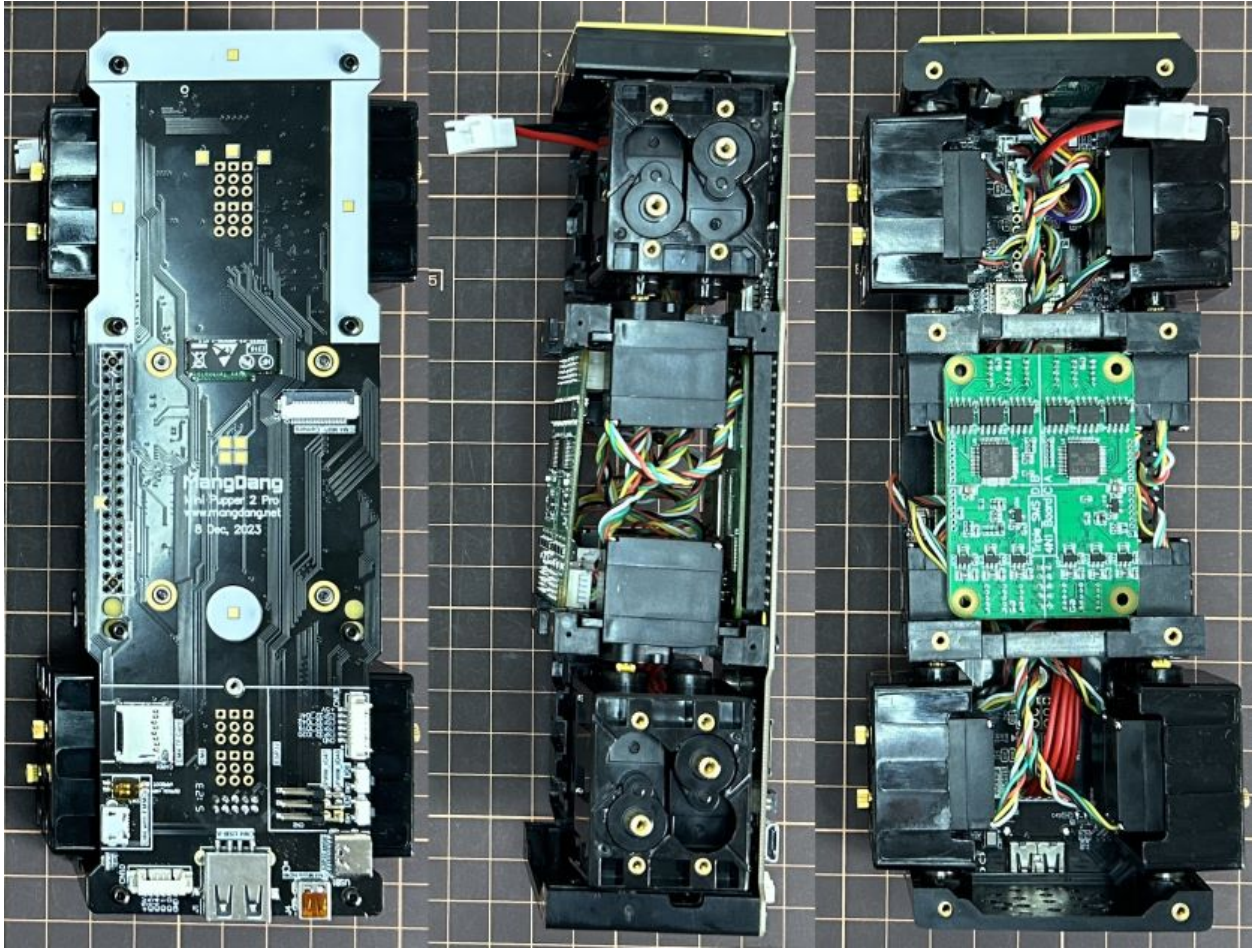
- Don't power off the battery now.
- Ensure all the servo positions are right.

Step 5.3 Front and back body parts

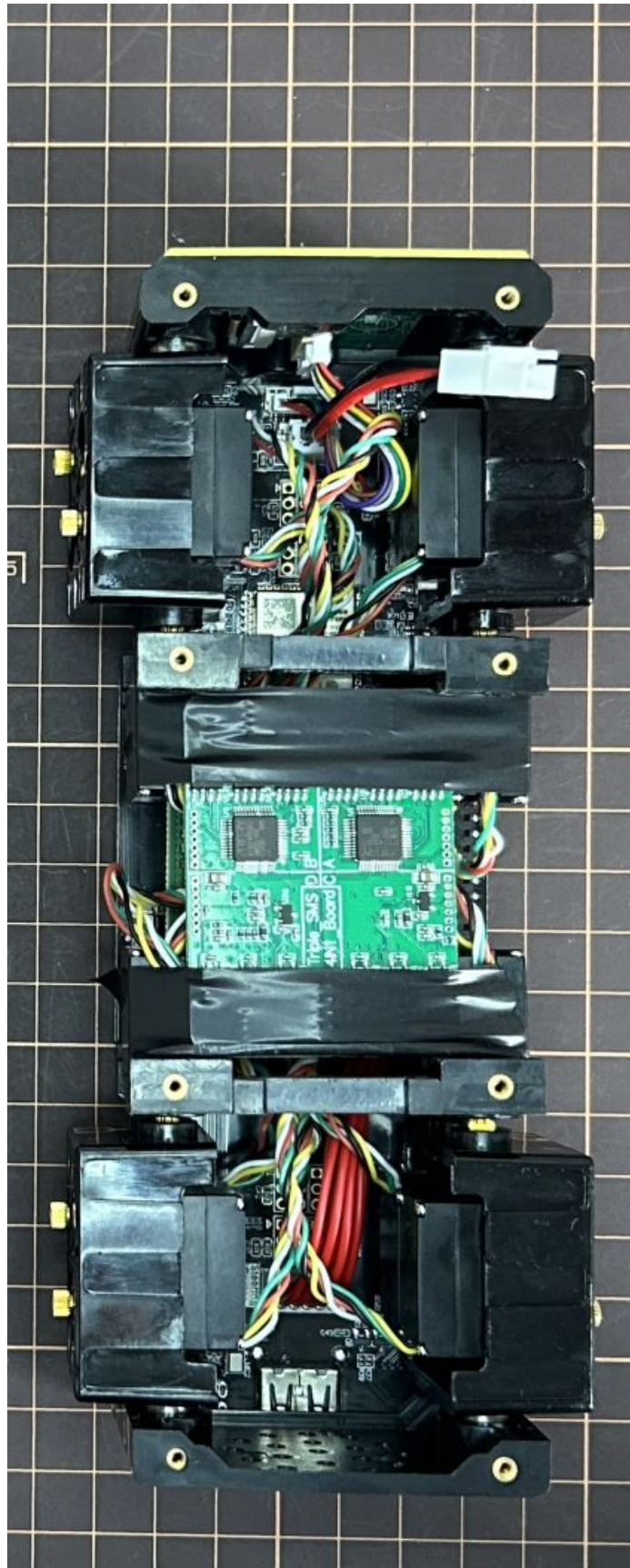
Power off the battery, adjust the red cable position and connect the front and back body parts.



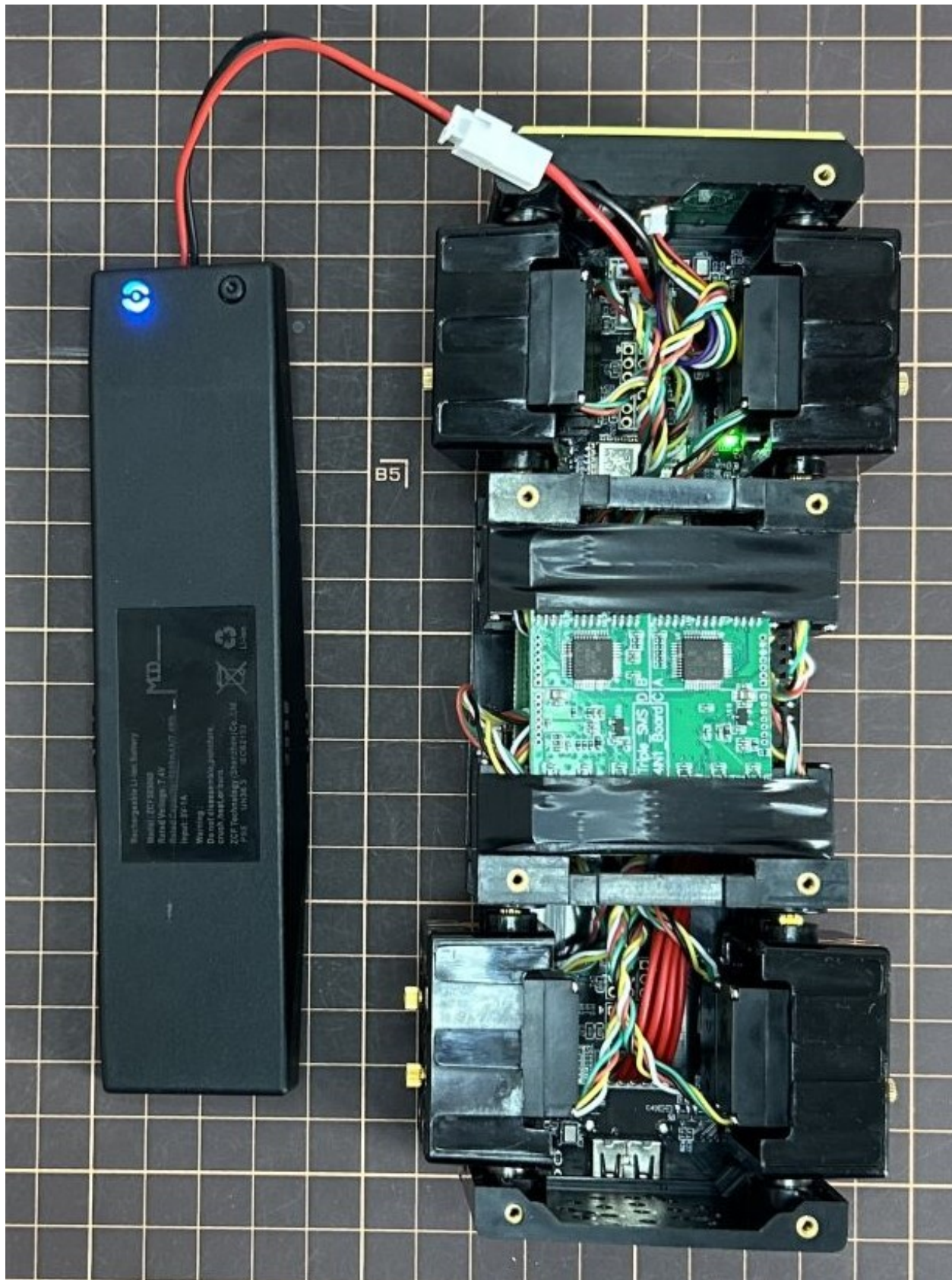
Use the screws to fix the top PCB board.



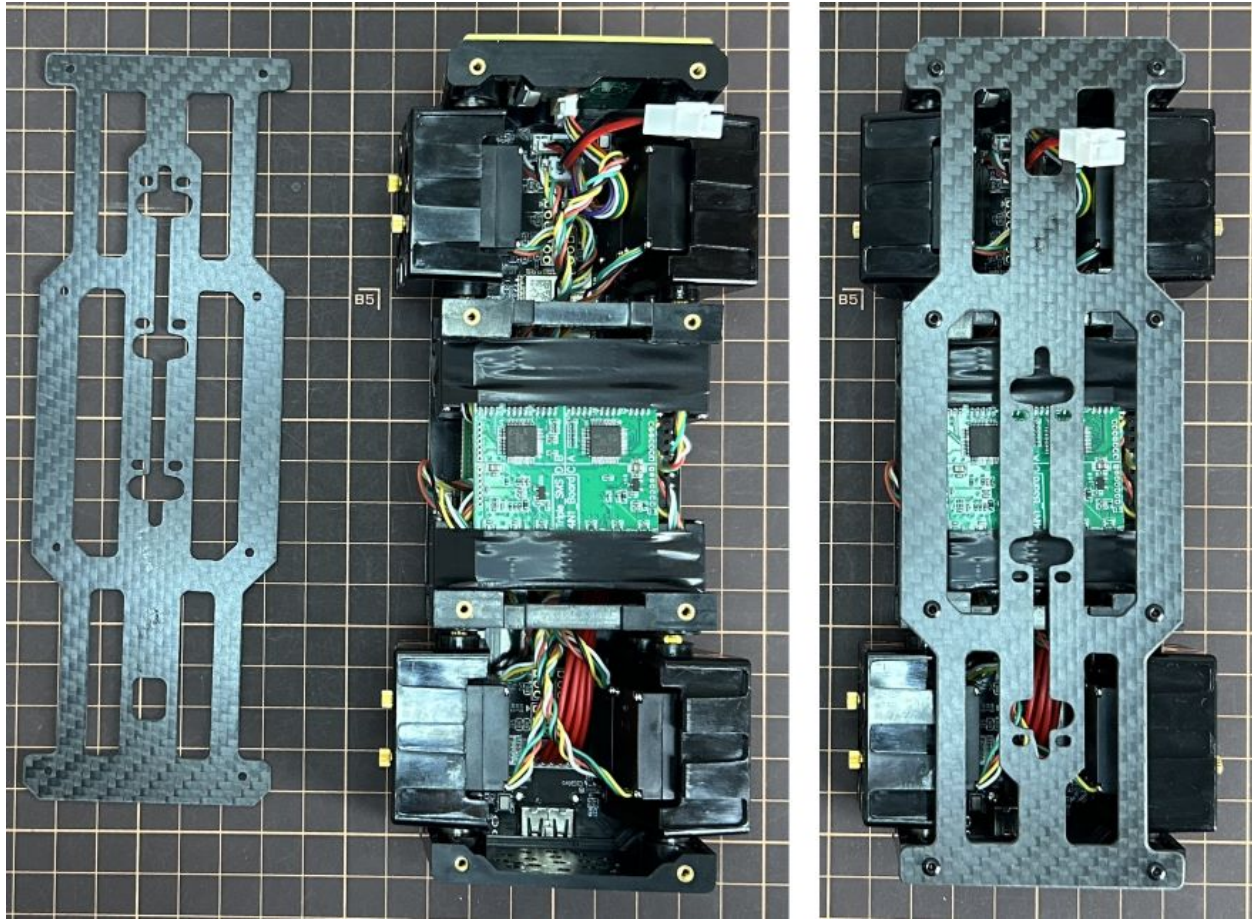
You can tighten the servo MCU PCB board with tape.



Power the battery and connect to the top PCB board to ensure the four black hip part positions are right.



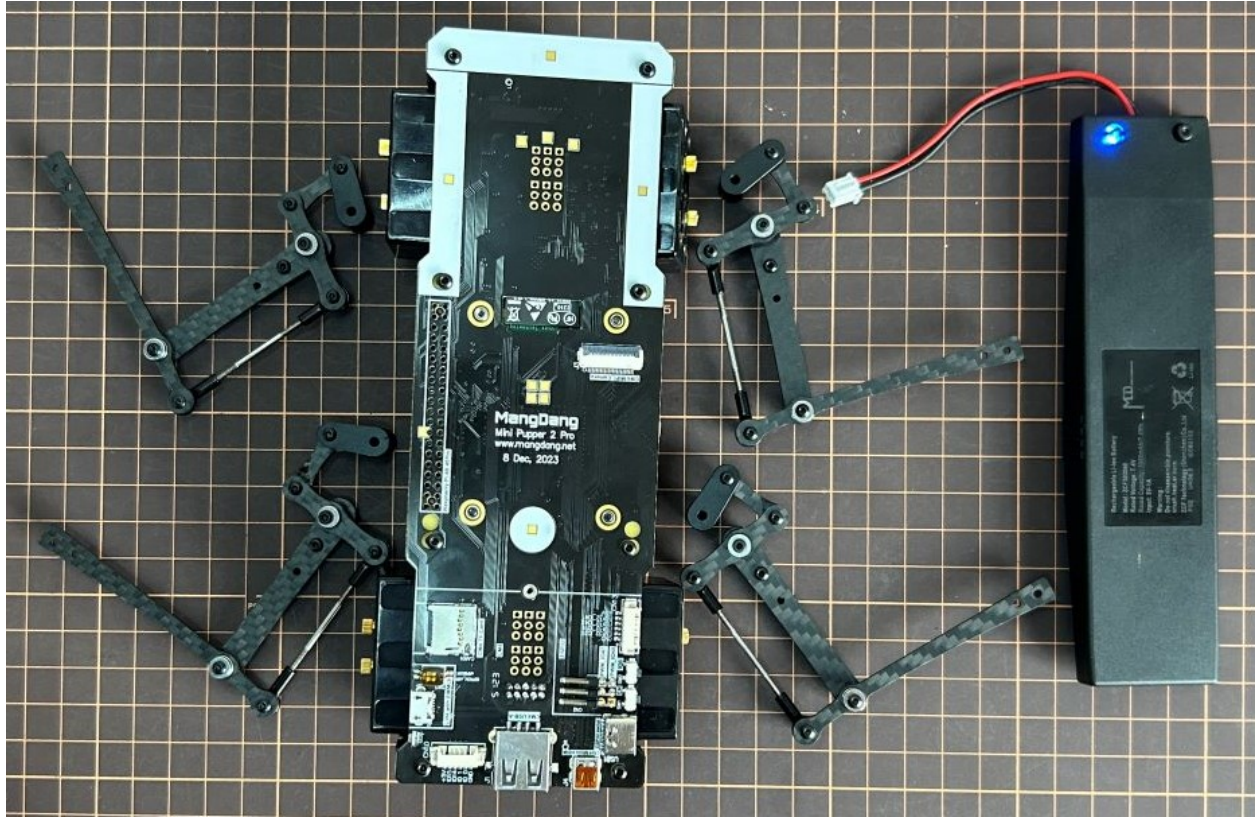
Connect the center parts to the bottom carbon fiber.



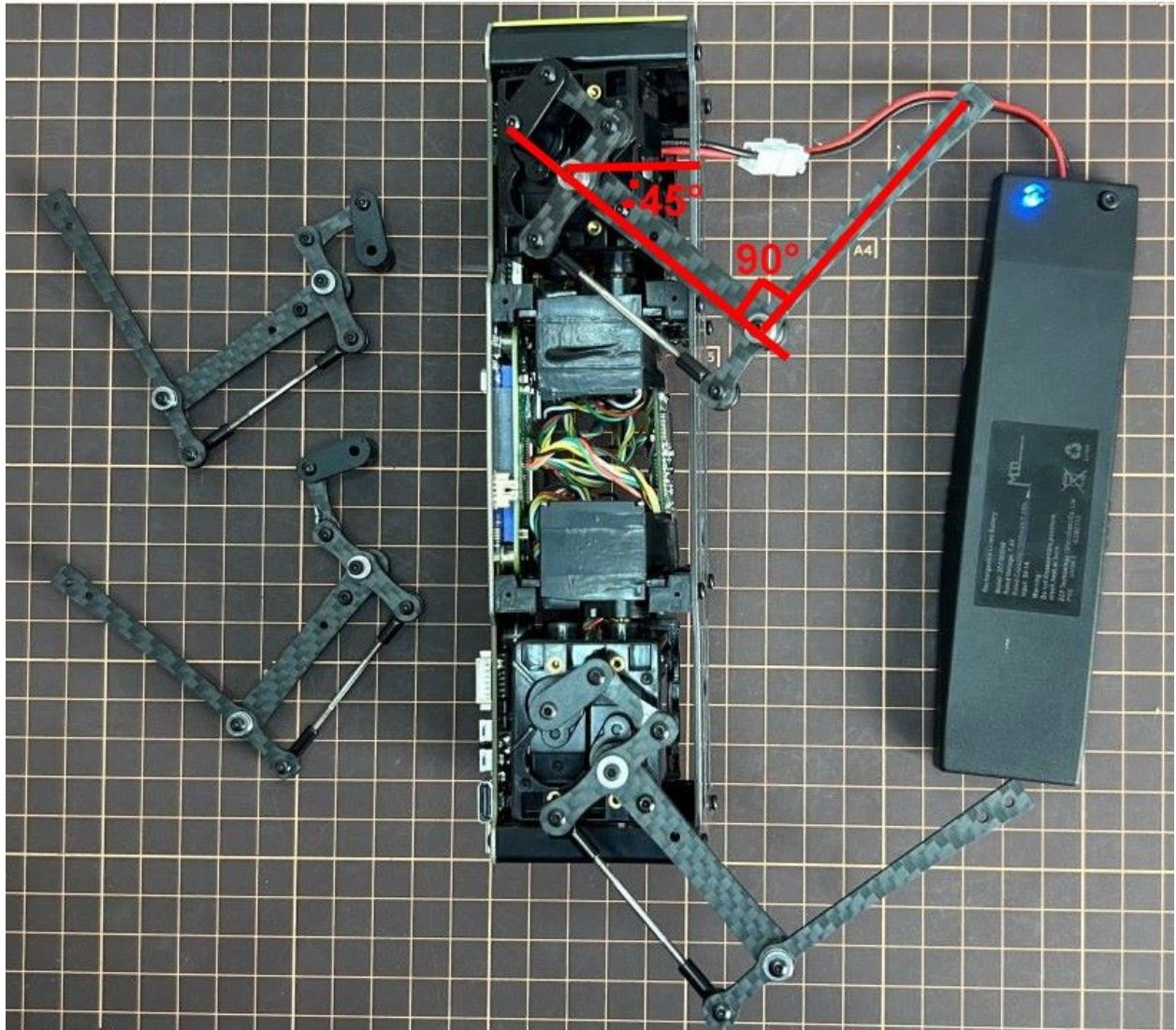
- Be careful of the carbon fiber front and rear orientation.

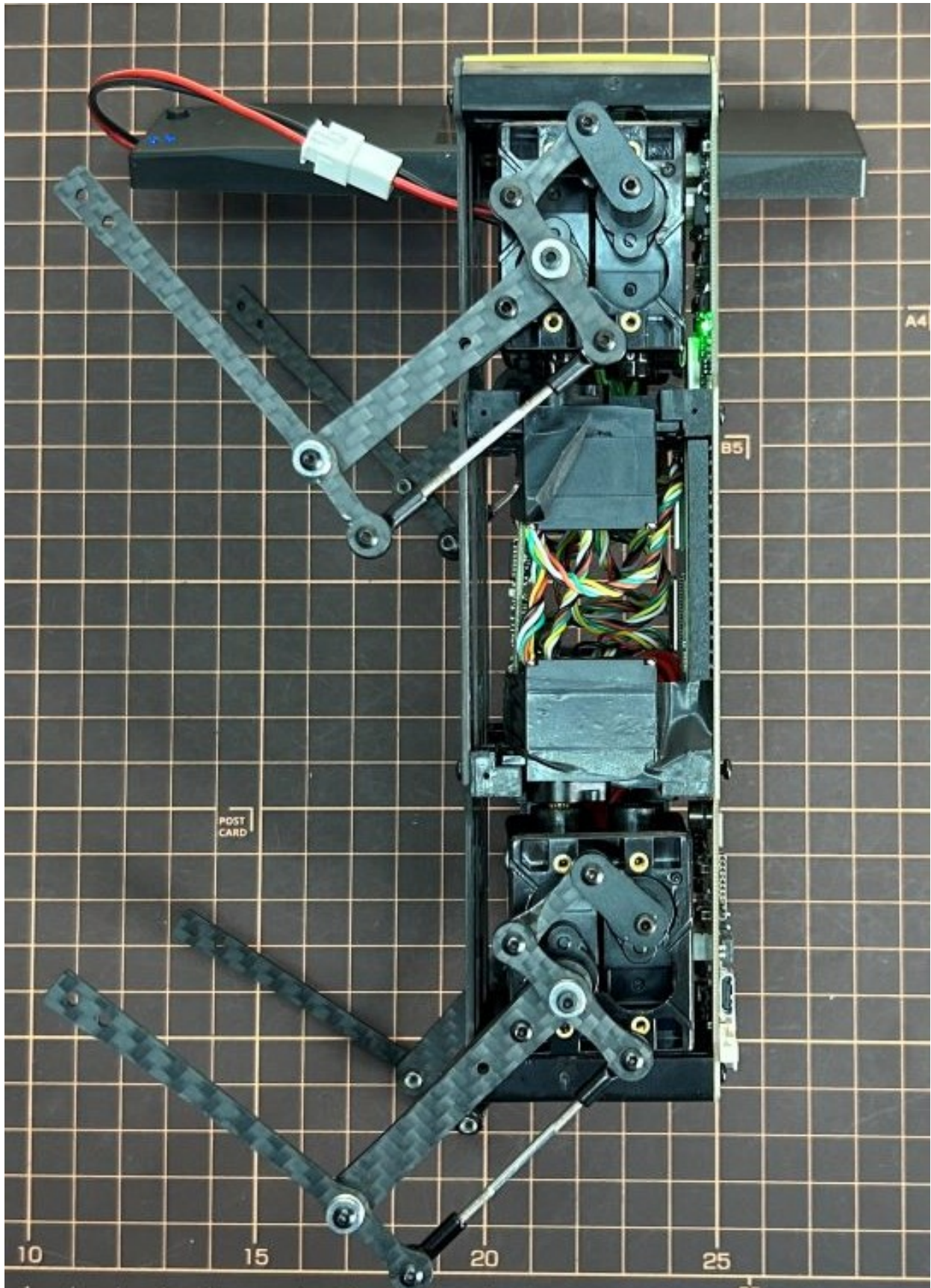
Step 5.4 Assemble four legs to the body

Prepare the four pre-assembled legs



Pay attention to the theoretically best angles, it's better to meet the theoretically best angles as much as possible. But don't worry, we'll use the software to calibrate the angles later.

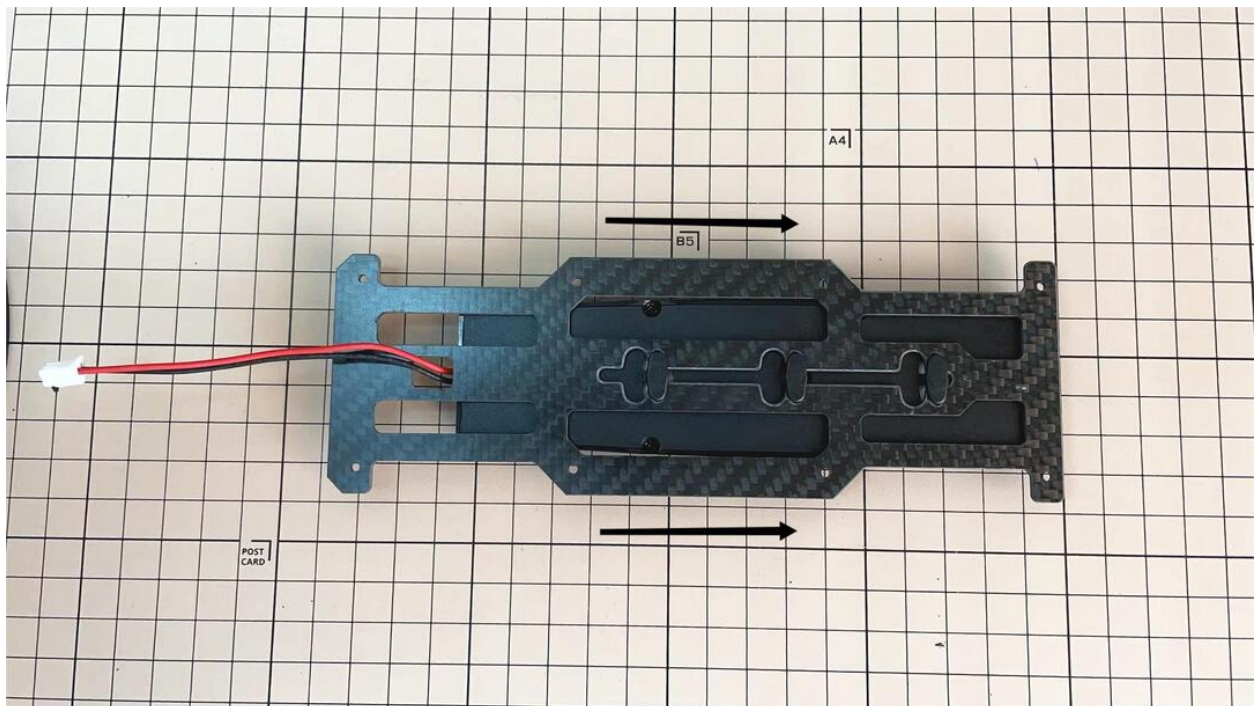
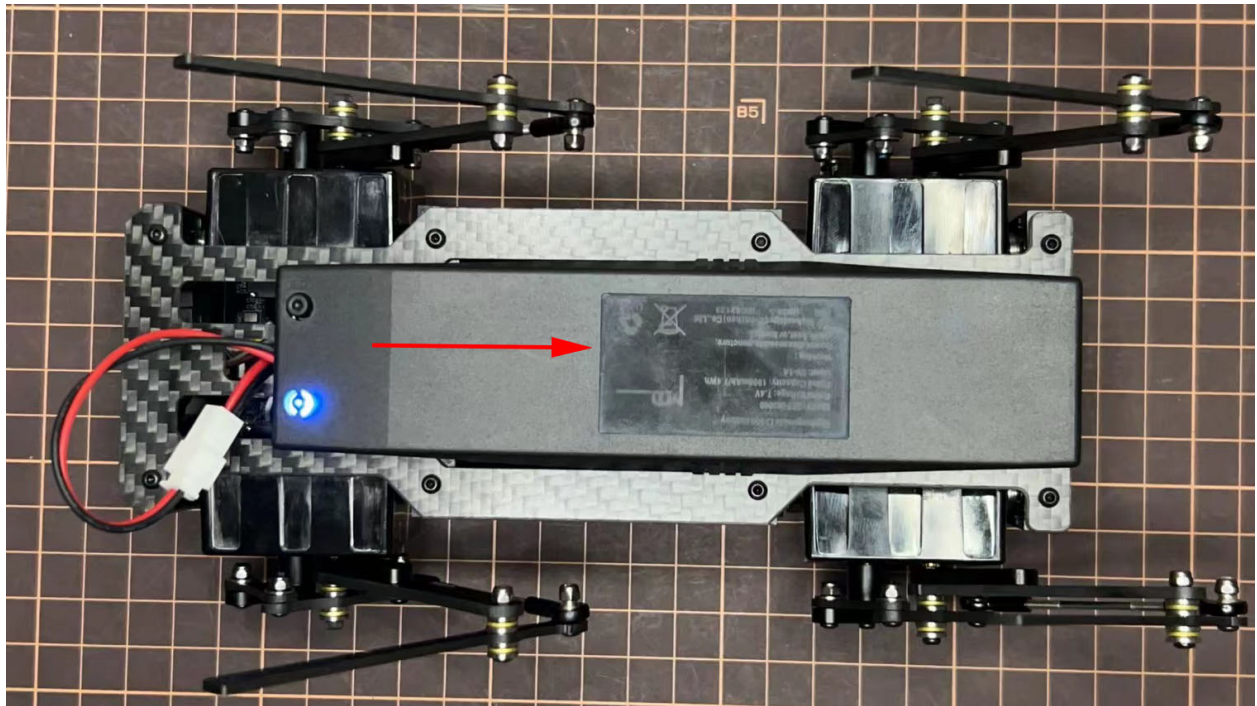


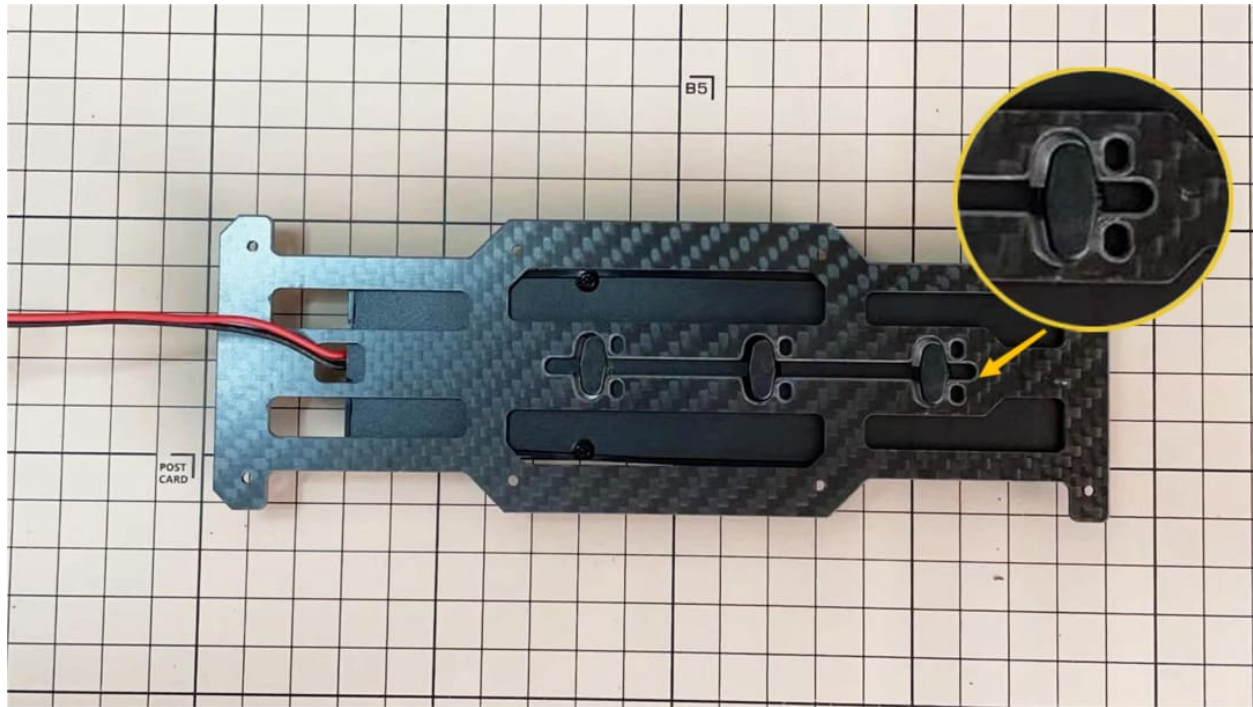


Step 5.5 Assemble the battery to the body

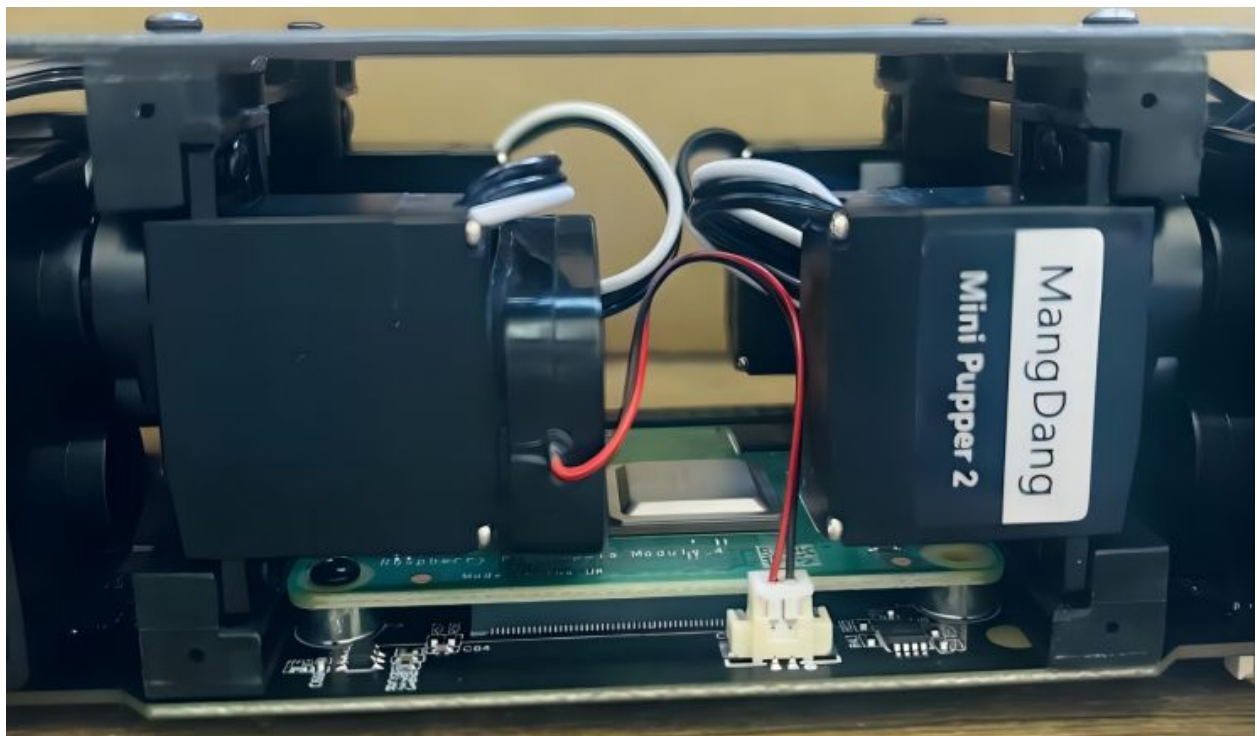
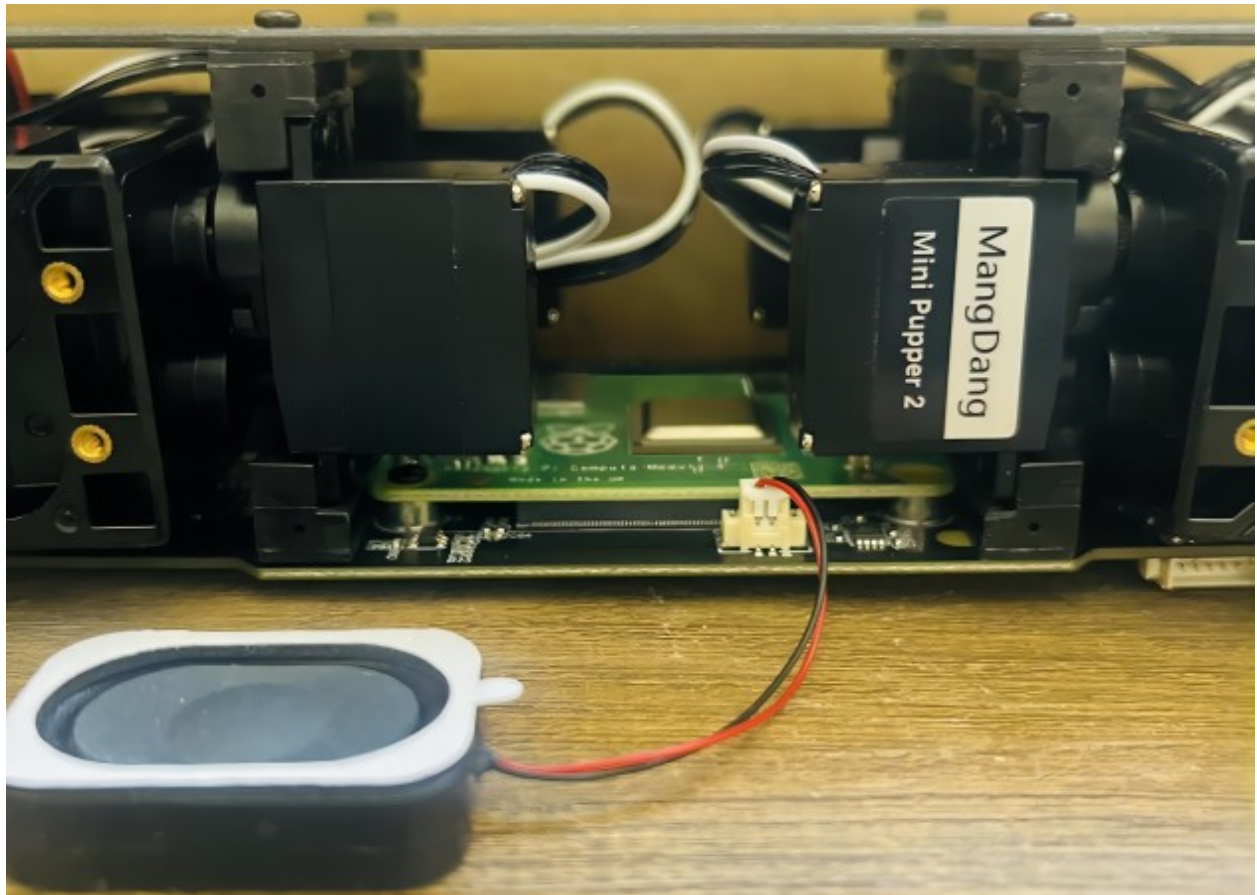


Slide the battery backward and secure it.





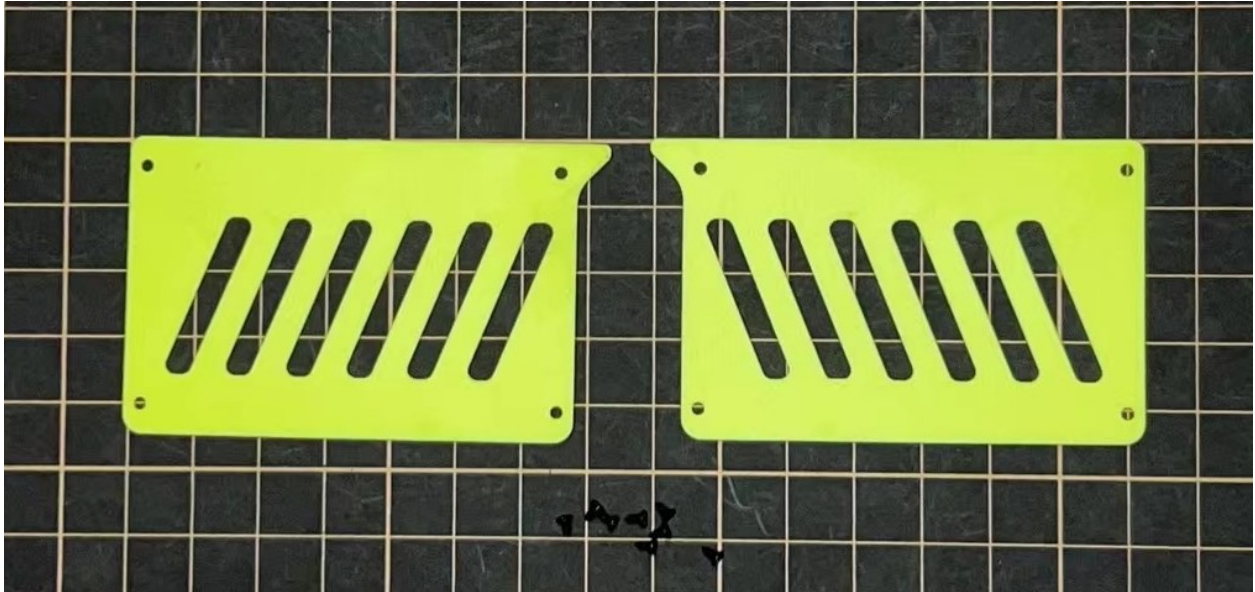
Step 5.6 Assemble the speaker



6. Cover Assembly

Please refer to the below video clip.

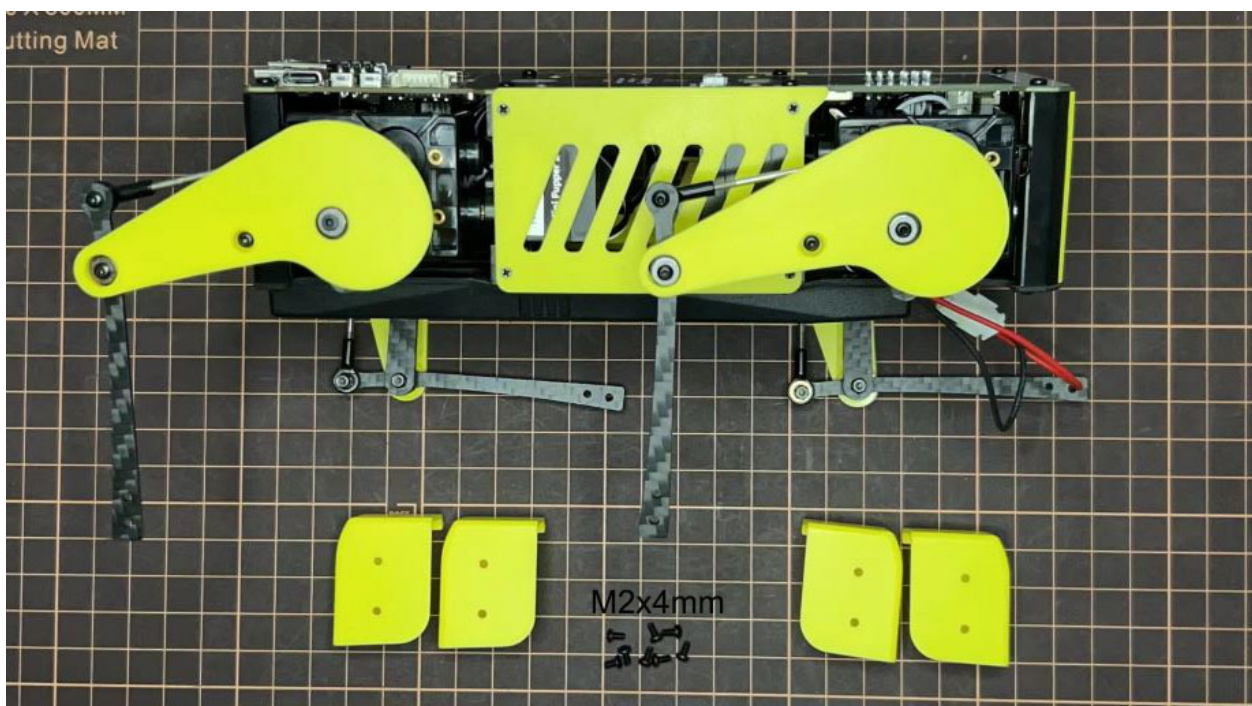
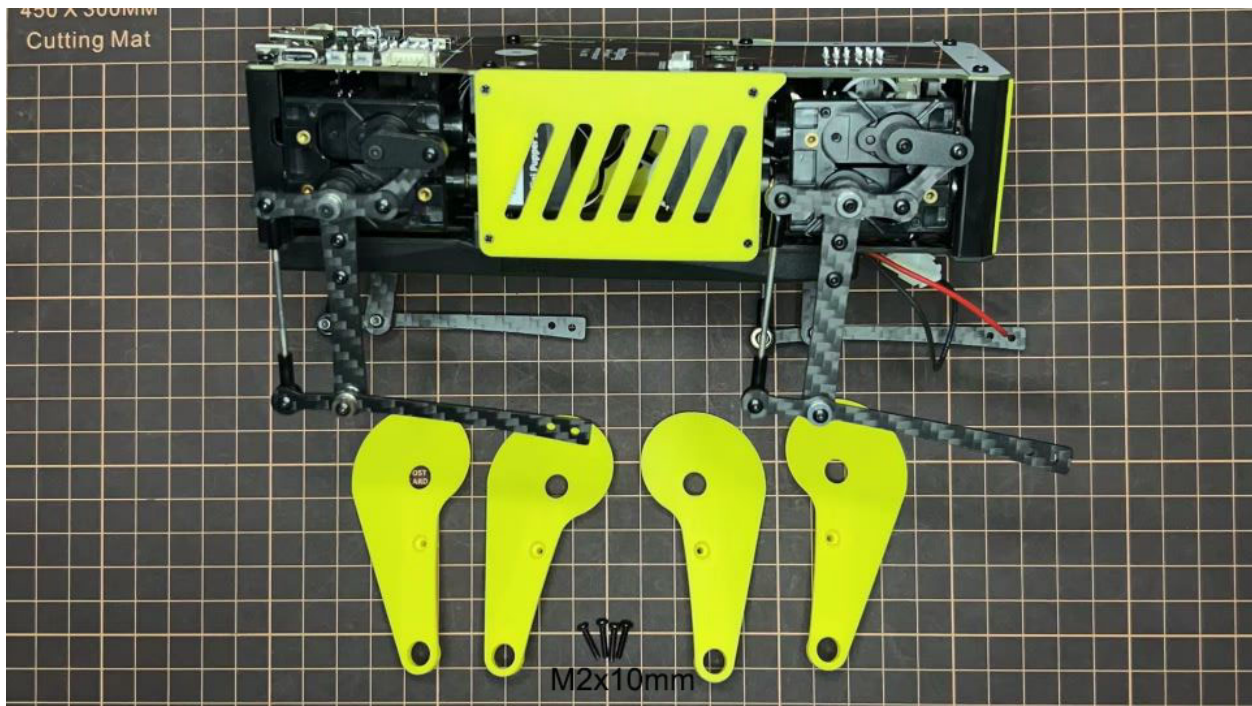
Step 6.1 Side panels





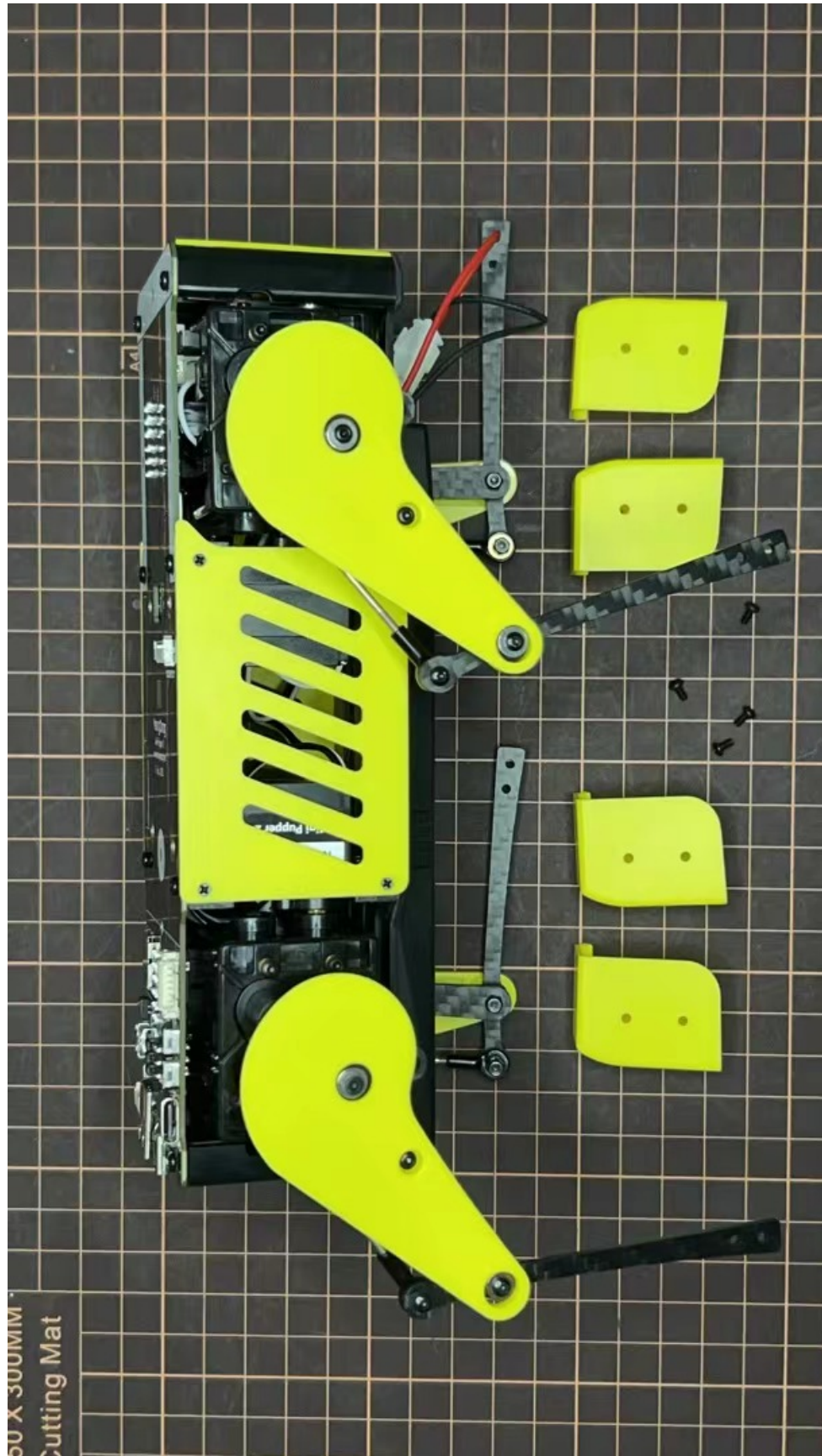
Step 6.2 Shin guards

- Use four M2x10mm countersunk screws.

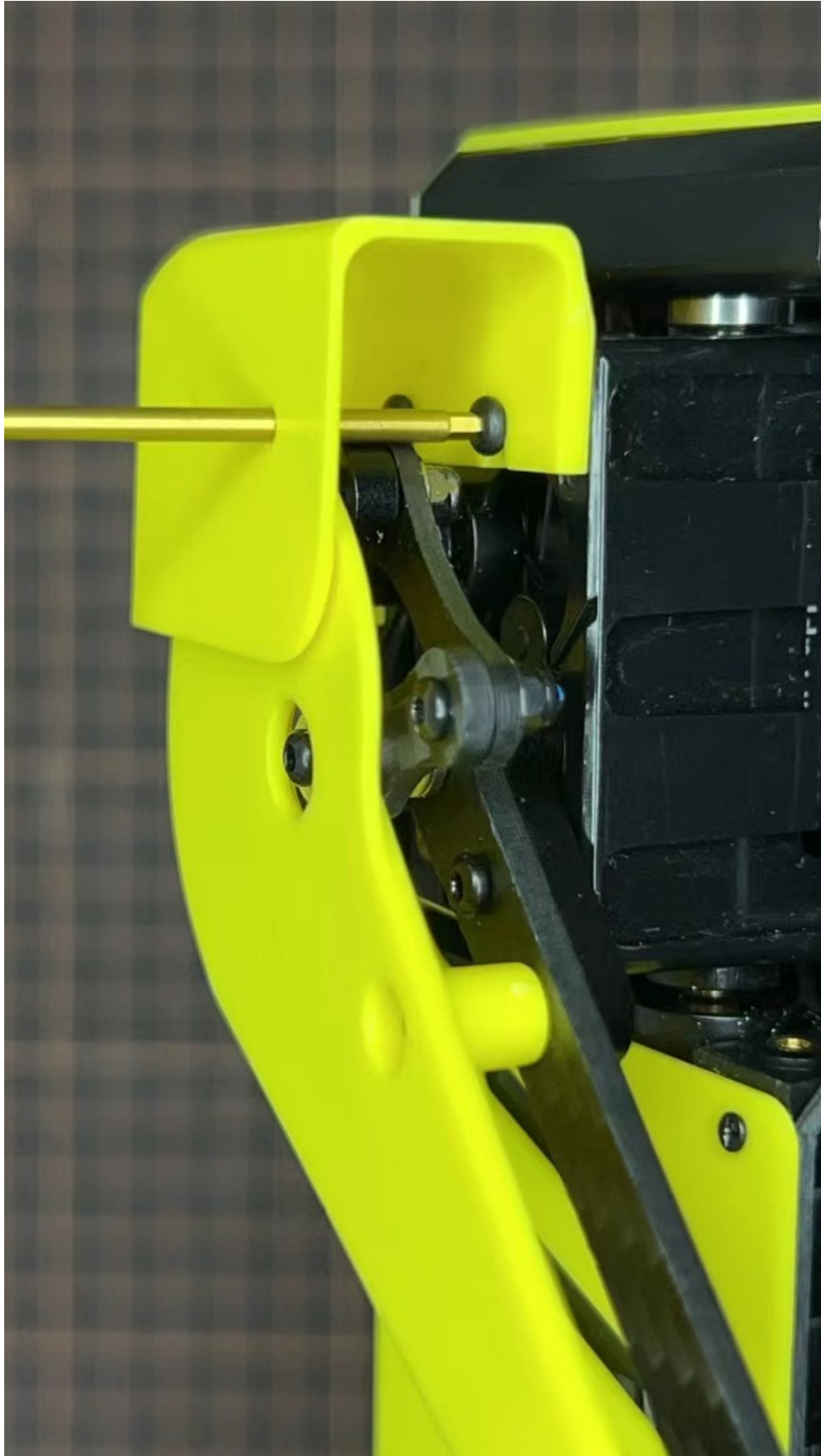


Step 6.3 Shoulders

- Insert only the screws first and then insert the shoulder parts into the gap. Insert the 2 mm hex driver into the hole in the shoulder part and tighten the screws.









Step 6.4 Shoes

- Put on 4 shoes.



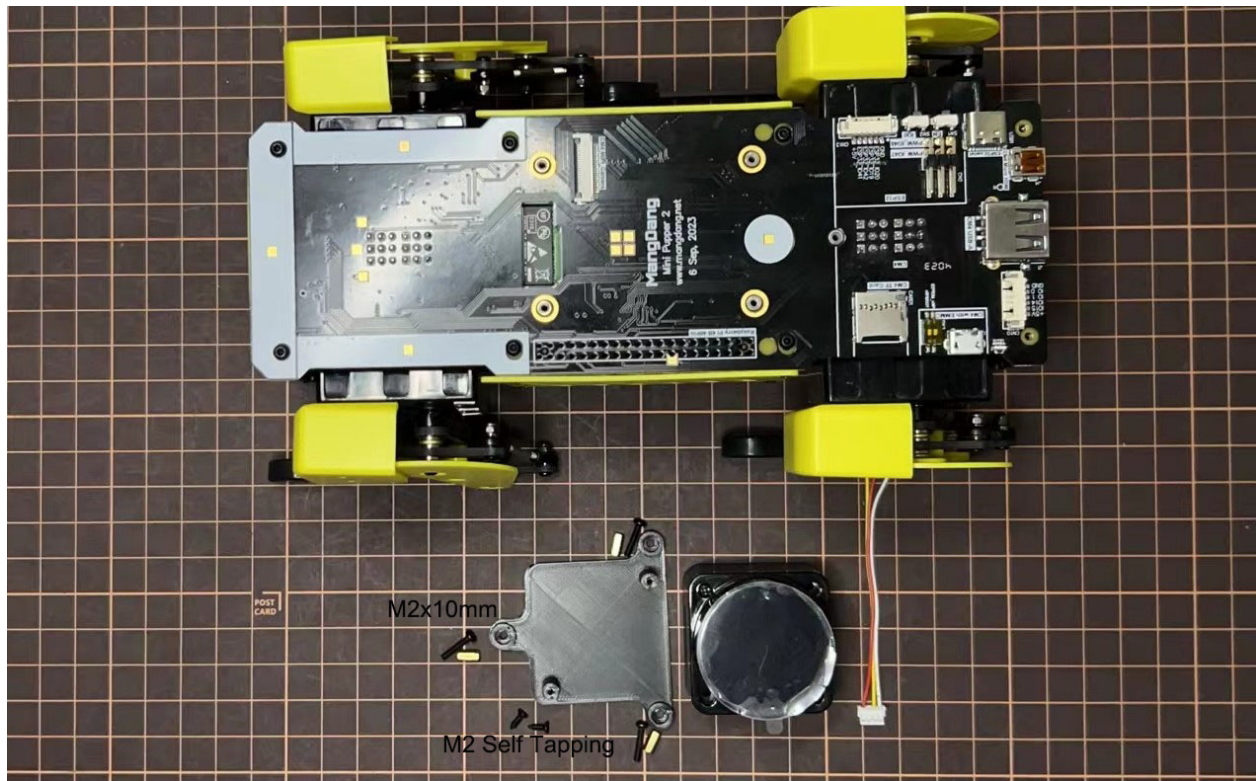


Complete!

7. Add-On Assembly

Step 7.1 Lidar

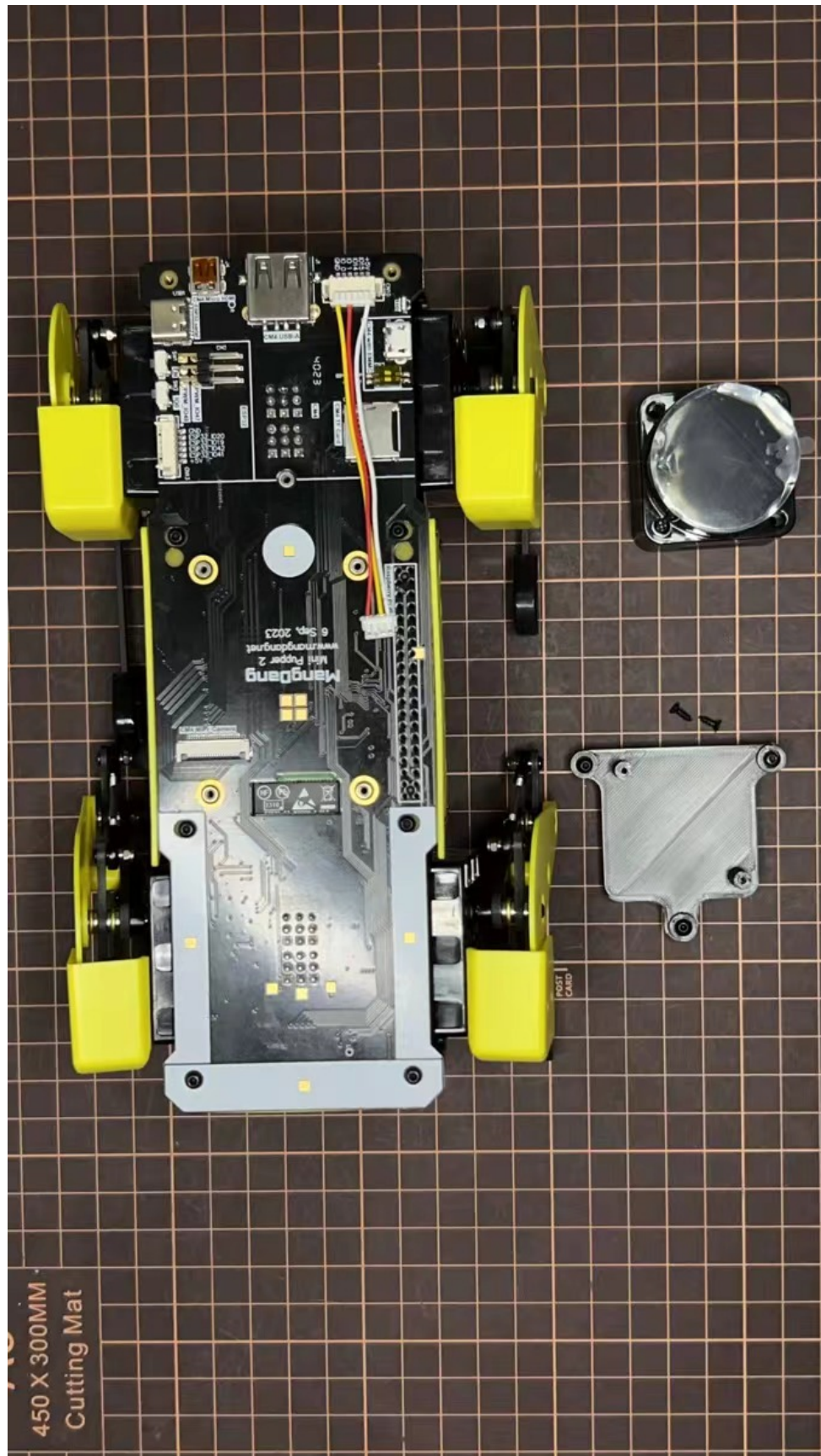
If you order the Lidar, the 3D-printed Lidar holder and custom cable will be shipped together. You can also print the holder by yourself using the [Mini Pupper 2 STL files](#)



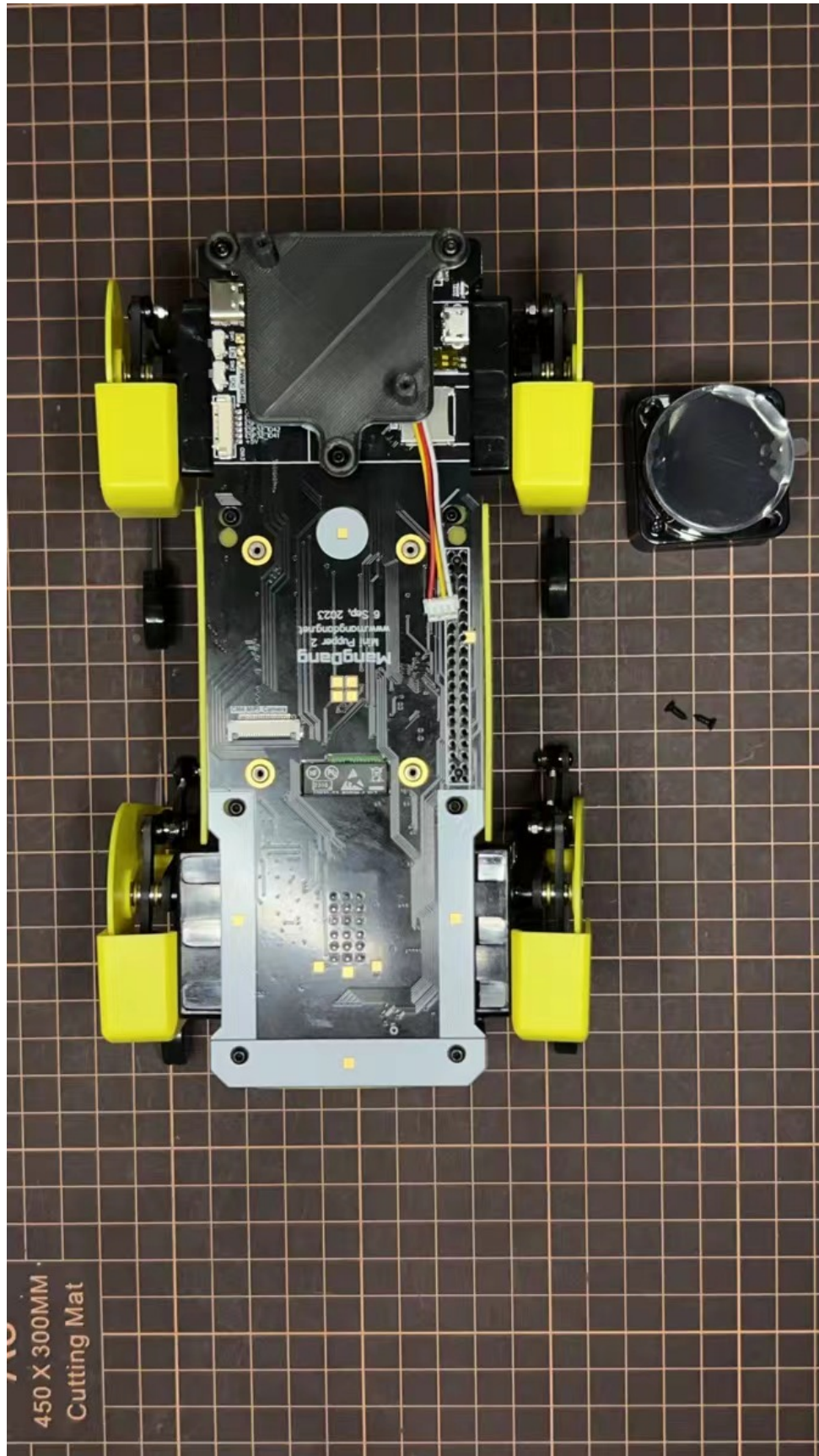
Connect the 3 holders to the 3D-printed part.



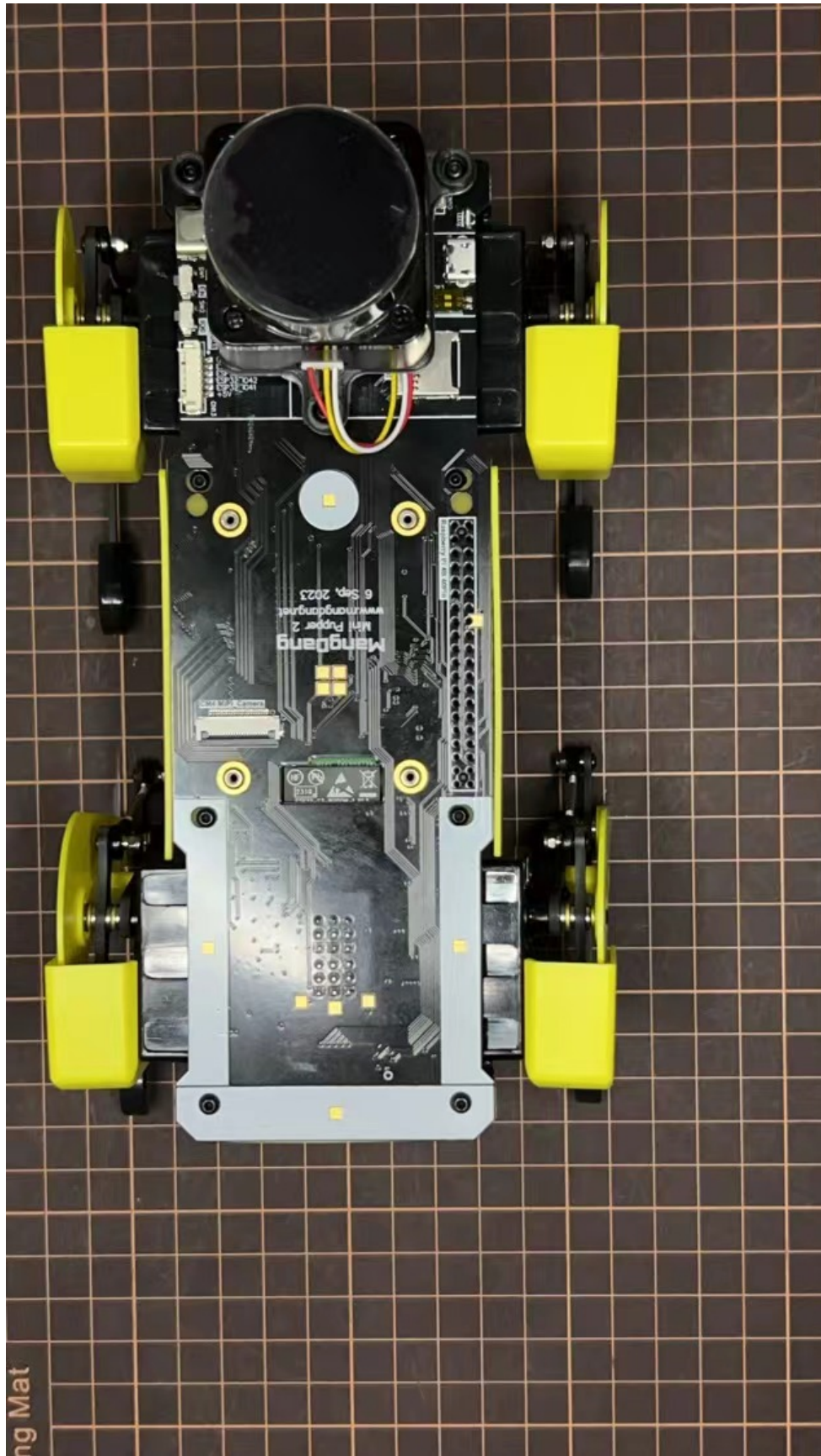
Connect the custom cable to the Lidar connector on the PCB board.



Fix the 3D-printed part on the PCB board.

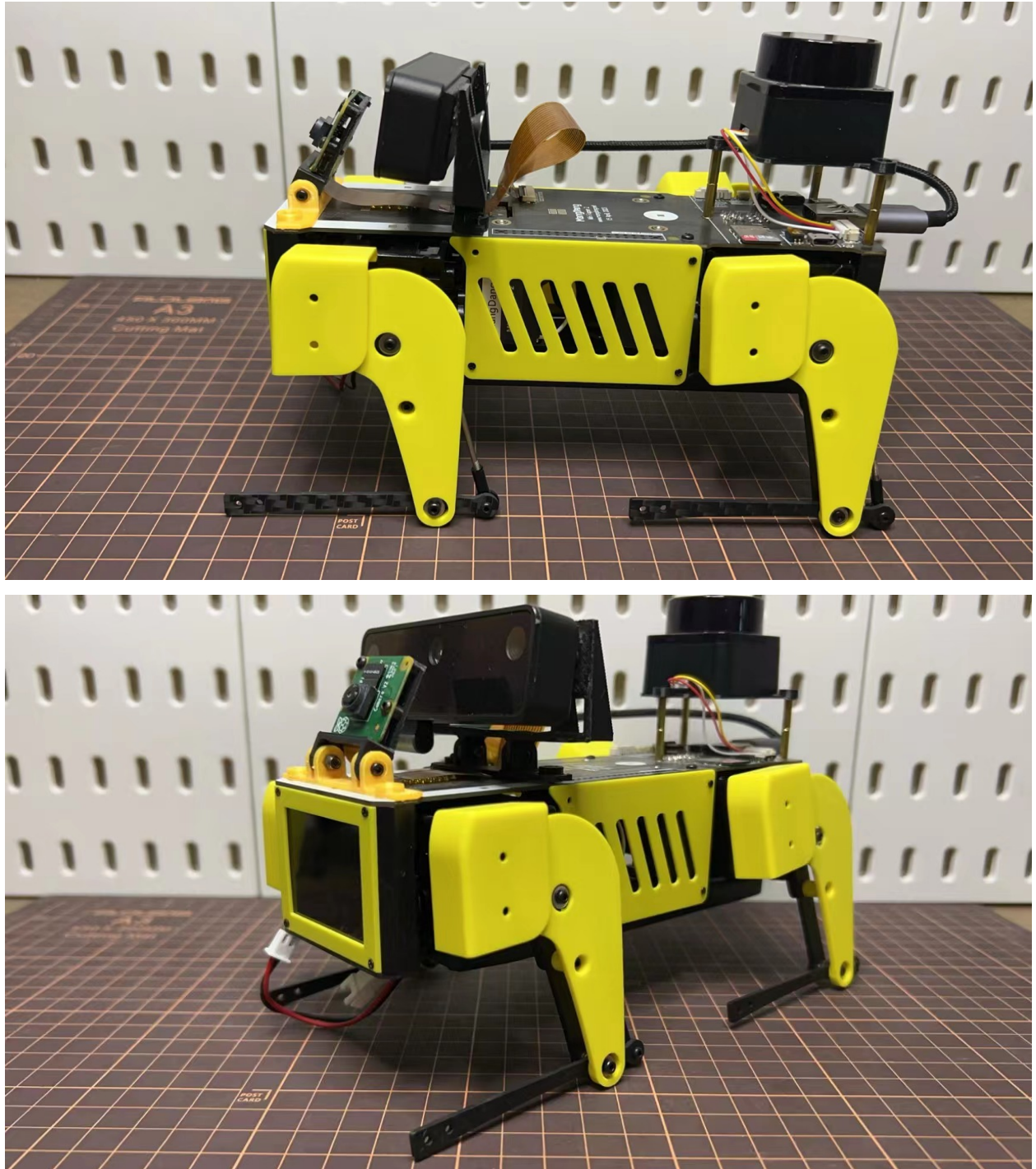


Connect the custom cable to the Lidar module and fix it using the self-tapping screws.



Step 7.2 Camera

Mini Pupper 2 also supports the single Pi camera or OpenCV OAK-D-Lite camera module. You can also print the holder by yourself using the [Mini Pupper 2 STL files](#)





1.2.7 Software Calibration

Contents

- *Software Calibration*
 - 1. *Calibration Setup*
 - 2. *Calibration*

1. Calibration Setup

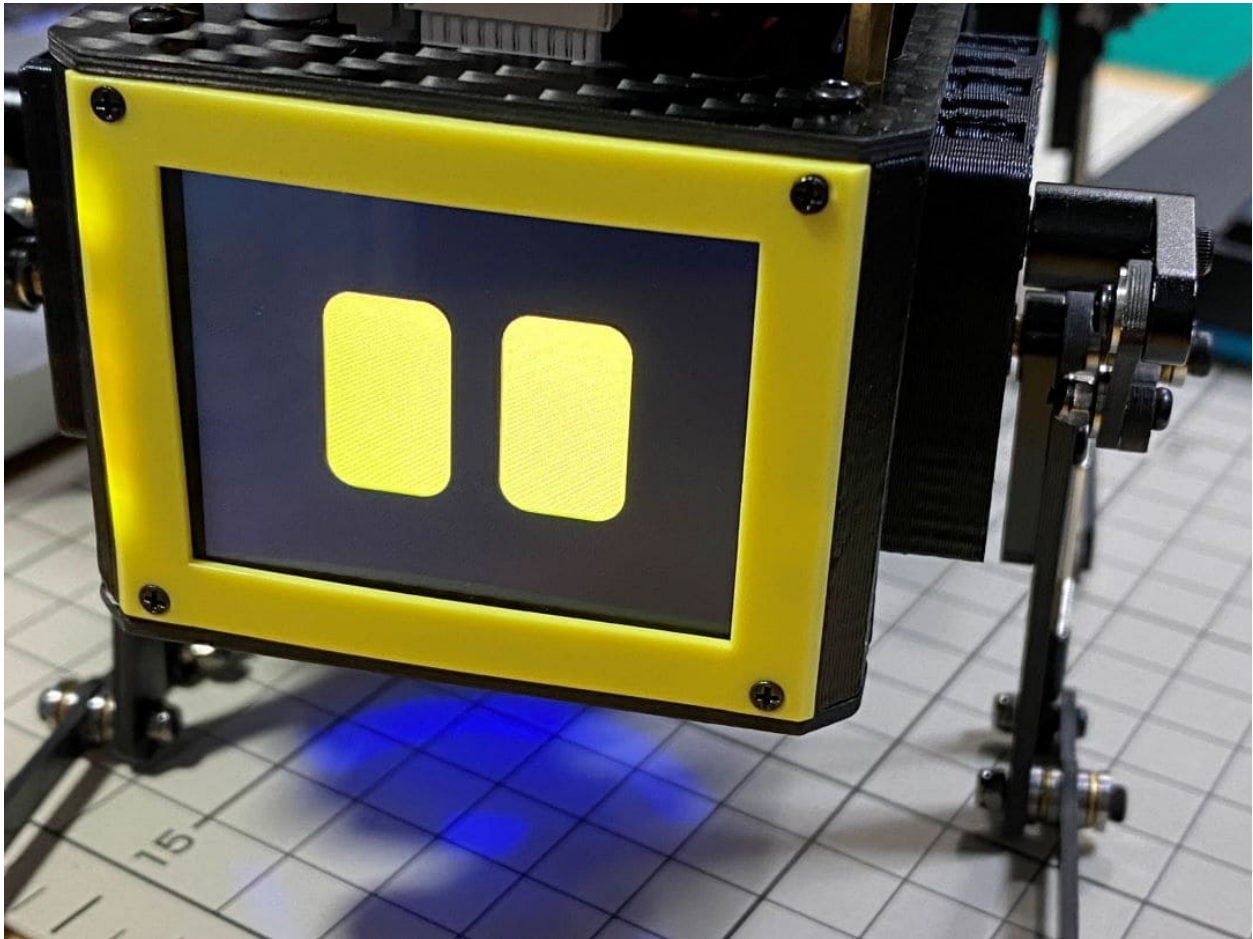
Tools

In addition to the tools included in the kit, the following items are required.

- USB keyboard
- USB mouse
- HDMI display
- micro HDMI cable for connection between display and Raspberry Pi

Step 1.1 Startup raspberry pi

- Connect the Raspberry pi to the display with a microHDMI cable.
- Connect a USB keyboard and mouse to the Raspberry pi.
- Press and hold the battery button of the Mini Pupper for three seconds to start Raspberry pi.
- If you can see Ubuntu running on your screen, you have succeeded. You should also see the face on Mini Pupper display.

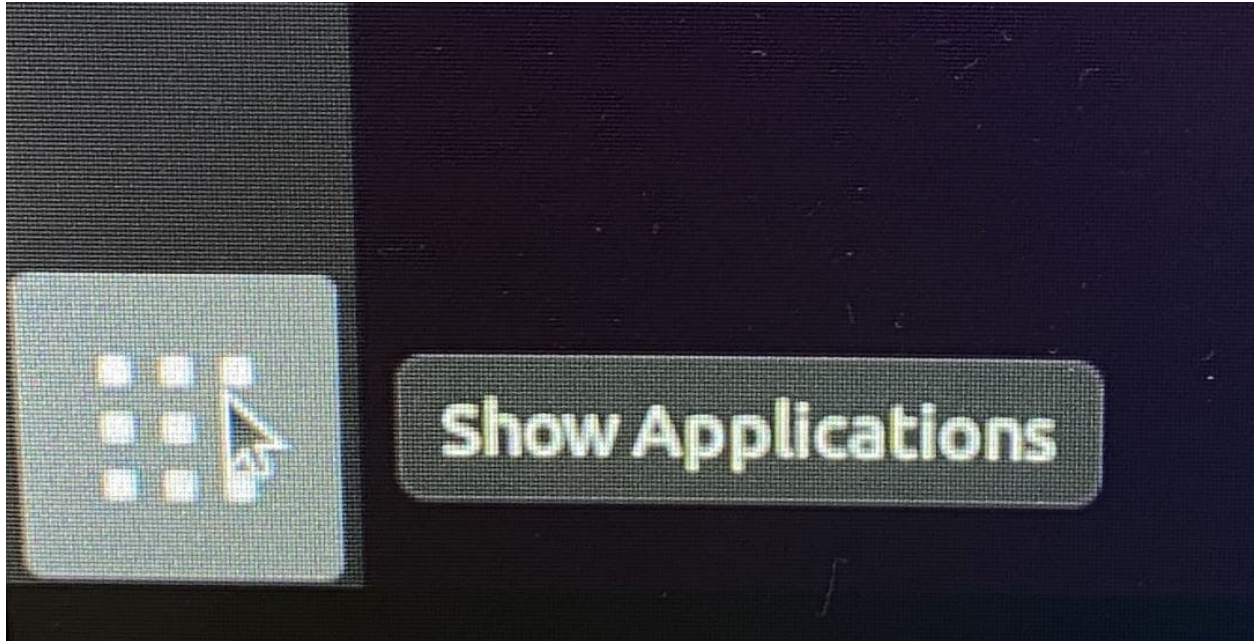


Step 1.2 Log in

- Press ubuntu button on the screen to log in.
- Default username: ubuntu
- Default password: mangdang

Step 1.3 Set keyboard (Optional)

- If you want to change the keyboard type, for an example, Japanese keyboard, you will need this setting. Press the menu button in the bottom left corner and type settings to bring up settings.



- Select Region & Language and press + for Input Sources. On the screen that comes up, select the three dots for other and type Japanese to select it. Type Japanese to select it.

Step 1.4 Open ports for ssh (Optional)

- Attempt to make an ssh connection from your PC to Ubuntu.

```
ssh ubuntu@192.168.x.x -p 22
```

- If you are unable to make an ssh connection from your PC, you will need to configure the following, maybe.

```
sudo ufw allow 22  
sudo ufw reload
```

- If firewall is not running, do the following.

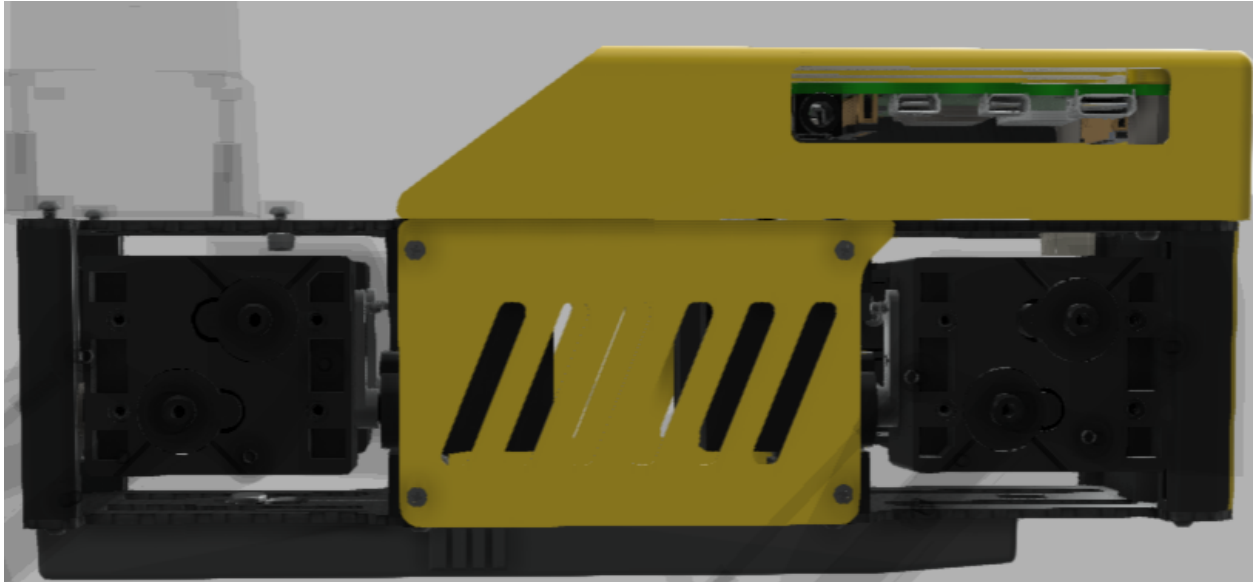
```
sudo ufw enable
```


2. Calibration

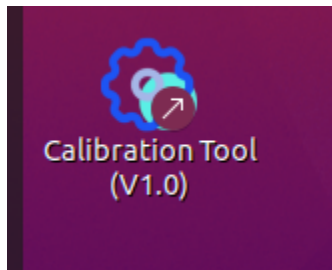
Step 2.1 Leg calibration (not for ROS image)

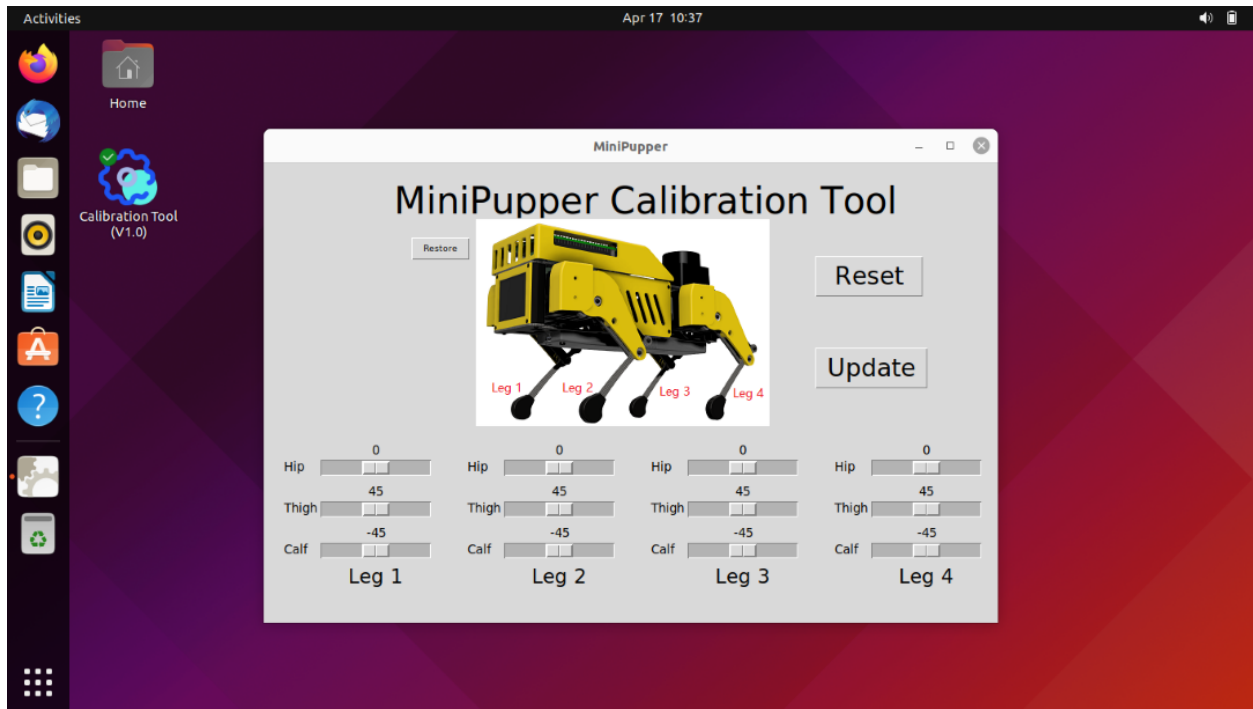
Please refer to the below calibration video clip.

- During Mini Pupper calibration, if the servo horn assembly position is not right, it is not easy to calibrate, even break the servo. Please follow the below easy guide(not for ROS image).
- Make sure Mini Pupper is pre-assembled except the 4 legs.



- Power on, double-click on the Calibration Tool icon on your desktop to launch it.





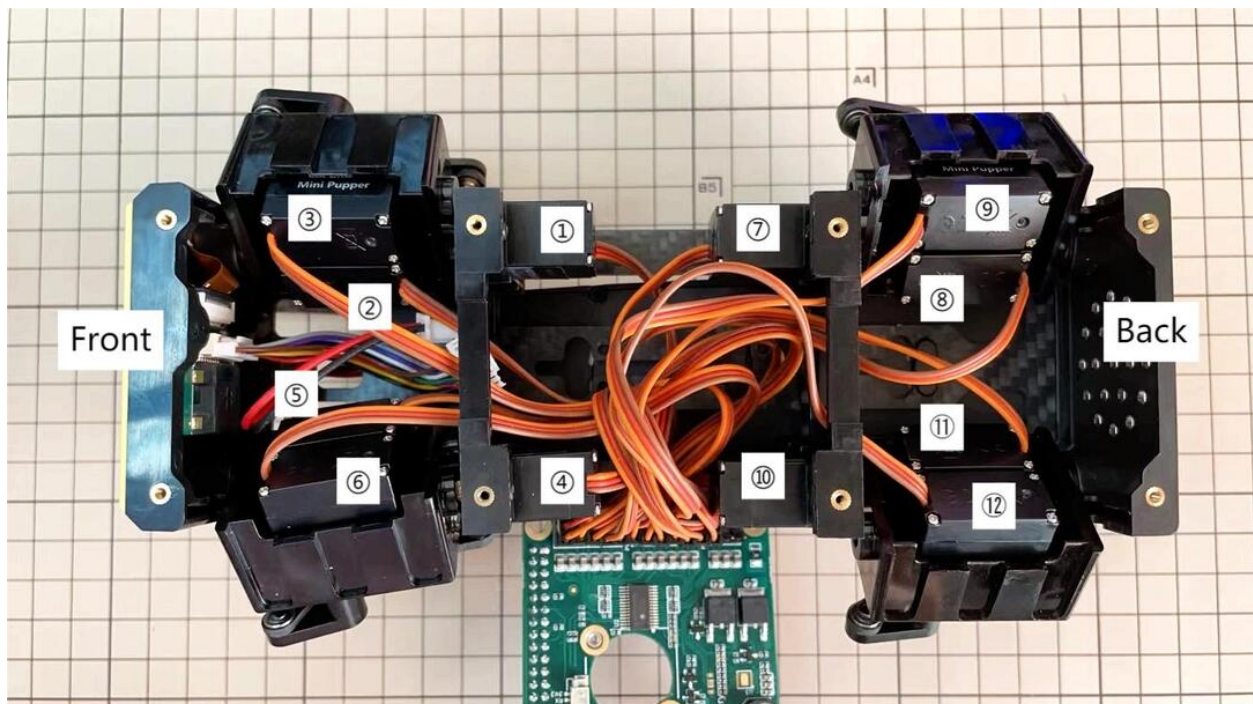
✧ The calibration process is: calibrate each servo → Press “Update” button to save the settings → Press × to close and save the calibration.

✧ Calibrate each servo by moving the bars or click the space position near the bars.

✧ Reset button: when you hope to re-start from the last time.

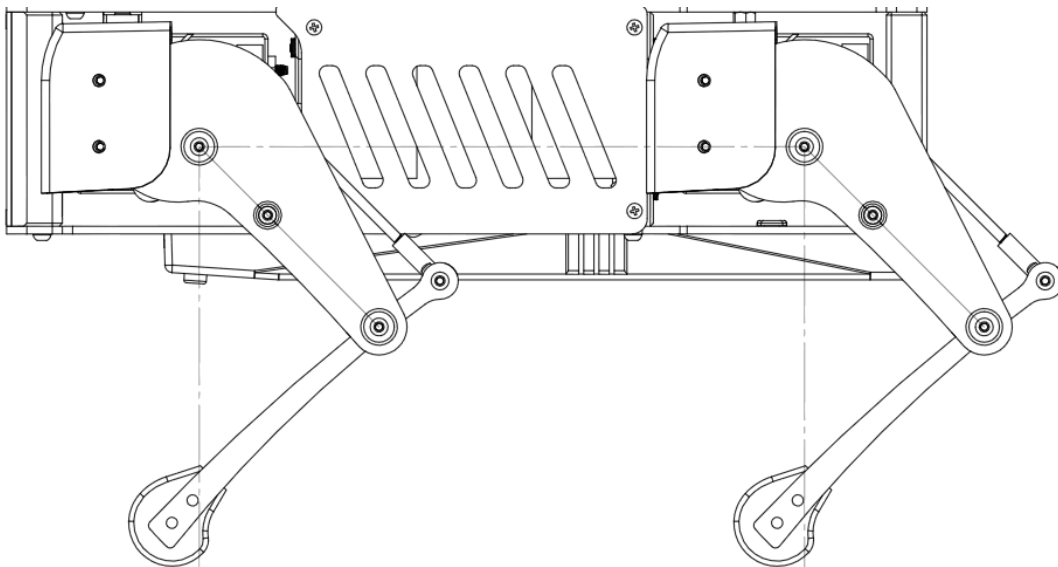
✧ Restore button: Restore factory settings and Press × to close.

- Use the calibration GUI tool to calibrate #1 #4 #7 #10 hip servos to the horizontal position.

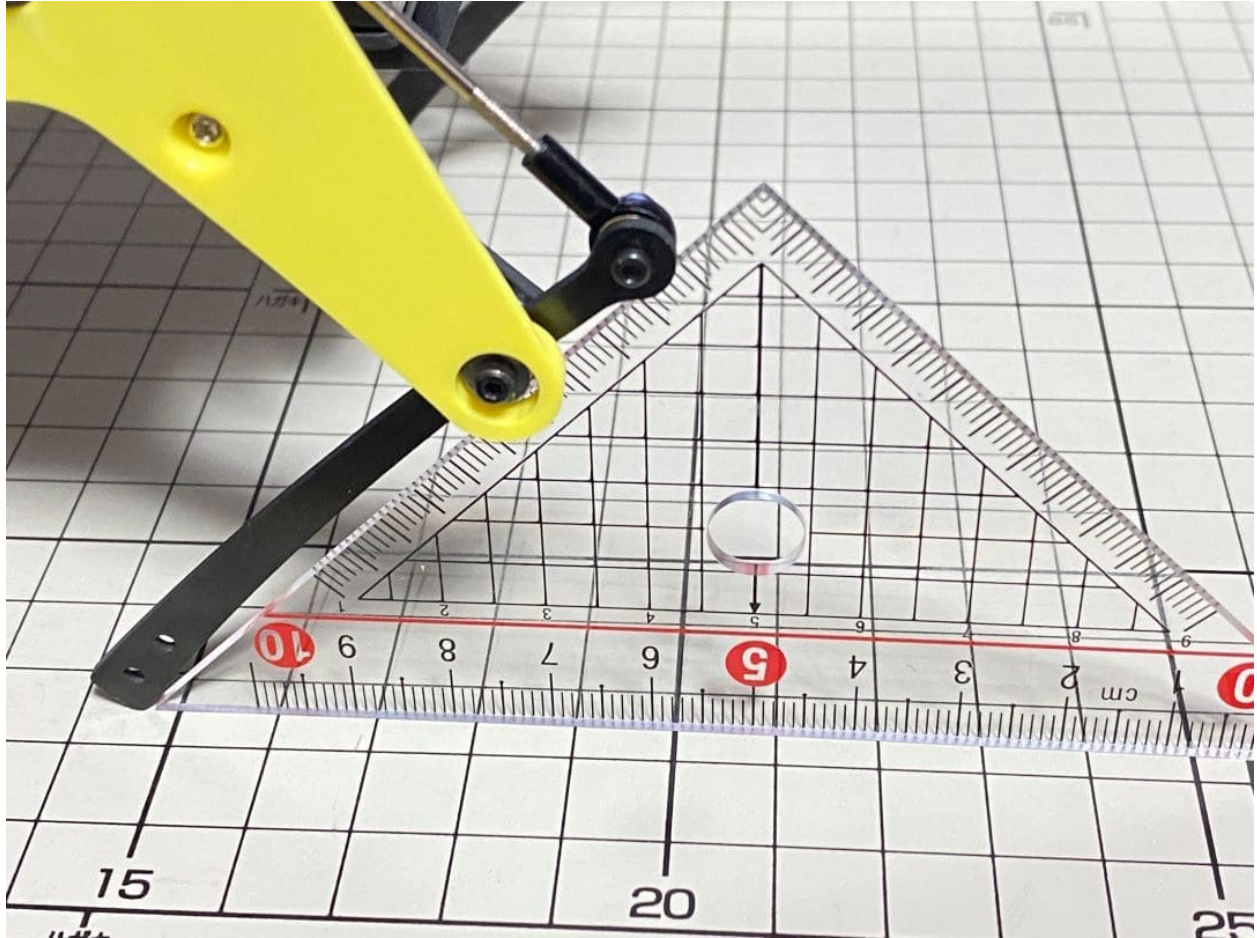




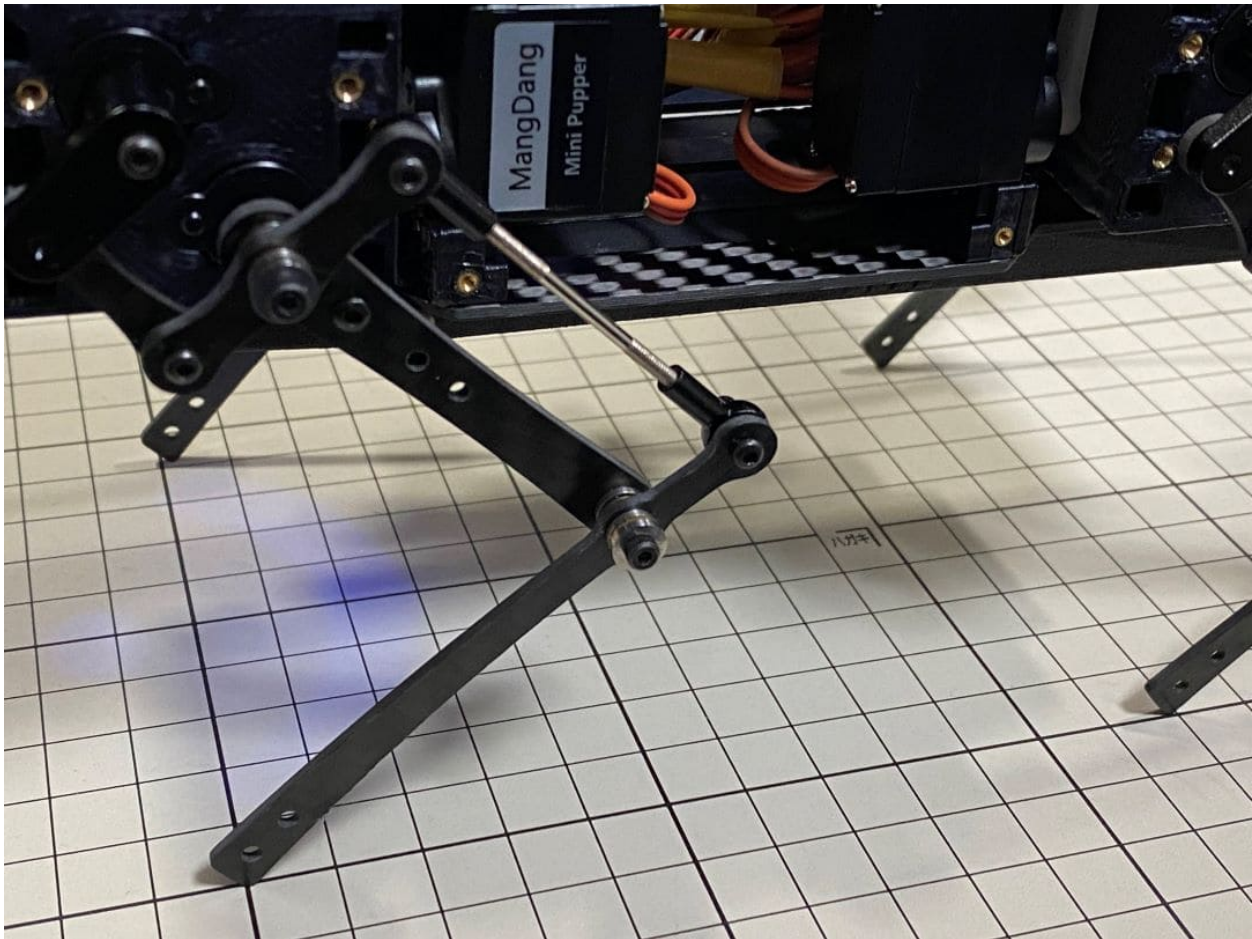
- Then assemble the 4 legs by hand at the right position as the below picture shows.



- Use the calibration GUI tool to optimize the legs position. For each leg, move the bars so that all the legs are at a 45 degree angle. The angle of the legs will change in conjunction with the position of the slide bar on the screen. However, if it does not move, then the steps you have followed are incorrect.
- You can use the iPhone's tilt sensor app, a ruler or a protractor to measure the angle. I also used a ruler and a protractor.



- It is a little bit difficult to measure the accurate inclination of the legs, so it is better to place the legs on a grid, like a piece of graph paper, to check that they are in the same position from front to back and from side to side, and to make any final adjustments.



- When all legs are at 45° inclination as shown, press Update to save the settings. Press × to close the calibration application.

Step 2.2 Connect controller

- Please check the next chapter.
- If you can control it with a controller, it's OK.

1.2.8 Software Calibration for Mini Pupper 2 and 2Pro

Contents

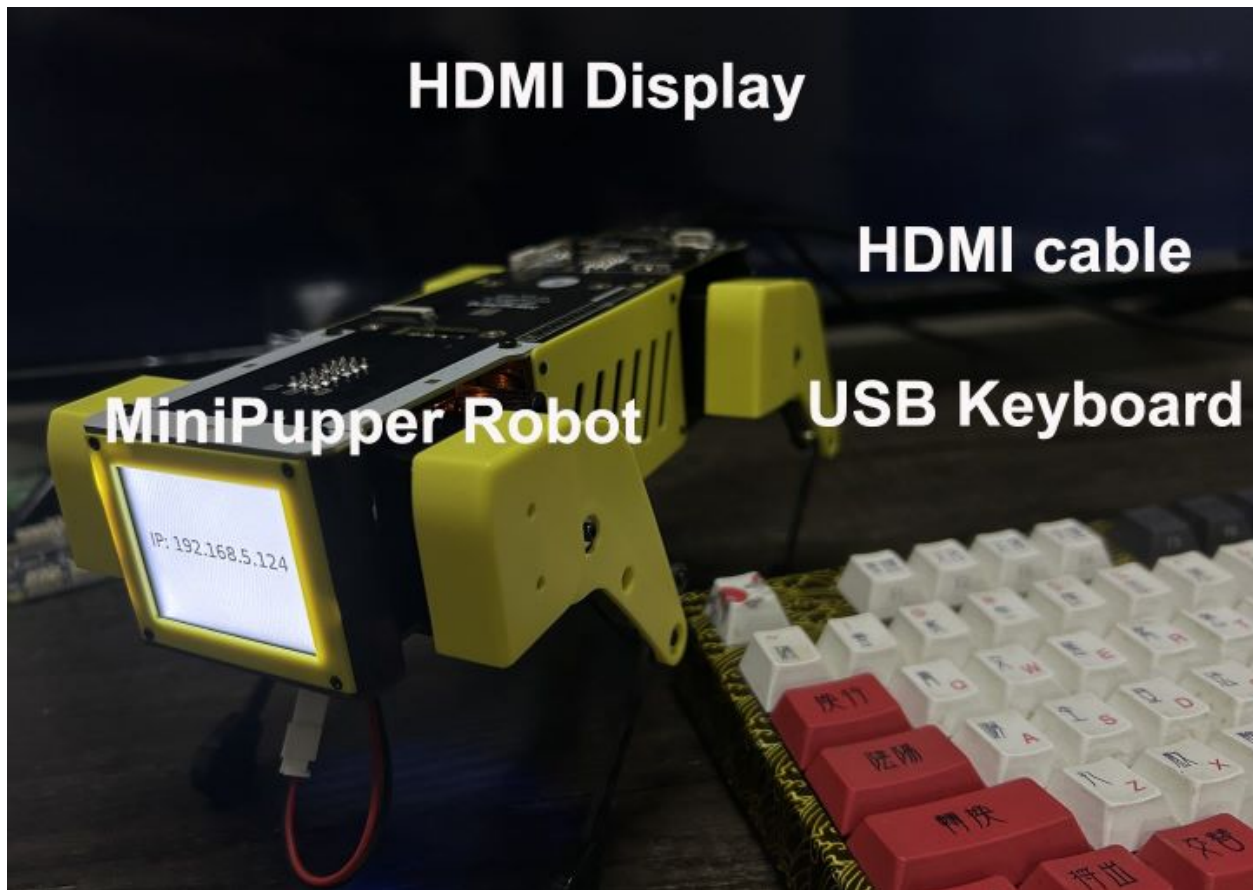
- *Software Calibration for Mini Pupper 2 and 2Pro*
 - 1. Calibration Setup
 - 2. Calibration

1. Calibration Setup

Tools

For beginners, in addition to the tools included in the kit, the following items are required.

- USB keyboard
- HDMI display
- micro HDMI cable for connection between display and carry board



For beyond, you can use your PC to ssh to Mini Pupper to do everything, please refer to step 1.4

Step 1.1 Startup

- Connect the carry board to the display with a microHDMI cable.
- Connect a USB keyboard to the carry board.
- Press and hold the battery button of the Mini Pupper for three seconds to boot up.
- If you can see Ubuntu running on your screen, you have succeeded. You should also see the IP address or “IP: no IPv4 address” on Mini Pupper display.

Step 1.2 Log in

- Press ubuntu button on the screen to log in.
- Default username: ubuntu
- Default password: mangdang

Step 1.3 Set your own WiFi

- Edit the WiFi configure file(50-cloud-init.yaml), and set your WiFi to your own.

```
sudo vi /etc/netplan/50-cloud-init.yaml
# Edit and save
sudo netplan apply
sudo reboot
```

```
# This file is generated from information provided by the datasource. Changes
# to it will not persist across an instance reboot. To disable cloud-init's
# network configuration capabilities, write a file
# /etc/cloud/cloud.cfg.d/99-disable-network-config.cfg with the following:
# network: {config: disabled}
network:
  ethernets:
    eth0:
      dhcp4: true
      optional: true
  wifis:
    wlan0:
      access-points:
        1  Mangdang:
          password: mangdang 2
      dhcp4: true
      optional: true
  bridges:
    br0:
      addresses: [10.0.0.10/24]
      parameters:
        stp: true
        forward-delay: 4
      dhcp4: false
      optional: true
  version: 2
```

- You can also refer to `mini_pupper_web_controller`

Step 1.4 Open ports for ssh without HDMI display

- Use your phone to set the default WiFi used by Mini Pupper.

WiFi name: Mangdang

Password: mangdang

- Power on your robot and check the LCD display

If the LCD shows “IP: no IPv4 address”, then reboot your robot again.

- After the LCD shows the IP address, make an ssh connection from your PC to your robot.

```
ssh ubuntu@192.168.x.x
```

- If you are unable to make an ssh connection from your PC, you will need to configure the following, maybe.

```
sudo ufw allow 22  
sudo ufw reload
```

- If firewall is not running, do the following.

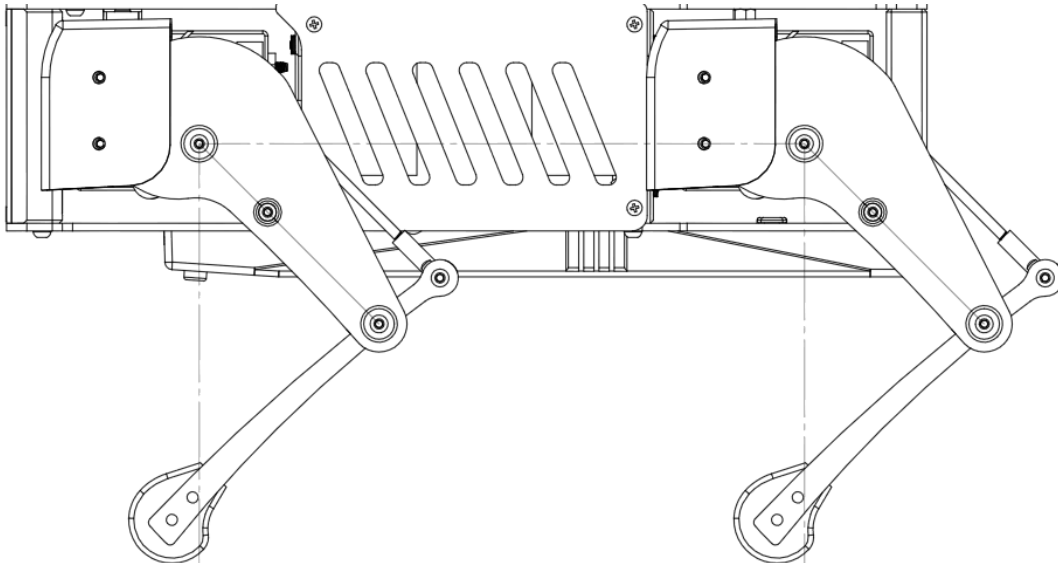
```
sudo ufw enable
```

2. Calibration

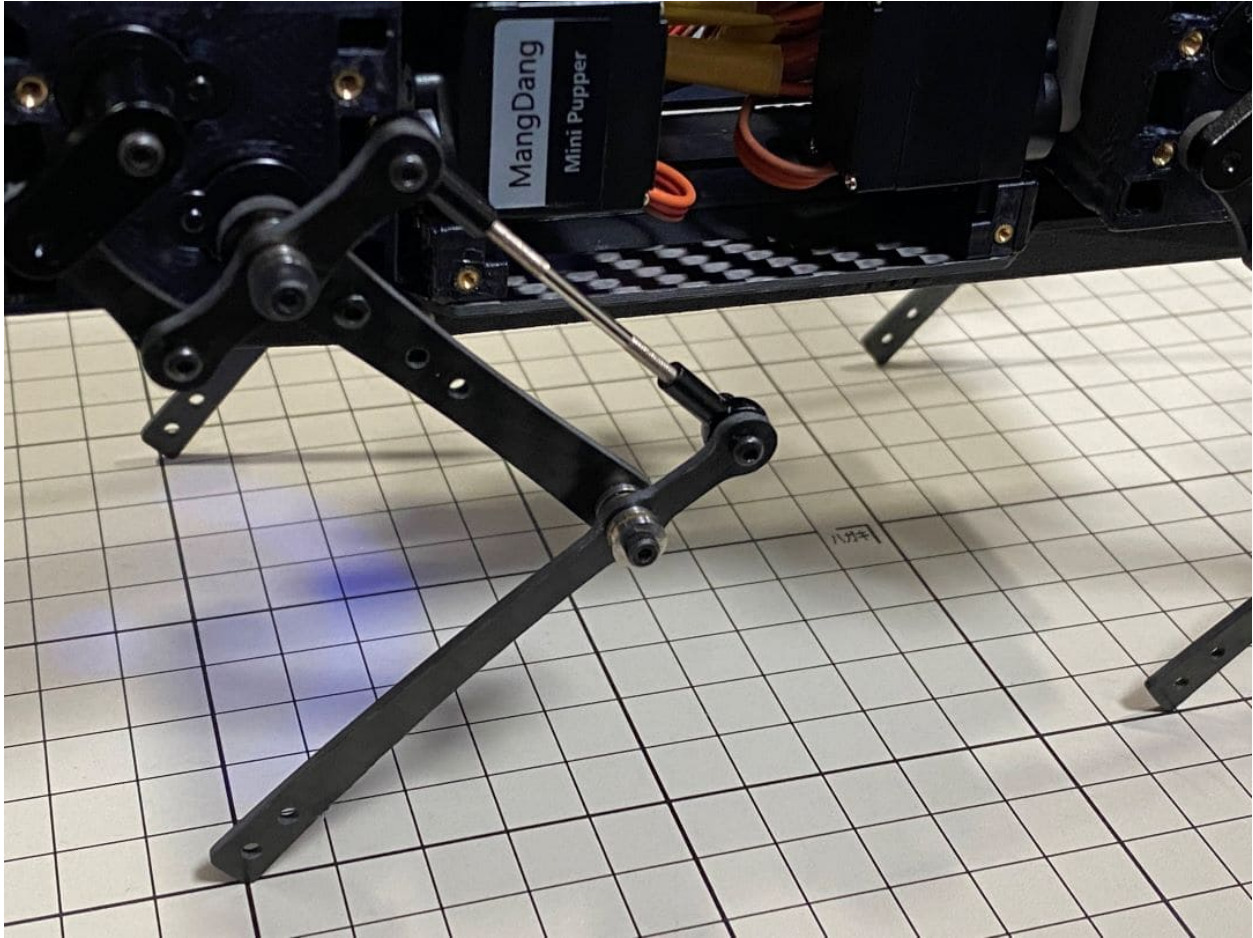
Step 2.1 Leg calibration

Please refer to the below calibration video clip.

- Then assemble the 4 legs by hand at the right position as the below picture shows.



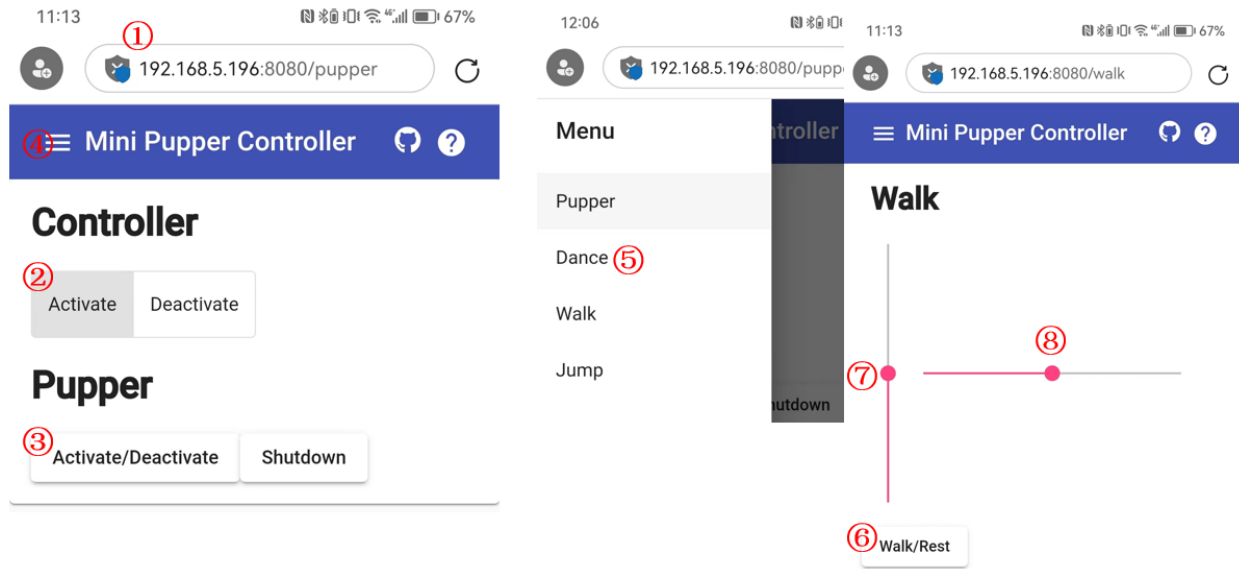
- It is a little bit difficult to measure the accurate inclination of the legs, so it is better to place the legs on a grid, like a piece of graph paper, to check that they are in the same position from front to back and from side to side, and to make any final adjustments.



- When all legs are at 45° inclination as shown, press “s” to save the settings. Press “q” to quite the calibration application.

Step 2.2 Use a web browser to run

- Point a web browser to <http://x.x.x.x:8080> where x.x.x.x is the IP address of your mini_pupper, such as, <http://192.168.5.196:8080>
- Click the “Activate” button of the “Controller” tab.
- Click the “Activate/Deactivate” button of the “Pupper” tab.
- Click the “” icon at the top left corner.
- Choose the “Walk” option.
- Click the “Walk/Rest” button.
- Use the scroll bar to control your Mini Pupper



1.2.9 SLAM

Contents

- *SLAM*
 - *SLAM(Simultaneous Localization and Mapping)*
 - *1.Installation*
 - *2.Quick Start*
 - *3. SLAM*

SLAM(Simultaneous Localization and Mapping)

Mini Pupper's ROS version is based on [Champ](#) open source project, and we made some changes to SLAM and Navigation functions.

1. Installation

We recommend you explore Mini Pupper with ROS network, make sure your PC and Mini Pupper have connected to the same WiFi.

1.1 PC Setup

PC Setup corresponds to PC (your desktop or laptop PC) for controlling Mini Pupper remotely. Do not apply these commands to your Mini Pupper.

- 1.1.1 Cartographer ROS packages installation

Our SLAM and Navigation functions are based on [cartographer_ros](#).

```
cd ~
sudo apt-get update
sudo apt-get install -y python3-wstool python3-rosdep ninja-build stow
mkdir carto_ws
cd carto_ws
wstool init src
wstool merge -t src https://raw.githubusercontent.com/cartographer-project/cartographer_
↪ros/master/cartographer_ros.rosinstall
wstool update -t src
sudo rosdep init
rosdep update
rosdep install --from-paths src --ignore-src --rosdistro=${ROS_DISTRO} -y
src/cartographer/scripts/install_abseil.sh
sudo apt-get remove ros-${ROS_DISTRO}-abseil-cpp
catkin_make_isolated --install --use-ninja
source install_isolated/setup.bash
```

- 1.1.2 Mini Pupper ROS packages installation

```
cd <your_ws>/src
git clone --recursive https://github.com/mangdangroboticsclub/minipupper_ros
cd ..
rosdep install --from-paths src --ignore-src -r -y
catkin_make
source <your_ws>/devel/setup.bash
```

- 1.1.3 Network Setup

Connect your PC and Mini Pupper to the same WiFi and find the assigned IP address with the command below.

```
ifconfig
```

Open the file and update ROS IP settings with commands below.

```
sudo gedit ~/.bashrc
```

Then add your Master and hostname config, for an example

```
export ROS_MASTER_URI=http://192.168.1.106:11311
export ROS_HOSTNAME=192.168.1.106
```

1.2 Mini Pupper Setup

You can also download the [pre-built ROS image](#) for Mini Pupper side, named “xxx.Minipupper_ROS&OpenCV_Ubuntu20.04.03.img”.

- 1.2.1 Hardware Dependencies

You should first install dependencies of servos, battery monitor and display screen. Please refer to [minipupper_ros_bsp](#).

- 1.2.2 Controller Joystick interface installation

The Joystick interface in ROS is based on [ps4-ros](#) project.

```
pip install ds4drv
sudo apt install ros-noetic-joy
sudo wget https://raw.githubusercontent.com/chrippa/ds4drv/master/udev/50-ds4drv.rules -
→0 /etc/udev/rules.d/50-ds4drv.rules
sudo udevadm control --reload-rules
sudo udevadm trigger
sudo reboot
```

Then go into pairing mode with the controller: Home button + share button for ~3 sec. Run \$ds4drv from command line until the controller is connected.

```
ds4drv
```

This will output something like “Created devices /dev/input/jsX”. Then give the permissions to the device

```
sudo chmod a+rw /dev/input/jsX
```

- 1.2.3 Mini Pupper ROS packages installation

Then you can install the ROS packages for Mini Pupper. This should be installed both on Mini Pupper and your PC.

```
cd <your_ws>/src
git clone --recursive https://github.com/mangdangroboticsclub/minipupper_ros
cd minipupper_ros/champ
# it's not recommend to compile gazebo on raspberry pi
sudo rm -rf champ_gazebo
cd ../../..
rosdep install --from-paths src --ignore-src -r -y
catkin_make
source <your_ws>/devel/setup.bash
```

- 1.2.4 Network Setup

Connect your PC and Mini Pupper to the same WiFi and find the assigned IP address with commands below.

```
ifconfig
```

Open the file and update the ROS IP settings with the command below.

```
sudo gedit ~/.bashrc
```

Then add your Master and hostname config, for an example

```
export ROS_MASTER_URI=http://192.168.1.106:11311  
export ROS_HOSTNAME=192.168.1.107
```

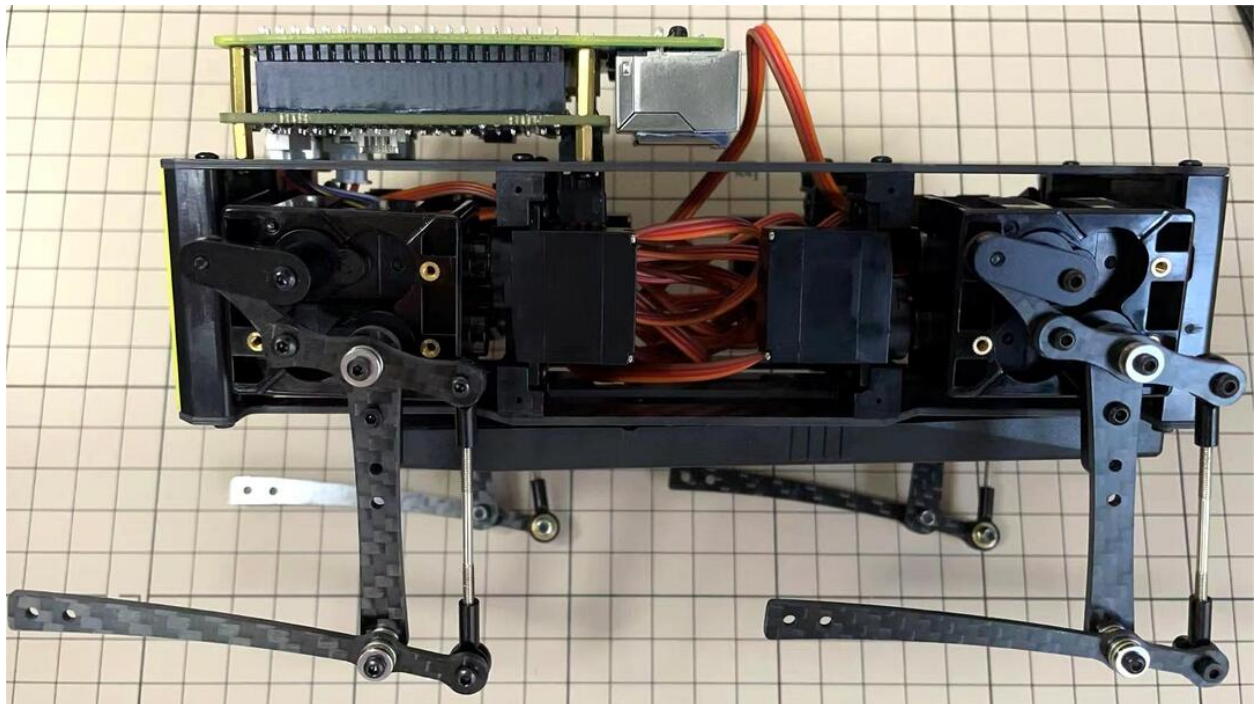
2.Quick Start

2.1 Calibration

Through this script, you can calibrate the angle of every servo in one turn. Just input the angles.</br> The hip and shank should be horizontal, and the ham should be vertical.

```
roslaunch servo_interface calibrate.launch
```

Make sure Mini Pupper looks like this after calibrating.



2.2 Walking

- 2.2.1 Run the base driver

You should run this command on Mini Pupper

```
roslaunch mini_pupper bringup.launch
```

If Mini Pupper didn't stand as what you expect, you can edit calibration.yaml in servo_interface/config/calibration to fix the angles.

- 2.2.2 Control Mini Pupper

There are two options to control Mini Pupper:

1. Use keyboard

It's recommended to run this command on PC.

```
roslaunch champ_teleop teleop.launch
```

2. Use the controller

It's recommended to run this command on Mini Pupper.

Don't run this command while using move_base because even if you are doing nothing with the joystick, it would still send cmd_vel with all the values as zero.

```
roslaunch ps4_interface ps4_interface.launch
```

For the controller usage, please refer to Quick Start Guide.

- 2.2.2 LCD Screen

```
python3 ~/minipupper_ros_esp/mangdang/LCD/demo.py
```

We also made a simple ROS interface of the LCD screen, which subscribes sensor_msgs/Image.

```
roslaunch display_interface display_interface.py
```

3. SLAM

3.1 Run the base driver

You should run this command on Mini Pupper

```
roslaunch mini_pupper bringup.launch
```

3.2 Run Cartographer

You should run this command on PC If you are using gazebo, set the param /use_sim_time to true in the launch file.

```
roslaunch mini_pupper slam.launch
```

Then you can use keyboard or joystick to control your Mini Pupper walking around and creating a map. To save the map, run these commands below.

```
rosservice call /finish_trajectory 0
rosservice call /write_state "{filename: '${HOME}/map.pbstream'}"
roslaunch cartographer_ros cartographer_pbstream_to_ros_map -map_filestem=${HOME}/map -
↪pbstream_filename=${HOME}/map.pbstream -resolution=0.05
```

Remember to edit map.yaml</br> The first line should be

```
image: map.pgm
```

Then, copy map.pbstream, map.pgm and map.yaml files you just saved to
<your_ws>/src/minipupper_ros/minipupper/maps

1.2.10 Navigation

Contents

- *Navigation*
 - *Summary*
 - *1. ROS1(Noetic) Navigation based on Lidar*

Summary

Mini Pupper's ROS version is based on [Champ](#) open source project, and we made some changes to Navigation functions.

1. ROS1(Noetic) Navigation based on Lidar

Before run the below steps, please confirm you already prepared all the environment in SLAM section.

1.1 Change the map file

Before running navigation, you should first change the launch file with the map you created.

```
roscd mini_pupper/launch
sudo gedit navigate.launch
```

Then change arg of the map_file and pbstream_file.

```
10      <!-- Map server -->
11      <arg name="map_file" default="$(find mini_pupper_config)/maps/map.yaml"/>
12      <node pkg="map_server" name="map_server" type="map_server" args="$(arg map_file)" >
13          <param name="frame_id" value="$(arg frame_prefix)map" />
14      </node>
15
16      <!-- Localization -->
17      <arg name="pbstream_file" default="$(find mini_pupper_config)/maps/map.pbstream"/>
18      <node name="cartographer_node" pkg="cartographer_ros"
19          type="cartographer_node" args="
20              -configuration_directory $(find mini_pupper_config)/config/cartographer
21              -configuration_basename nav.lua
22              -load_state_filename $(arg pbstream_file)"
23          output="screen">
24      </node>
```

1.2 Run the base driver

You should run this command on Mini Pupper

```
roslaunch mini_pupper bringup.launch
```

1.3 Run Cartographer(for localization) and Move_Base

You should run this command on PC If you are using gazebo, set the param /use_sim_time to true in the launch file.

```
roslaunch mini_pupper navigate.launch
```

1.2.11 Simulation

Contents

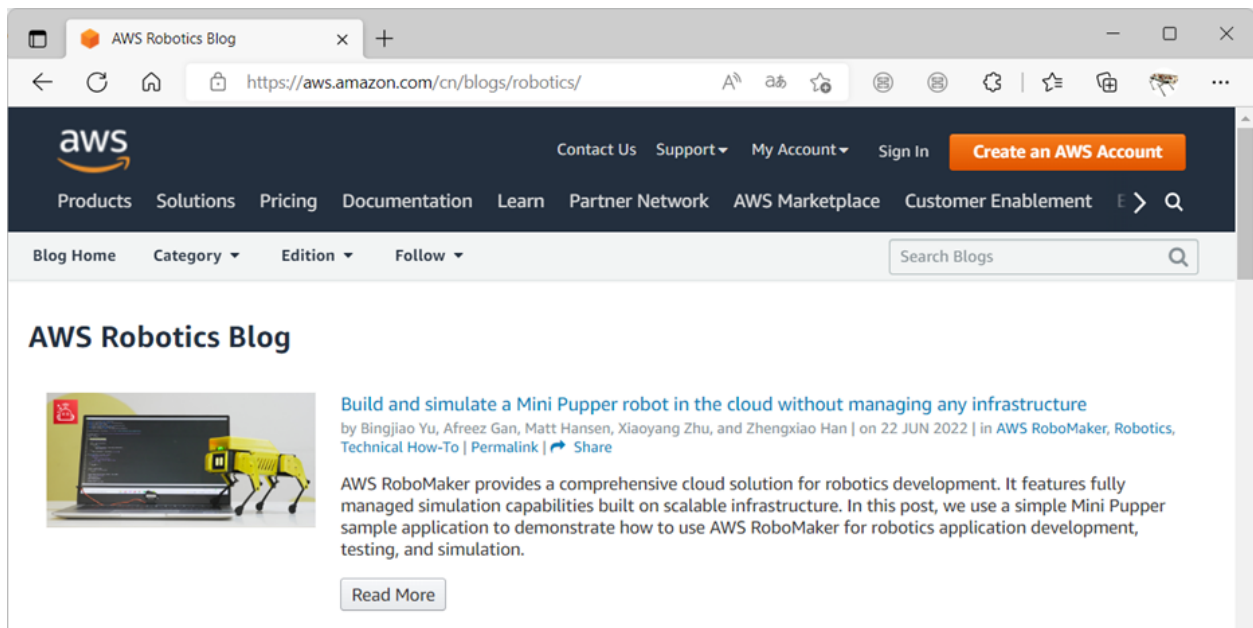
- *Simulation*

Instructions for Creating an AWS RoboMaker Environment for Mini Pupper, please refer to

<https://github.com/mangdangroboticsclub/aws-robomaker-mini-pupper-application/>

Instructions for Amazon AWS Robotics Blog, please refer to

<https://aws.amazon.com/blogs/robotics/build-and-simulate-a-mini-pupper-robot-in-the-cloud-without-managing-any-infrastructure/>



Instructions for Amazon 2022 re:MARS RoboMaker&MiniPupper Workshop, please refer to

<https://catalog.us-east-1.prod.workshops.aws/workshops/511d7599-73bd-4142-bd6b-fa83dbe3d8ce/en-US>



1.2.12 Machine Learning

Contents

- *Machine Learning*
 - *Summary*
 - *1. Single camera module*
 - *2. 3D(OAK-D-Lite) camera module*

Summary

For potential security issues, the camera module is not included in our default package. If you want to explore camera AI functions, you can choose a normal USB camera module, of course, a 3D camera module is better for study. If try the 3D camera module, we recommend you OpenCV's latest 3D camera module, named OAK-D LITE, comes from OpenCV&Luxonis.

1. Single camera module

1.1 Collision Avoidance

Will update late.

1.2 Teleoperation

Will update late.

1.3 Road Following

Will update late.

1.4 Object Following

Will update late.

1.5 Face Detect

Will update late.

2. 3D(OAK-D-Lite) camera module

2.1 Object Following

You can download the [pre-built ROS image](#) , named “xxx.Minipupper_ROS&OpenCV_Ubuntu20.04.03.img” to test the object following feature using OAK-D-LITE 3D camera module.

```
# Terminal 1
roslaunch mini_pupper bringup.launch

# Terminal 2
roslaunch depthai_examples mobile_publisher.launch

# Terminal 3
roslaunch mini_pupper_detect oak_detect.py
```

2.2 Live streaming

Will update late.

1.2.13 Examples

Contents

- *Examples*
 - *1. Custom shell parts*
 - *2. Custom Facial Animation*
 - *3. Keyboard controller*
 - *4. Web controller*
 - *5. How to control a Mini Pupper PWM servo*
 - *6. Forward Kinematics*
 - *7. Inverse Kinematics*
 - *8. PID control*
 - *9. Docker*
 - *10. Scratch program*

1. Custom shell parts

Mini Pupper is an open source project, that means, you can custom what you want. You can find all the [3D printed shell files](#) and custom them.

How about connect it to LEGO parts?



Or DIY it like @nisshan_

2. Custom Facial Animation

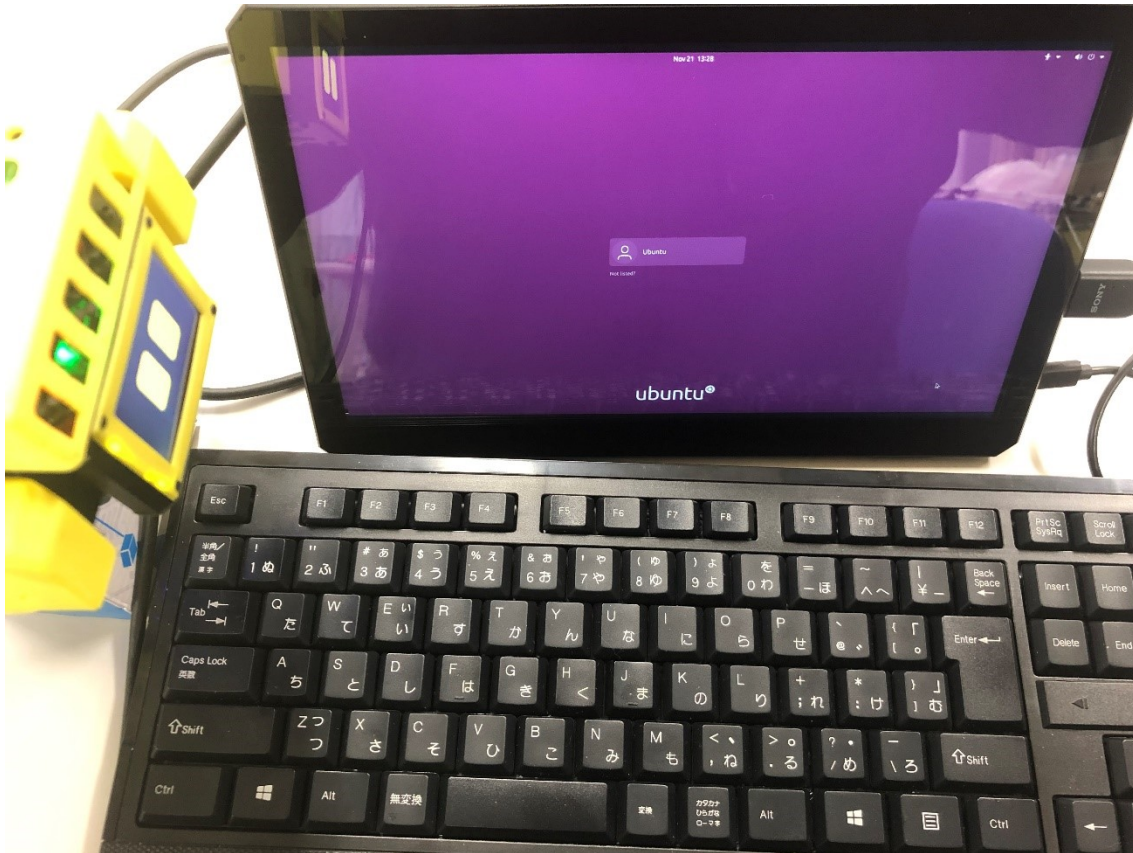
2.1 Prerequisites

- HDMI Display
- micro HDMI cable
- Keyboard and mouse
- a new custom picture(size: 320x240 pix)

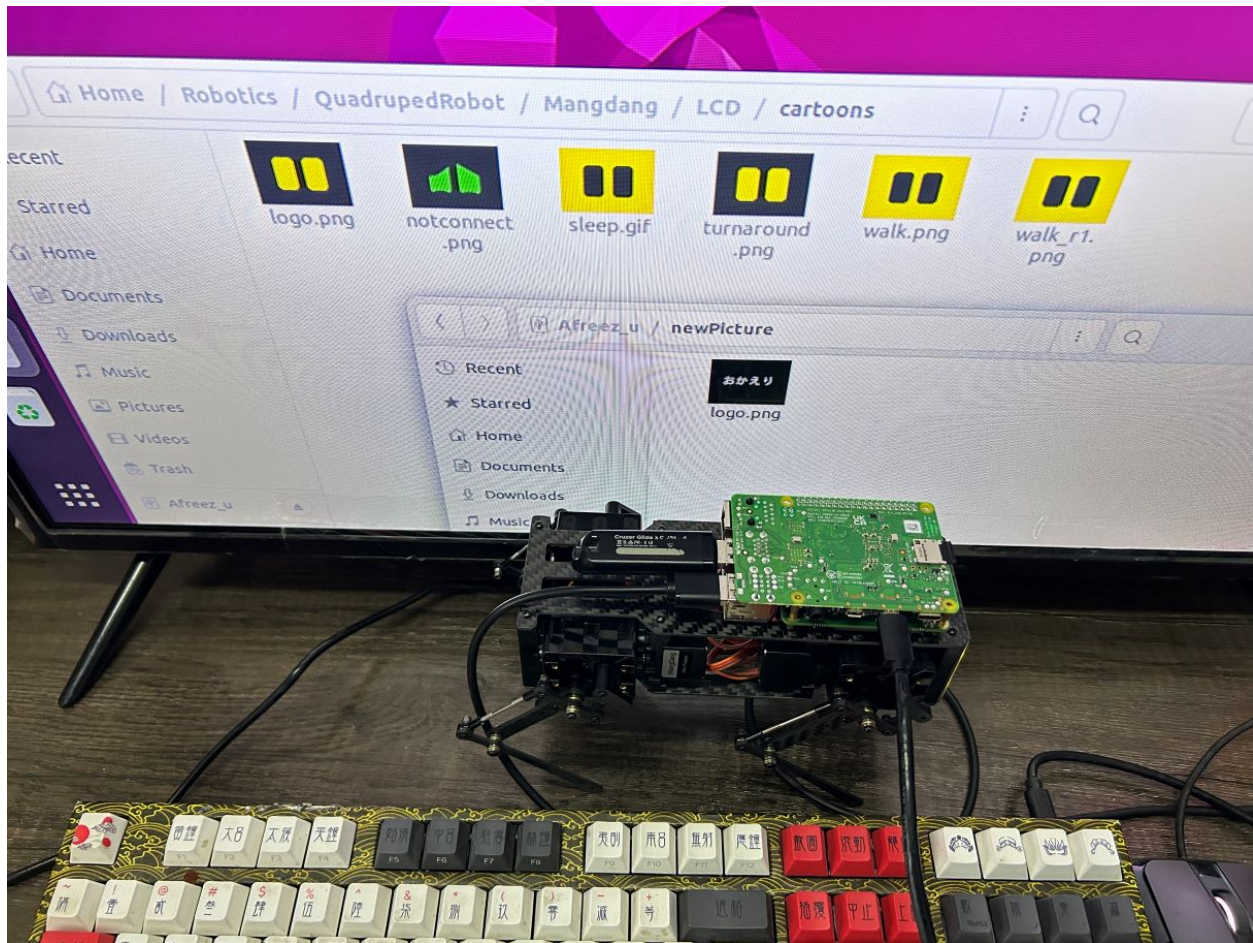


2.2 Run

- Connect MiniPupper to a display, a keyboard and a mouse.
- Ubuntu login(The default password is mangdang)



- Replace the logo.png file using your custom picture
- Reboot Mini Pupper and then you will see your custom picture



3. Keyboard controller

3.1 Keyboard controller based on nonROS version

The feature is based on [PupperKeyboardController project](#), it's Pygame-based keyboard controller for Stanford Pupper.

- Install PyGame

```
pip install pygame
```

- Controls

```
wasd: left joystick
arrow keys: right joystick
q: L1
e: R1
ijkl: d-pad
x: X
square: u
triangle: t
circle: c
```


3.2 Keyboard controller based on ROS version

Please refer to the SLAM section.

4. Web controller

Please refer to [Mini Pupper Web controller project](#).

5. How to control a Mini Pupper PWM servo

Mini Pupper servo is a PWM servo, You can connect one servo to Pi board as the following picture shows, run the same code, and then the servo will move. You can find the code [here](#). You can run it on your Windows or Ubuntu with Python environment, just like the following picture shows.

6. Forward Kinematics

Lecture

Please study the basic knowledge of forward kinematics online first.

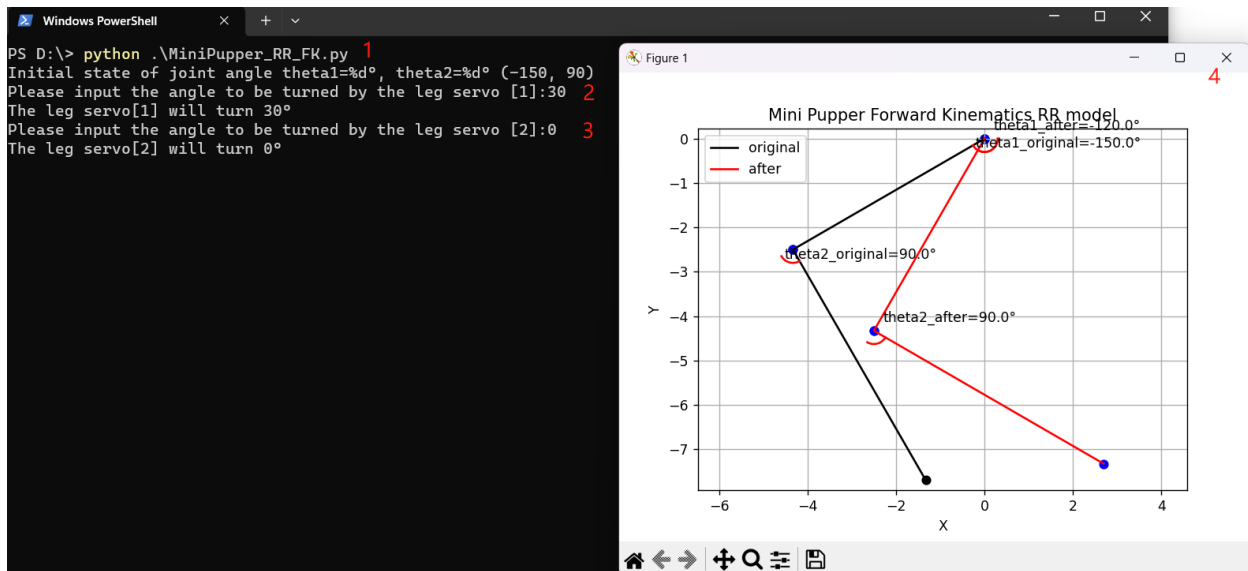
You can also refer to the following video clips come from [Stanford Robotics Independent Study](#).

Forward kinematics lecture

Follow-up lecture to clarify some things

Sample code

We prepared a simple Forward kinematics sample code based on Mini Pupper, you can try it [here](#). You can run it on your Windows or Ubuntu with Python environment, just like the following picture shows.



7. Inverse Kinematics

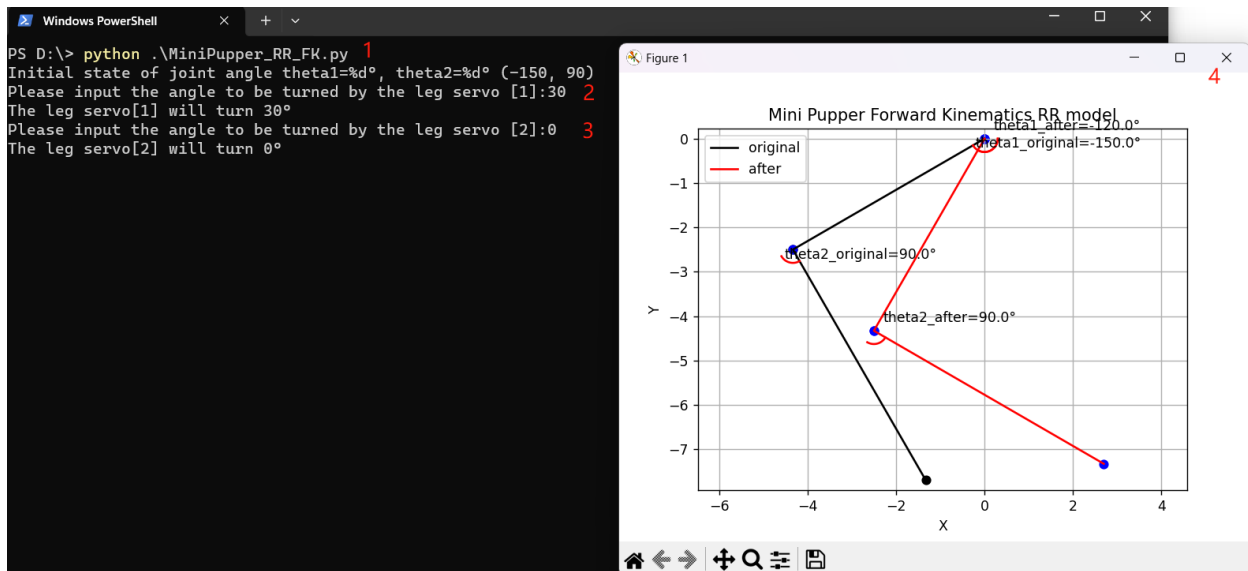
Lecture

Please study the basic knowledge of forward kinematics online first.

You can also refer to the following video clips come from [Stanford Robotics Independent Study](#).

Sample code

We prepared a simple Inverse kinematics sample code based on Mini Pupper, you can try it [here](#). You can run it on your Windows or Ubuntu with Python environment, just like the following picture shows.



8. PID control

Will update later!

9. Docker

9.1 Docker for Pupper

Dockerfile for Mini Pupper ROS package, comes from [docker-mini-pupper-ros](#) project.

9.2 Docker for Host

Host computer setup for interfacing with a Mini Pupper over a network, comes from [mp_host_setup](#) project.

10. Scratch program

Will update soon!

1.2.14 Mechanical Design

Contents

- *Mechanical Design*
 - *Fusion 360 CAD model*
 - *BOM*
 - *STL*

Fusion 360 CAD model

Mini Pupper: <https://a360.co/3wFLSIT>

BOM

Link: [Bill of Materials](#)

STL

Link: [STL for 3D print](#)

1.2.15 PCB

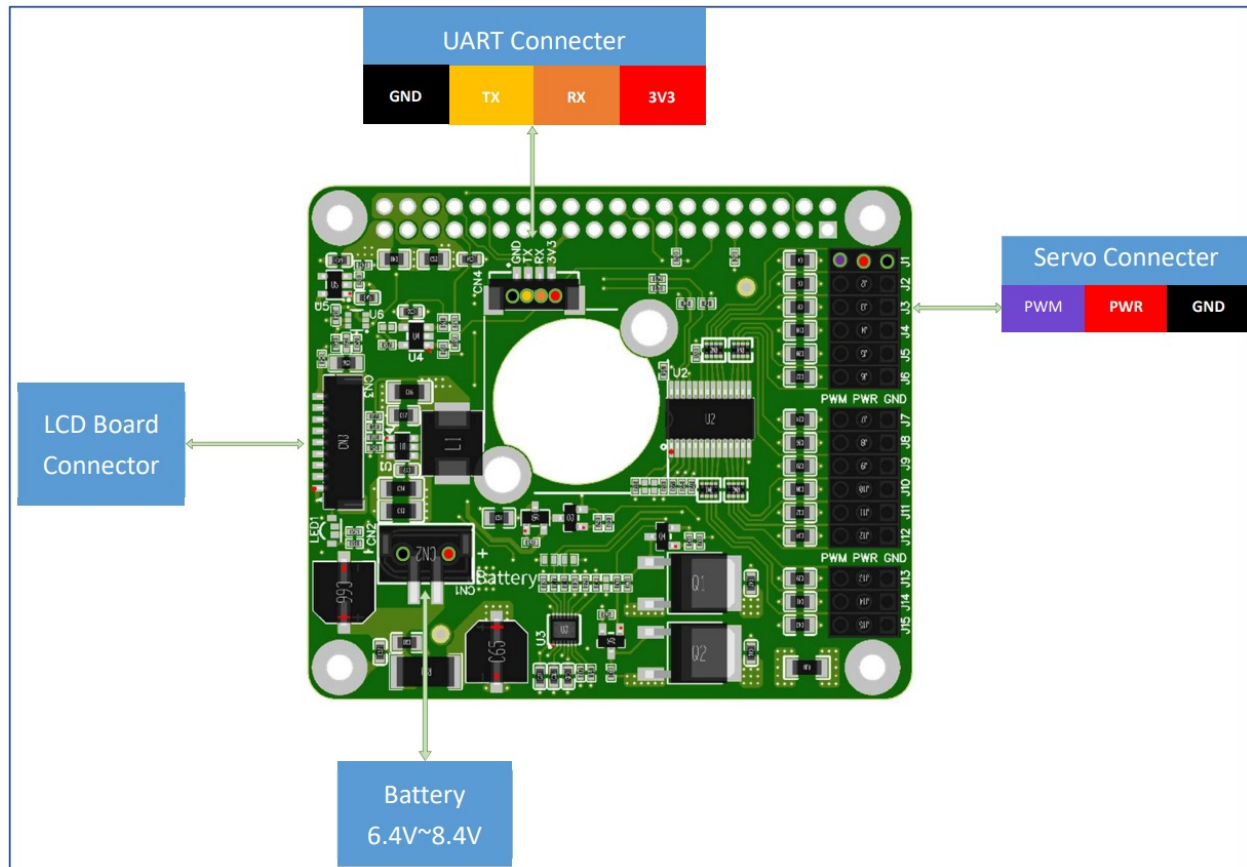
Contents

- *PCB*
 - *PCB Design*

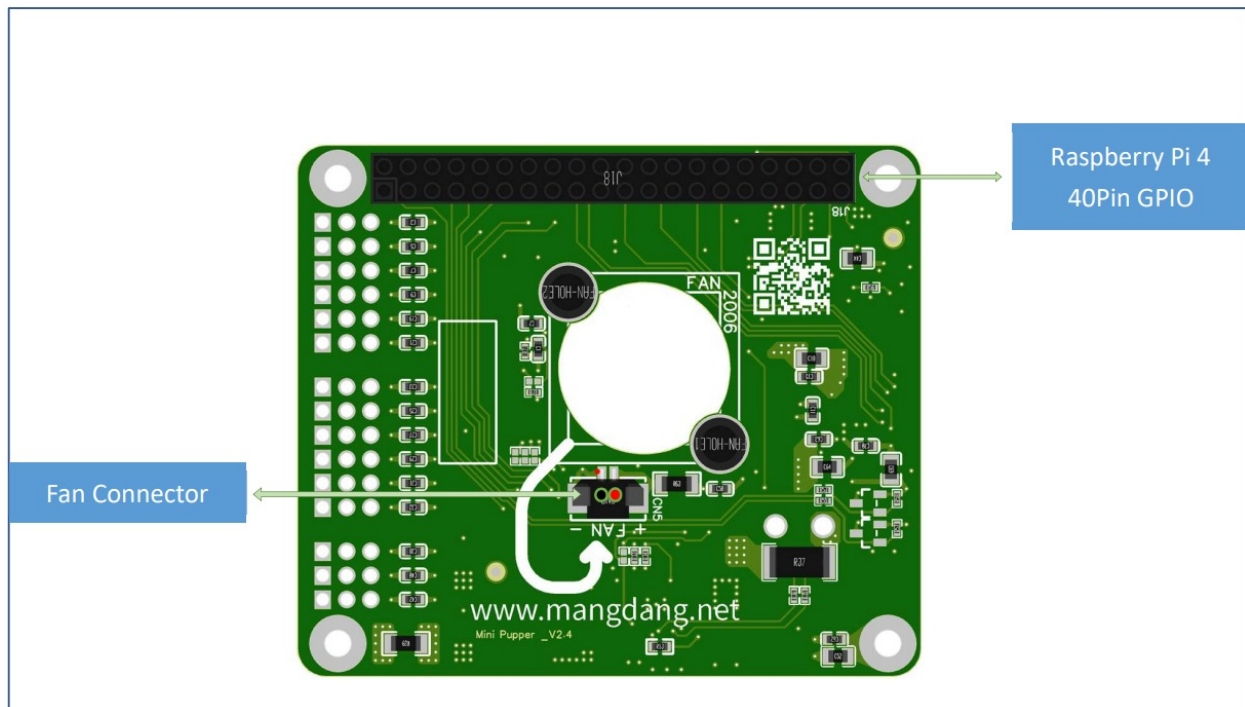
PCB Design

For Mini Pupper custom board design, please refer to the below pictures. You can also find the detailed [Schematic](#) and [Datasheet](#) .

Top side



Bottom side



1.2.16 FAQ(Frequently Asked Questions)

Contents

- *FAQ(Frequently Asked Questions)*
 - *FAQ*

FAQ

Q1. How to use Pupper long time for development?

The battery power can only run Pupper dozens of minutes, it is not convenient for long time development.

A1: Please confirm the below solutions for makers.

- Use Raspberry Pi default adapter to long time coding and debug, and use the battery to test the movement.
- Use DC power supply to long time coding, debug and test.

Q2. How about the leading time if I order?

A2: After get your payment, your package can be shipped from Shenzhen/China factory, the shipping time is about 1~3 weeks by air to most of places in the world.

Q3. Will the shipping be free?

A3: No, but we will also give you a special shipping fee, within \$30USD to most places of NA, JP, EU and UK.

Q4. Can I get the DDP(Delivered Duty Paid) service?

A4: Sure, the shipping fee already includes the DDP service, you don't care about the duty fee, just like you place an order locally.

Q5. What's the restrictions of the shipping address?

A5: Our 2 express vendors can ship to 135+ countries/regions, but not including India, Montenegro, Armenia, Nigeria, Colombia, South Africa, North Korea, Sudan, Syria, Hawaii, Palmañola, and County Antrim.

Q6. Shipping Info Requirement

A6: When you pay, please also let us know your below shipping info, thanks!

- 6.1. Address:
 - 6.2. The recipient's name:
 - 6.3. The recipient's phone:
 - 6.4. Recipient email:
 - 6.5. Company name (if have)
 - 6.6. Post code(zip code):

- If you live in Japan, please use the Japanese information.
- If you live in South Korea, also need your ID number.
- If you live in Taiwan, also need your ID number and Chinese information.
- If you live in Brazil, also need your tax number (CPF), or corporate tax number (CNPJ).

If you have any requirements or questions, please feel free to mail to sales@mangdang.net, thanks!