

SMALLKAT ASSEMBLY INSTRUCTIONS

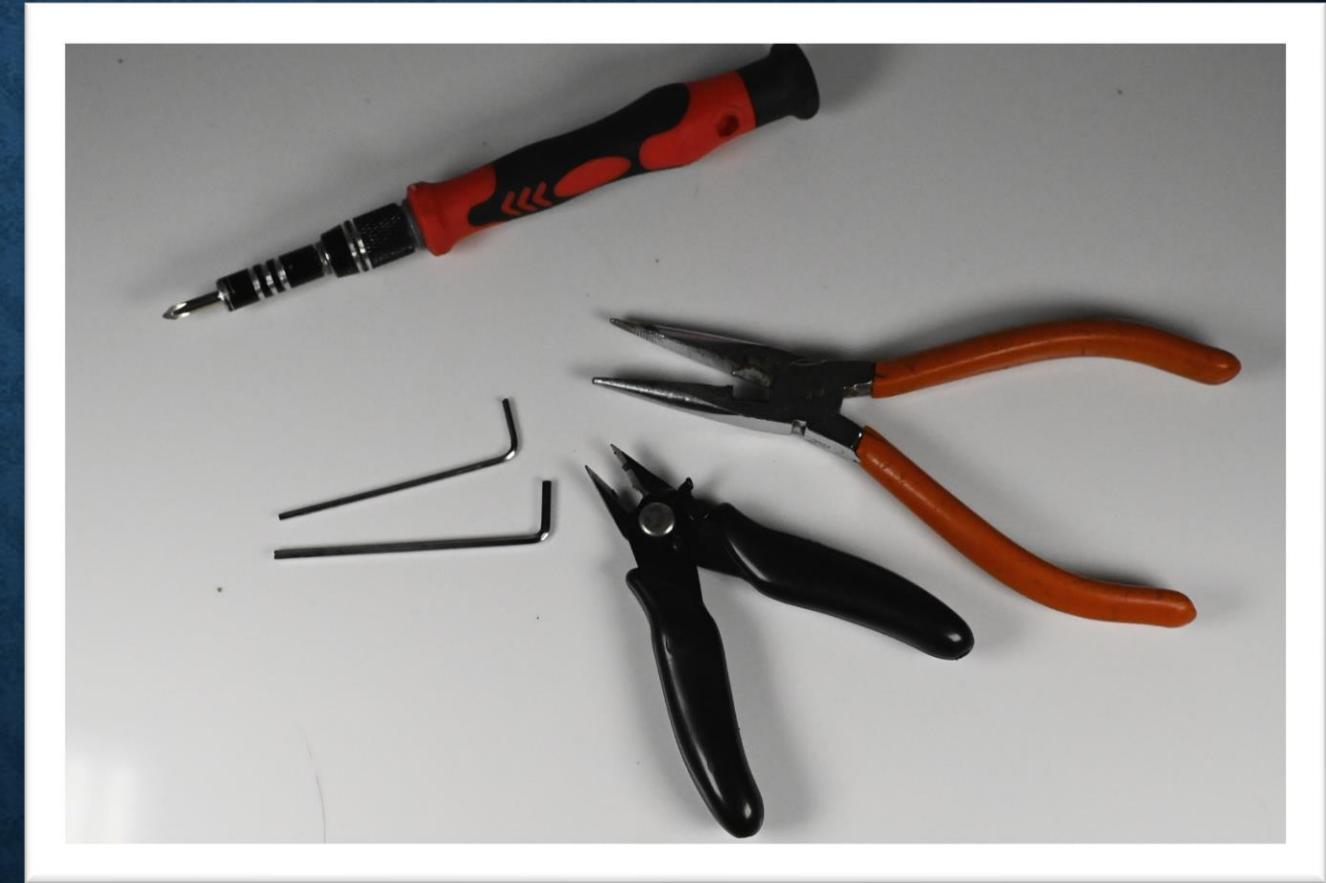


NOTES

- Before assembly be sure all support material is removed from your parts. A pair of pliers and small flat head screw driver can be helpful in removing support material.
- This design uses imbedded square nuts to screw bolts into. The fits should be tight but not impossible to slide in. If the square nuts won't fit you can try a couple of solutions. Use a persuasion tool such as a small hammer. Or a big one. If you printed your own parts check the settings on your printer to make sure you are getting accurate prints. Check for any possible burs, elephant feet or loose plastic blocking the hole. Another possible solution is to carefully heat up the square nuts. Holding the nut with a pair of pliers heat carefully with a lighter or open flame and carefully press the nuts into place. Be mindful of any extra plastic that may ooze out and cover the threads.
- If the nuts are too loose you can add a small dab of your favorite glue to try and prevent the nuts from spinning or try and slip a small piece of extra plastic or thin material in between the nut and printed part to prevent spinning when screwing in the bolt.
- The joints rely on several close tolerance parts that rotate inside each other. These joints should be a comfortable fit and rotate with minimal side to side motion. Initial assembly may have additional friction that should go away after a few rotations. Ensure there are no burs or extra plastic in the parts before assembly. If parts are too tight a light sanding can help remove extra friction. Additionally, a small amount of plastic safe lubricant could be used to help ensure a smooth motion. Parts should still operate with a fair amount of play if parts are loose. If there is a considerable amount of play in the system check parts are assembled correctly and printer settings are correct.
- Some of the parts and link lengths depicted in this assembly may be different than your parts. But the overall assembly process is the same.

TOOLS NEEDED

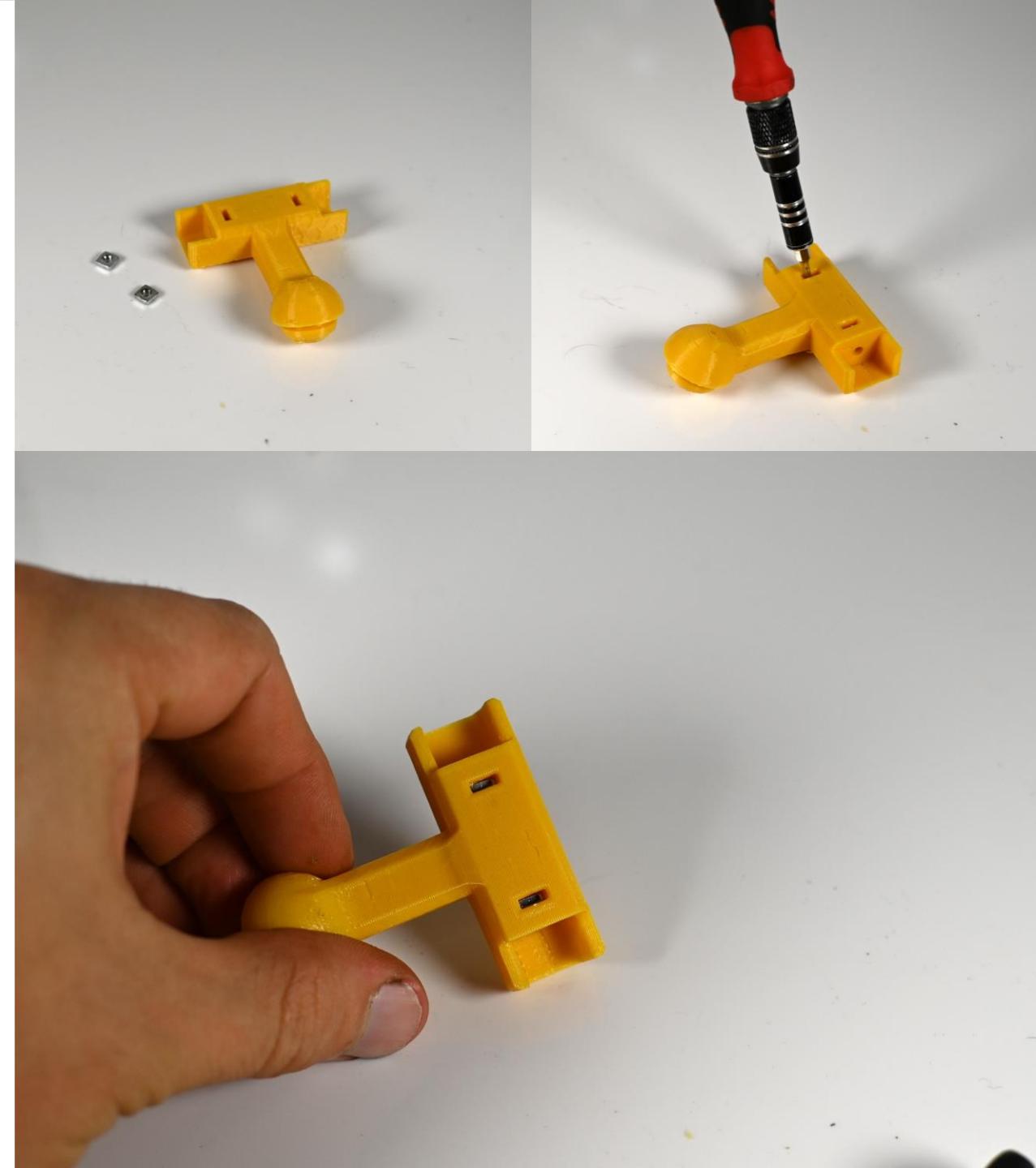
- 2mm hex driver
- 1.5mm hex driver
- Screwdriver
- Pliers
- Flush Cutters



STEP 1

- Parts:
- Smallkat Foot
- x2 M3 Square Nuts

Insert the square nuts into the slots on top of the foot. Using a flat head screw driver can be helpful in pushing the nuts all the way down

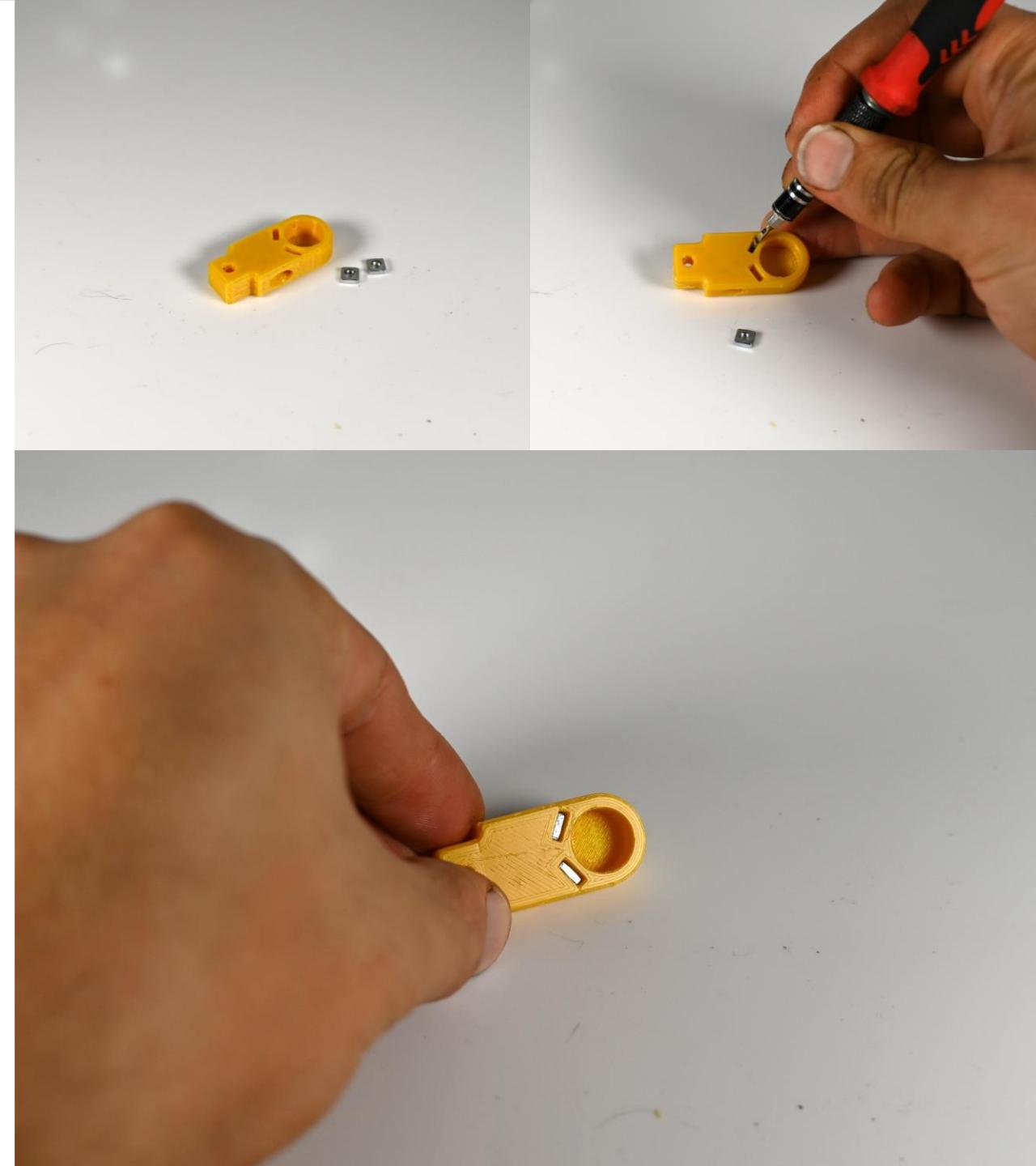


STEP 2

- Parts:
- Calibration Link
- x2 M3 Square Nuts

Insert square nuts into link. Using a flat head screw driver can be helpful in pushing the nuts all the way down

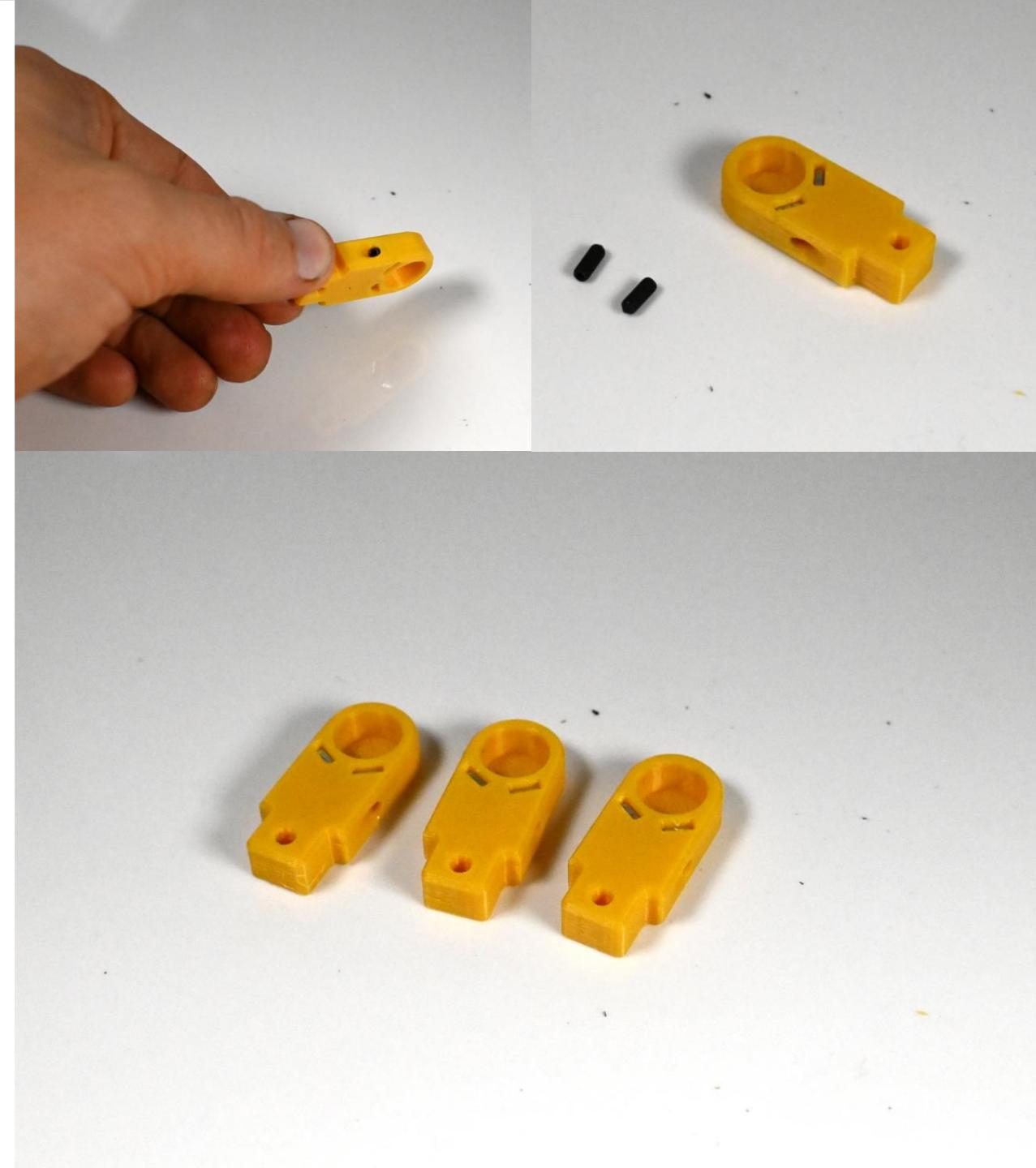
Note: If you are using the DIY servo horns see the amendment at the end.



STEP 3

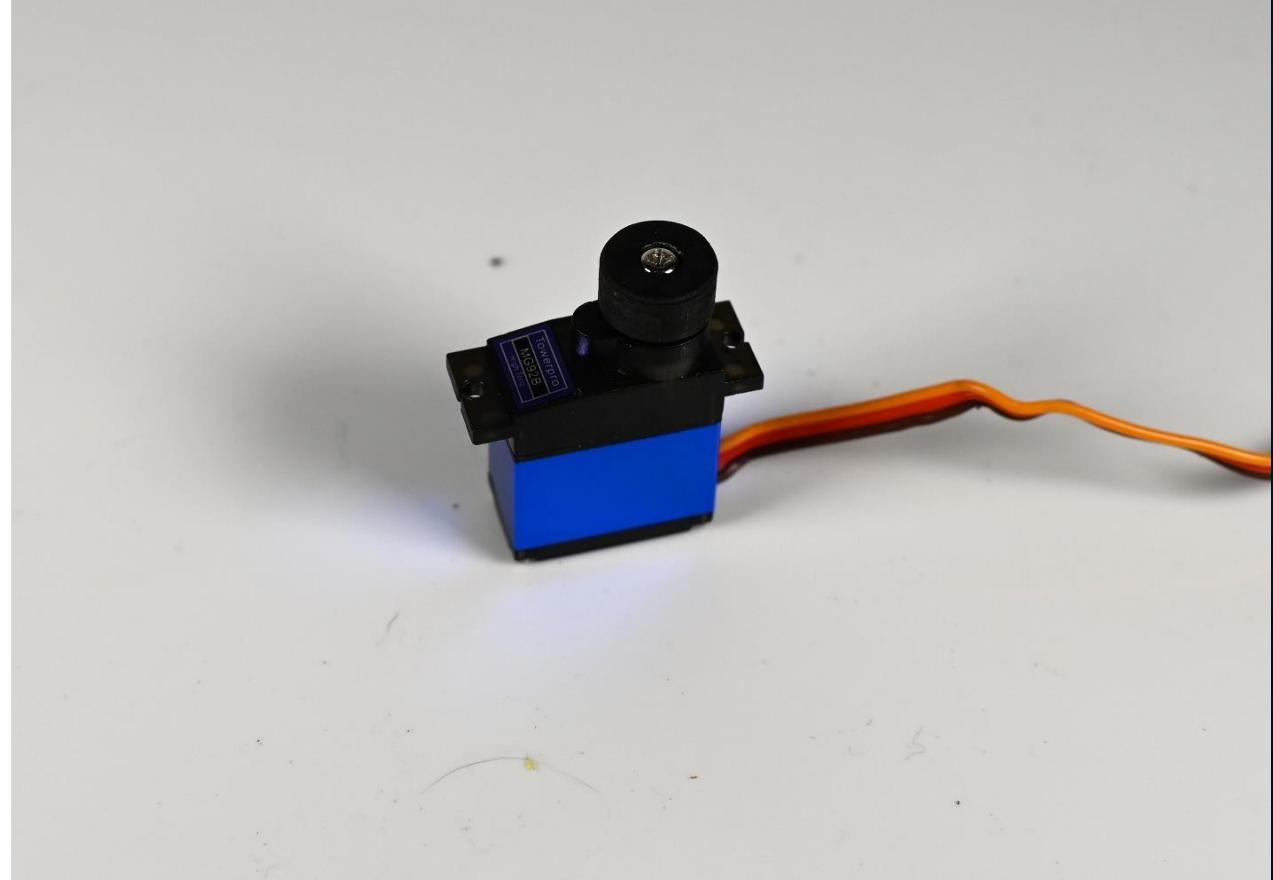
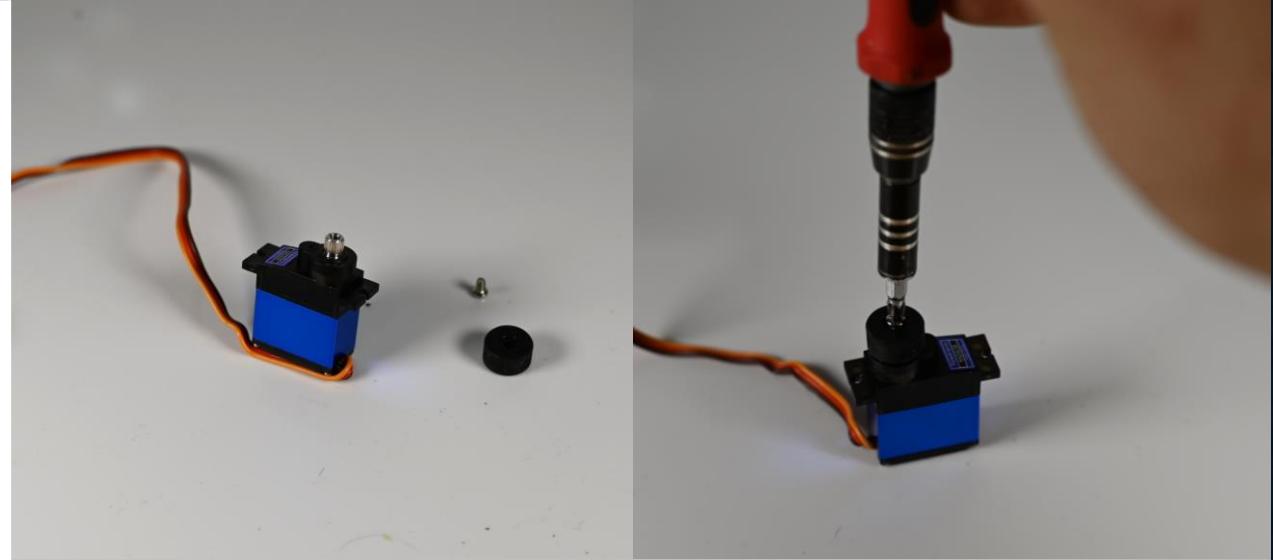
- Parts:
- Calibration Link
- 2 M3x8mm Set Screw

Screw the setscrews into the holes on the side of the calibration link. They should just thread into the square nuts but not go into the inner hole. We will adjust them later. Repeat steps 2 and 3, for all 12 calibration links. We will need 3 for each leg.



STEP 4

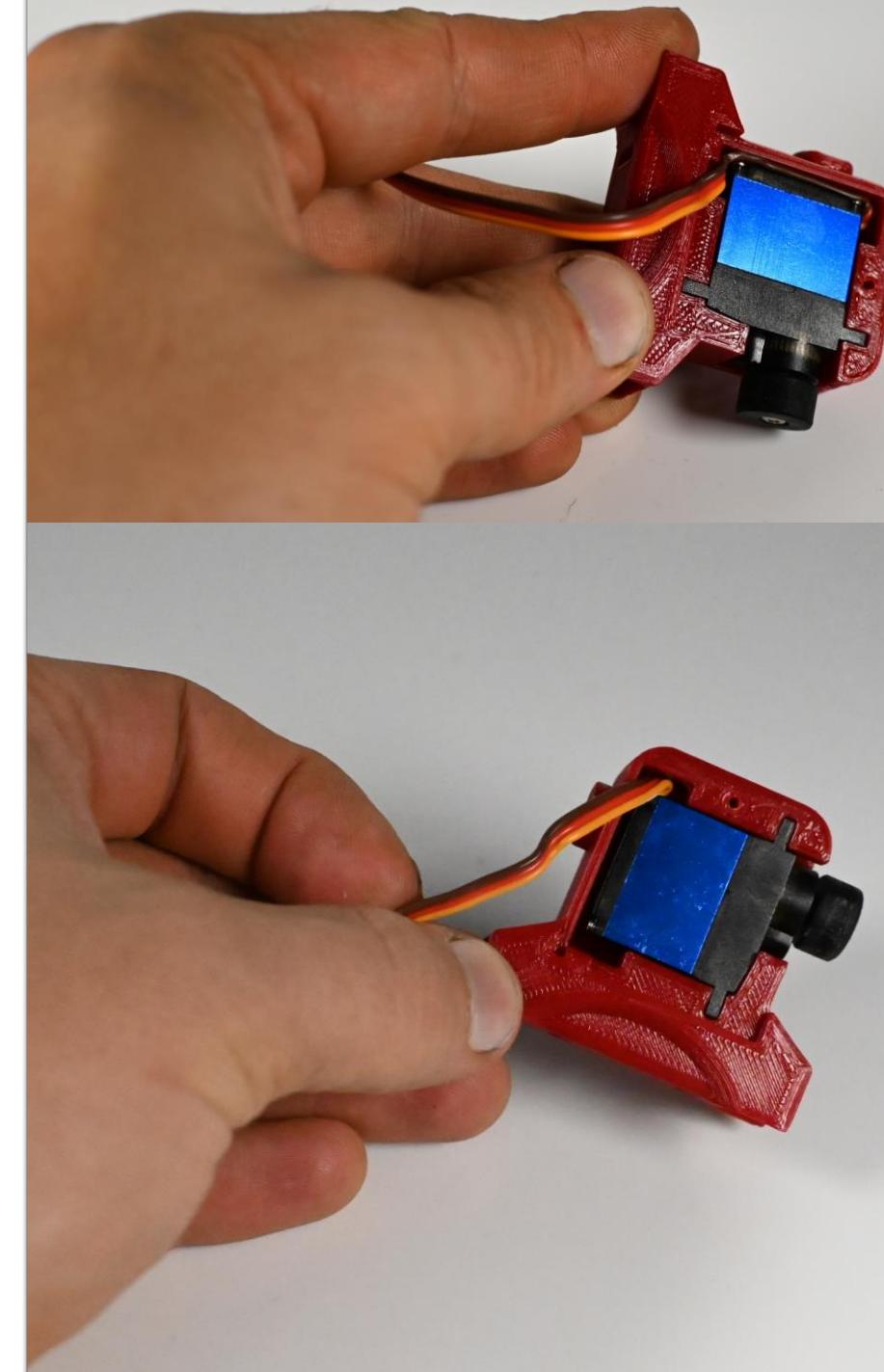
- Parts:
- MG92B Servo
- Resin Servo Horn
- M2.5mm x 3mm screw
- Press the resin horn onto the servo. It will be a tight fit. Secure the servo horn with the M2.5mm x 3mm screw. Repeat this step for all 16 servos.



STEP 5

- Parts:
- MG92B Servo Assembly
- Left Knee Body

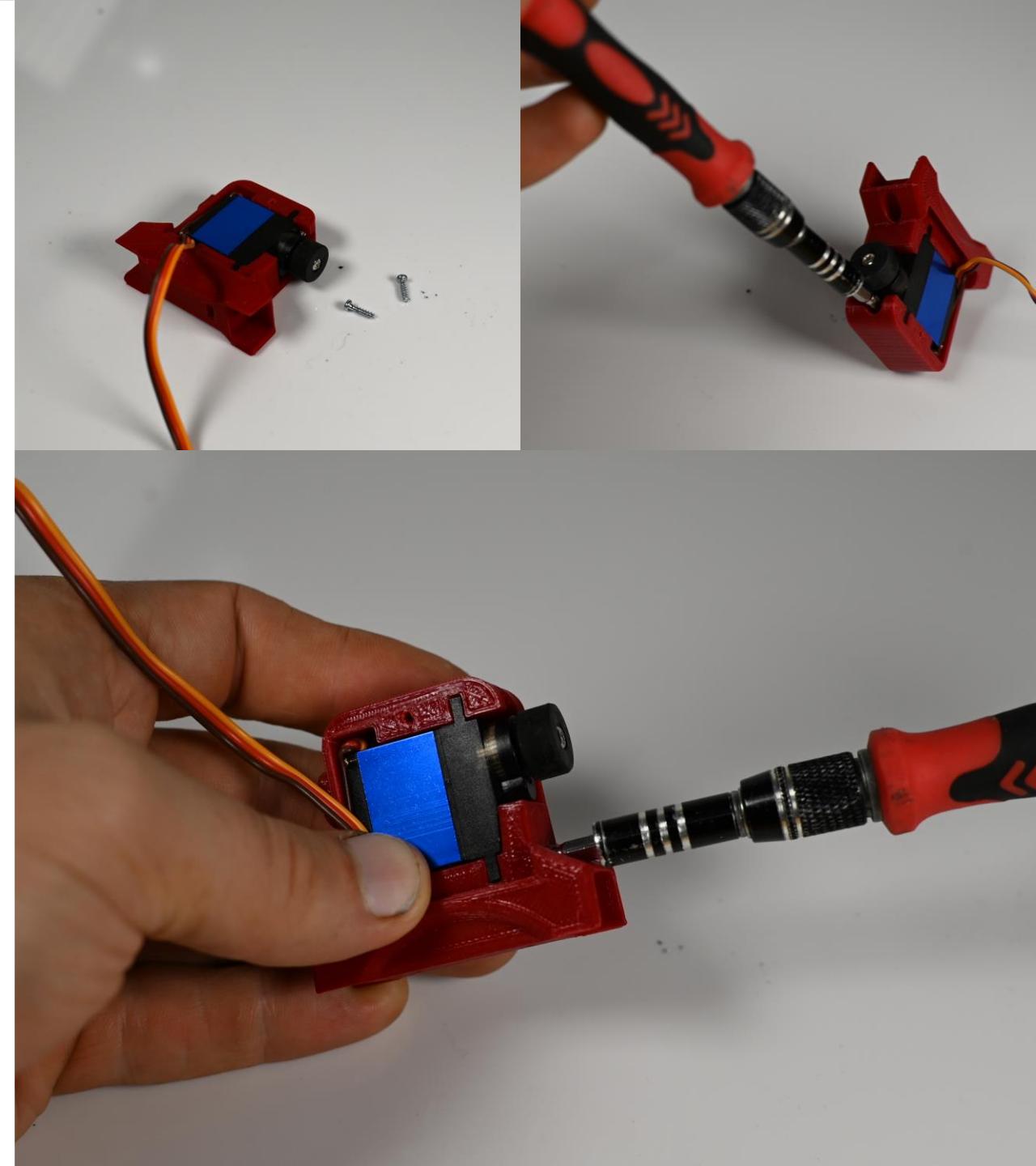
Press the servo assembly into the knee body. Be careful not to pinch the wires. After pressing the servo into the body the wire should sit in the relief. Guide the wires in between the servo and the plastic body.



STEP 6

- Parts:
- Knee Assembly
- x2 M2x8 Plastic Screws

Screw the Plastic screws into the two holes on the side of the assembly to secure the servo in place. Careful not to overtighten. You are screwing into plastic and overtightening can rip out the threads.

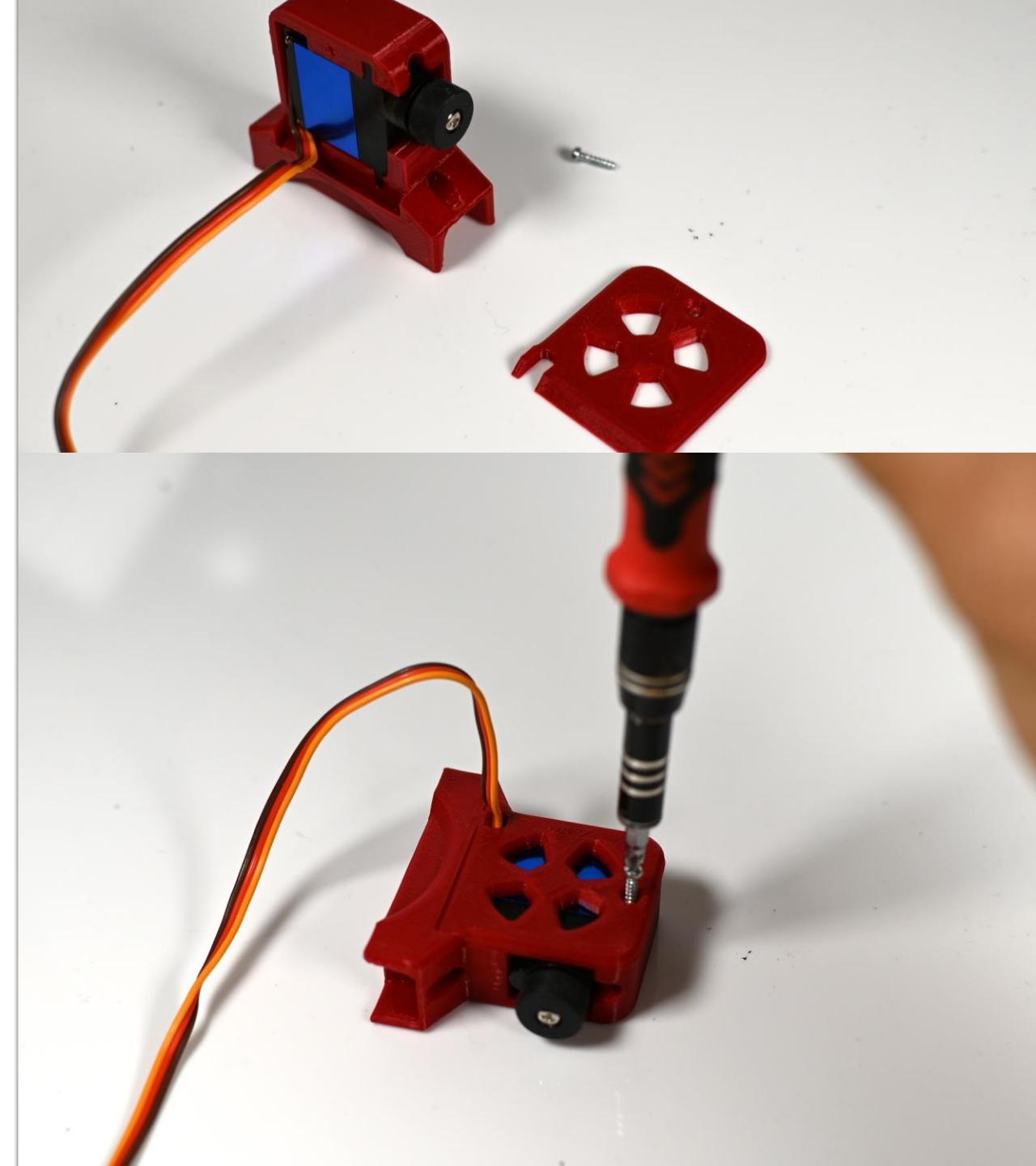


STEP 7

- Parts:
- Knee Assembly
- x1 M2x8 Plastic Screws
- Left Knee Cover

Fit the knee cover over the knee assembly.

Guide the wire through the cut out and be careful not to pinch them. Screw the cover down with the M2 plastic screw. Careful not to over tighten.



STEP 8

- Parts:
- Knee Assembly
- Smallkat Foot
- Calibration Link
- Idle Link
- x2 M3x16mm Bolts

Screw the calibration link into the foot using the M3x16mm screw. The screw will go through the plastic and thread into the M3 nut in the foot.



STEP 8 CONT.

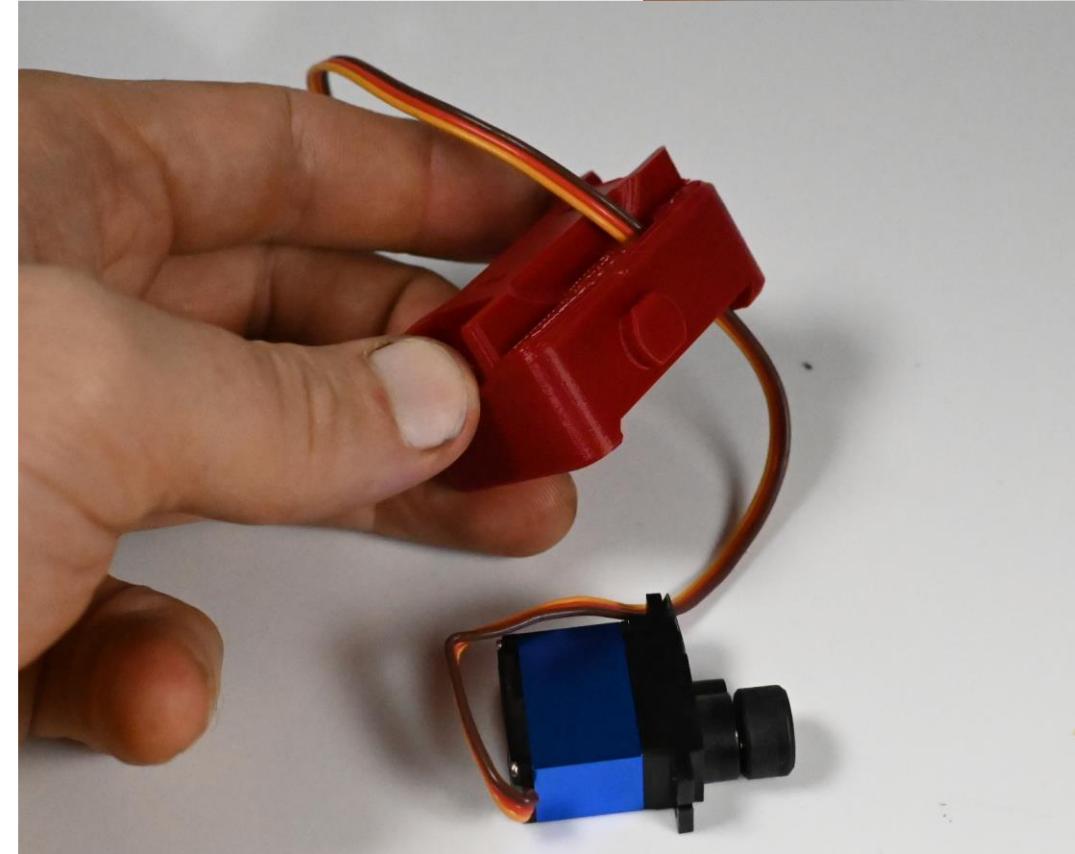
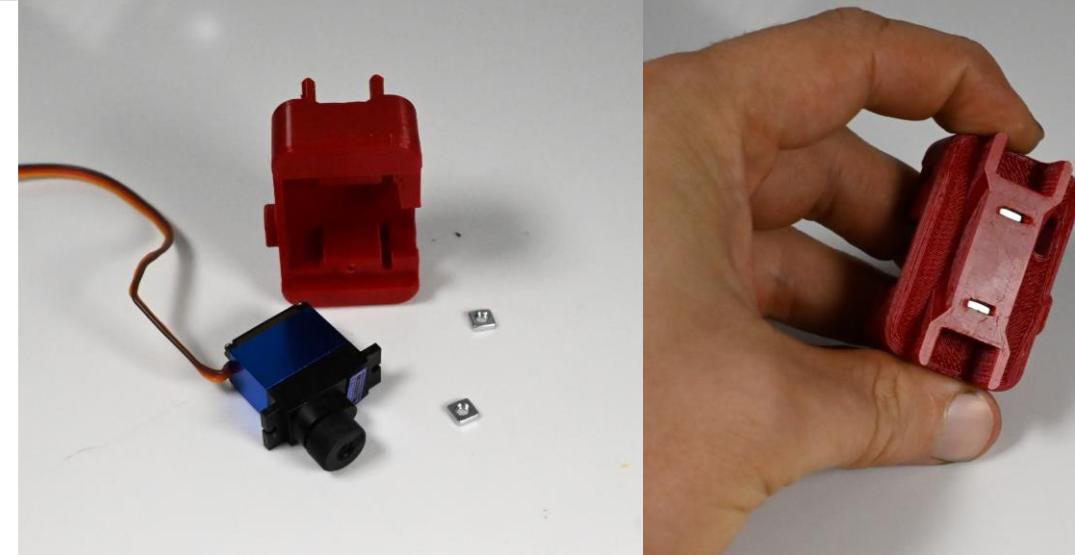
Press the calibration link over the servo horn. Press the idle link onto the other side and secure it with a M3x16mm screw. The foot should be able to rotate freely. There may be a little friction that causes the servo to rotate but this is ok. As long as the set screws in the calibration link aren't touching the servo horn. Set this assembly aside for now.



STEP 9

- Parts:
- Left Shoulder Body
- x2 M3 Square Nut
- x1 Servo Assembly

Press the square nuts into the slots on top of the shoulder. Feed the wires through the hole on top of the shoulder from the open face side.



STEP 9 CONT.

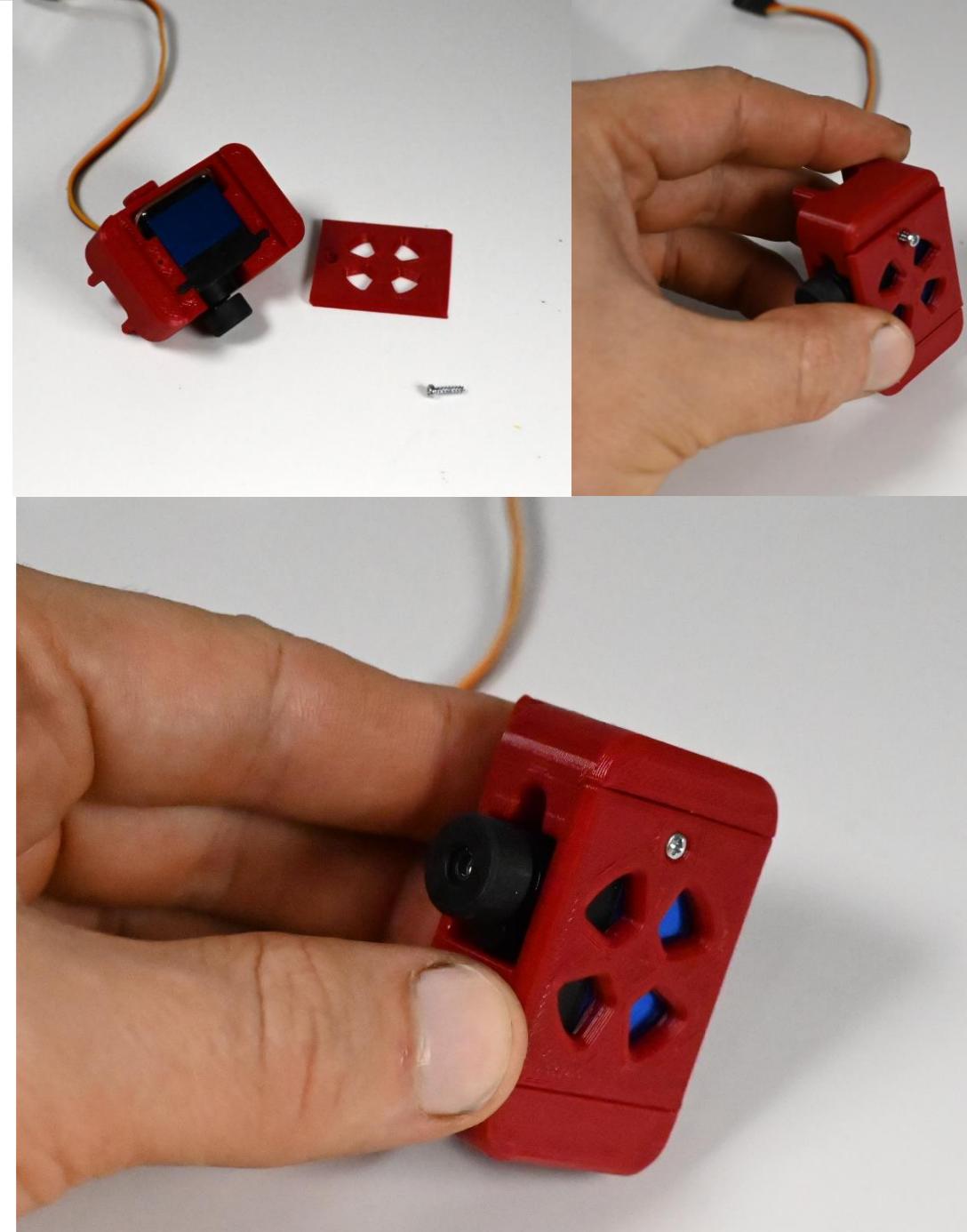
Press the servo into shoulder body. The wires from the servo start on the opposite side of the hole they travel through. Its easier to let the wires pass over the top of the servo and then push them gently into place in between the servo and plastic housing.



STEP 10

- Parts:
 - Left Shoulder Body Assembly
 - Shoulder Cover
 - x1 M2x8 Plastic Screw

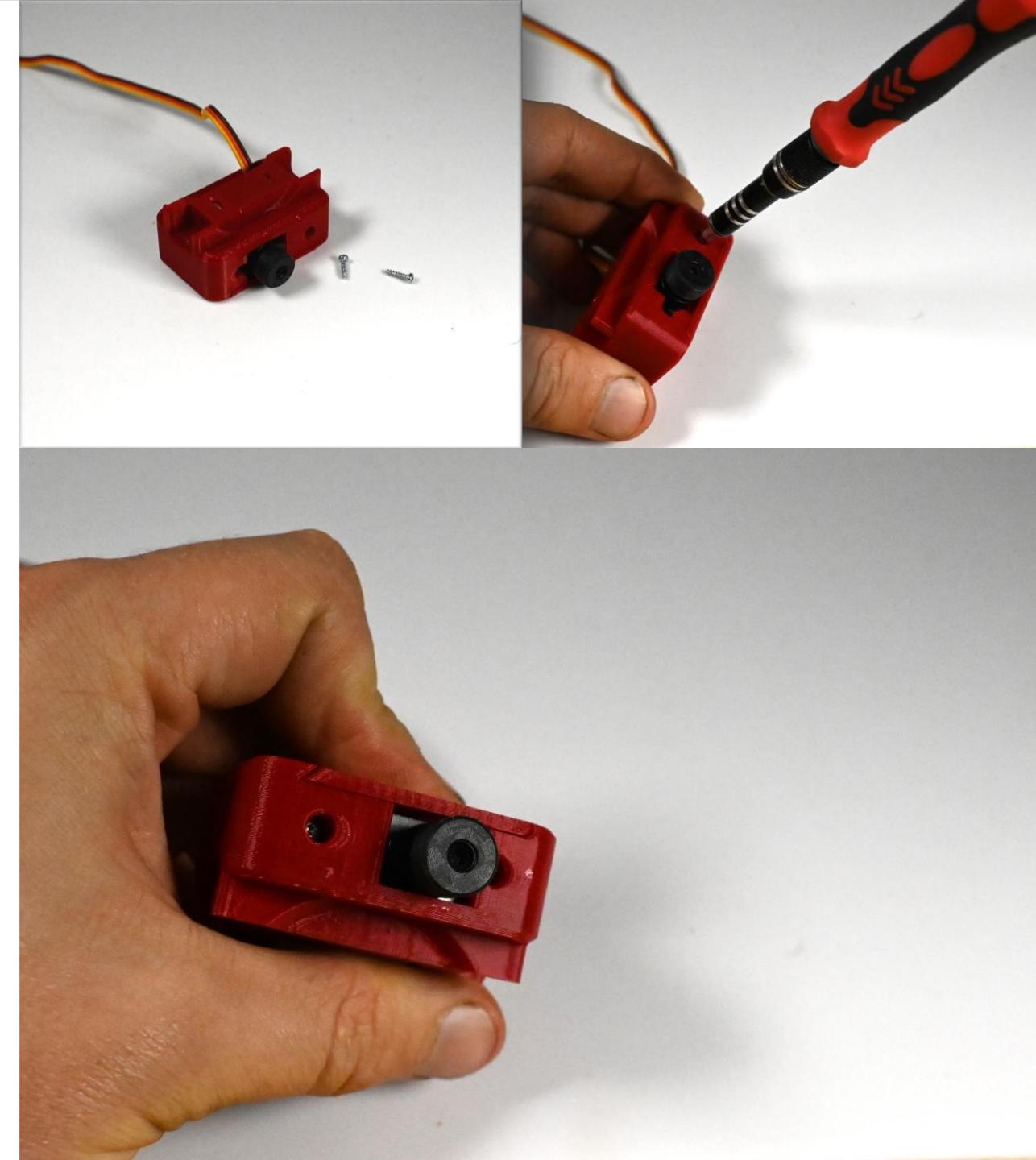
Fit the shoulder cover over the shoulder assembly. Screw the cover down with the M2 plastic screw. Careful not to over tighten.



STEP 11

- Parts:
- Shoulder Assembly
- x2 M2x8 Plastic Screws

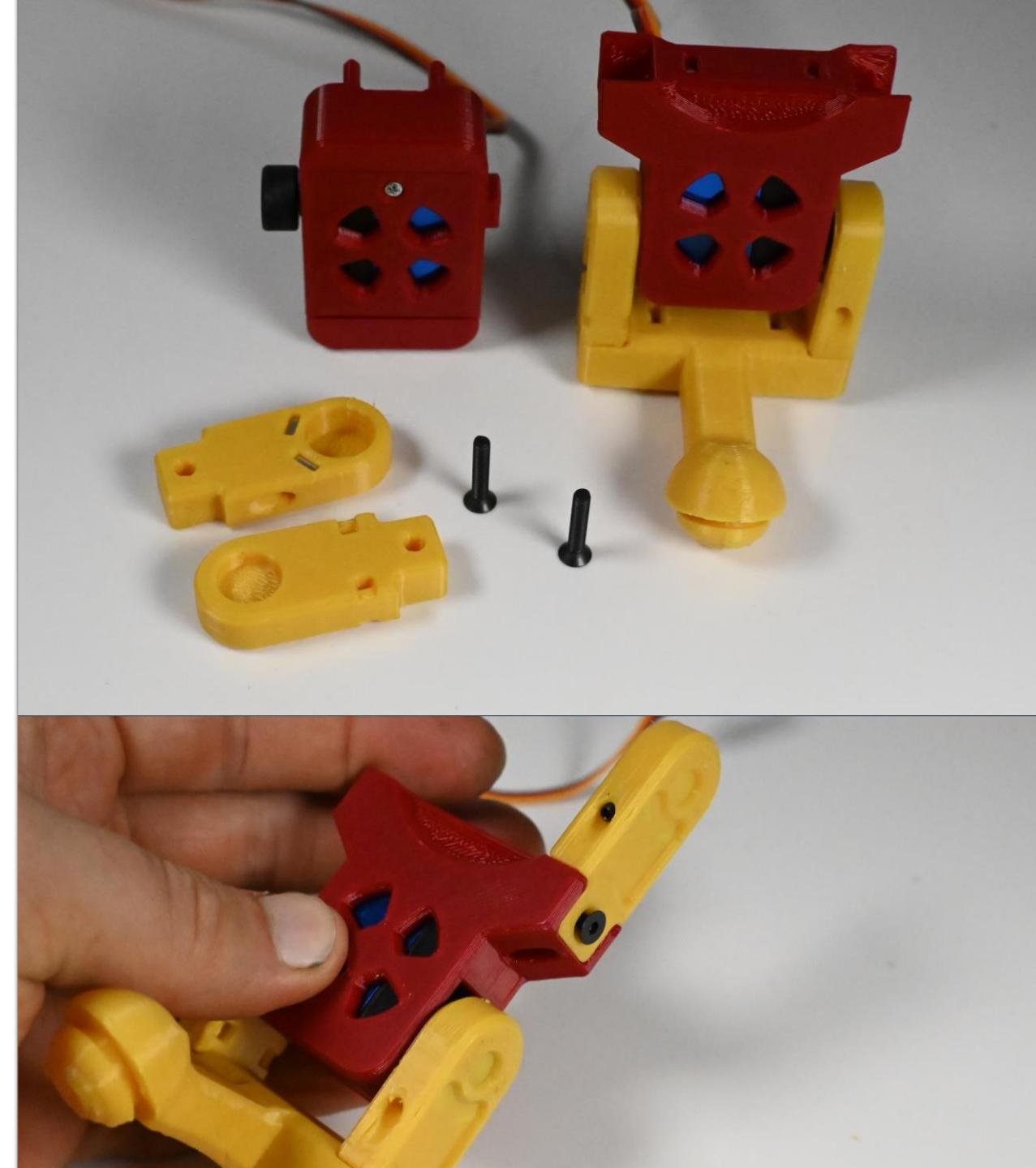
Screw the Plastic screws into the two holes on the side of the assembly to secure the servo in place. Careful not to overtighten.



STEP 12

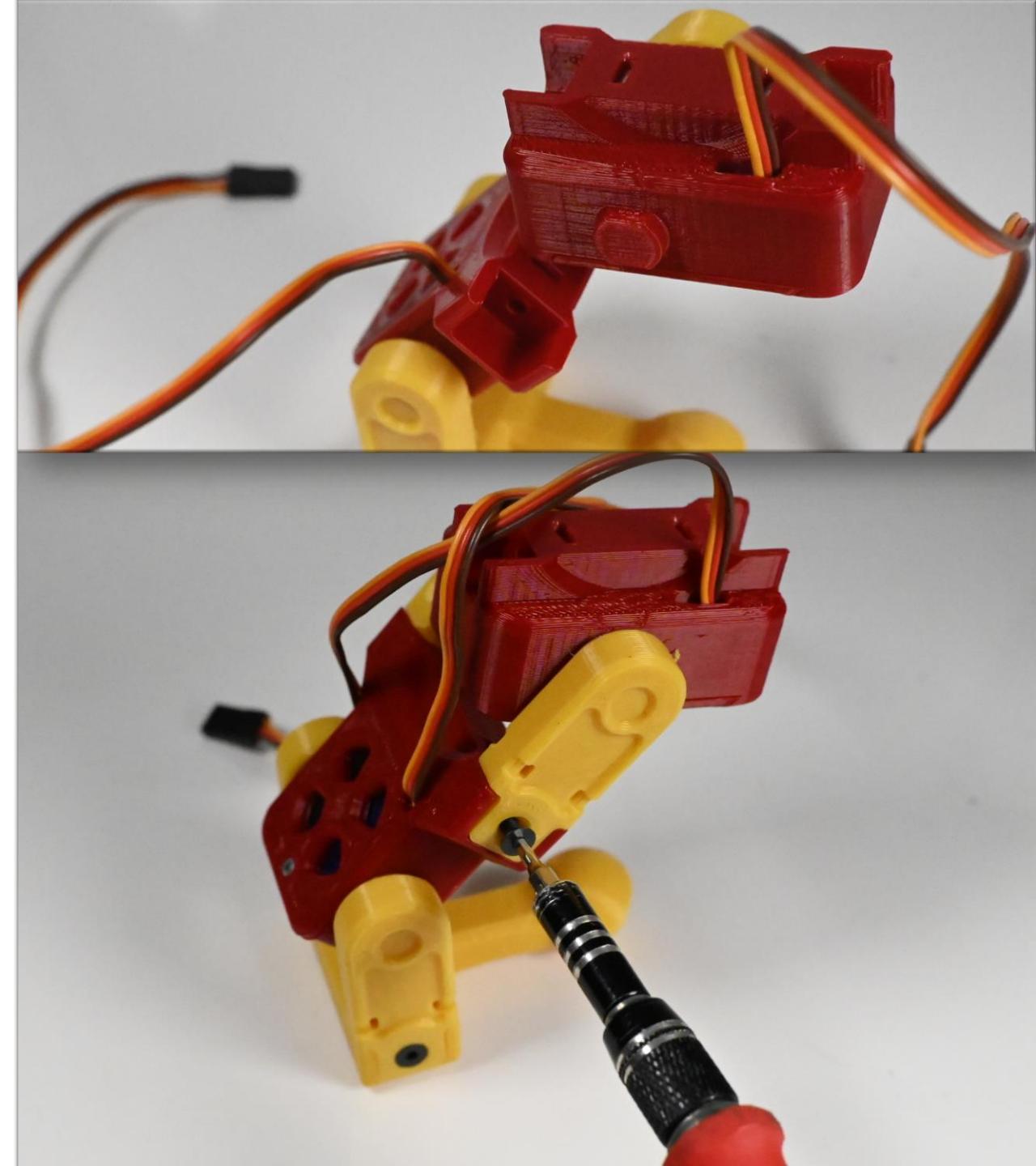
- Parts:
 - Shoulder Assembly
 - Knee and Foot Assembly
 - Calibration Link
 - Idle Link
 - x2 M3x16mm Bolts

Screw the calibration link into the knee using a M3x16mm screw. Make sure both calibration links are on the same side.



STEP 12 CONT.

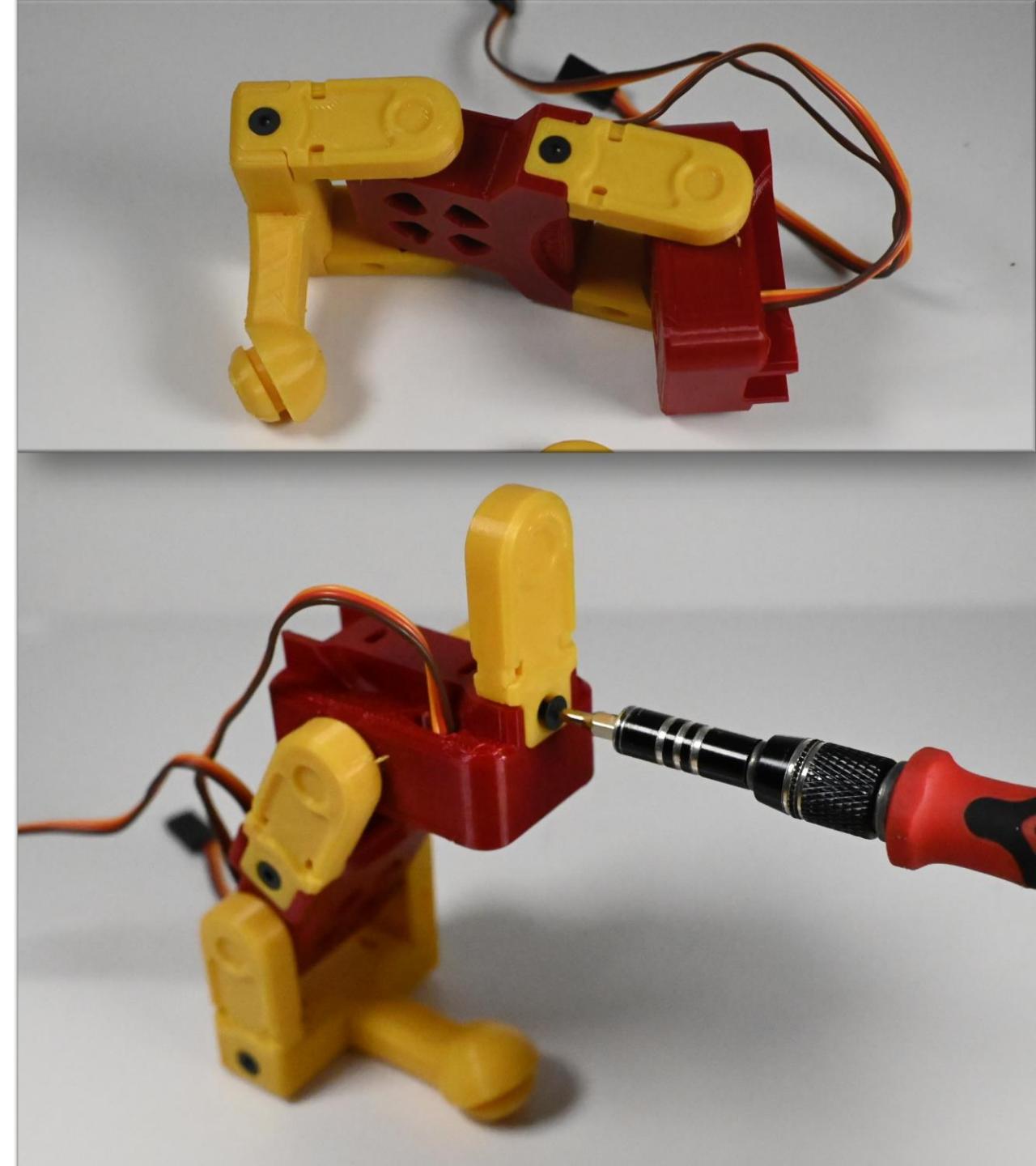
Screw the idle link into the other side of the leg using a M3x16mm screw. The knee should be able to rotate freely. There may be a little friction that causes the servo to rotate but this is ok. As long as the set screws in the calibration link aren't touching the servo horn.



STEP 13

- Parts:
- Leg Assembly
- Idle Link
- x1 M3x16mm Bolt

Screw the idle link into the front of the leg assembly using a M3x16mm screw.



STEP 14

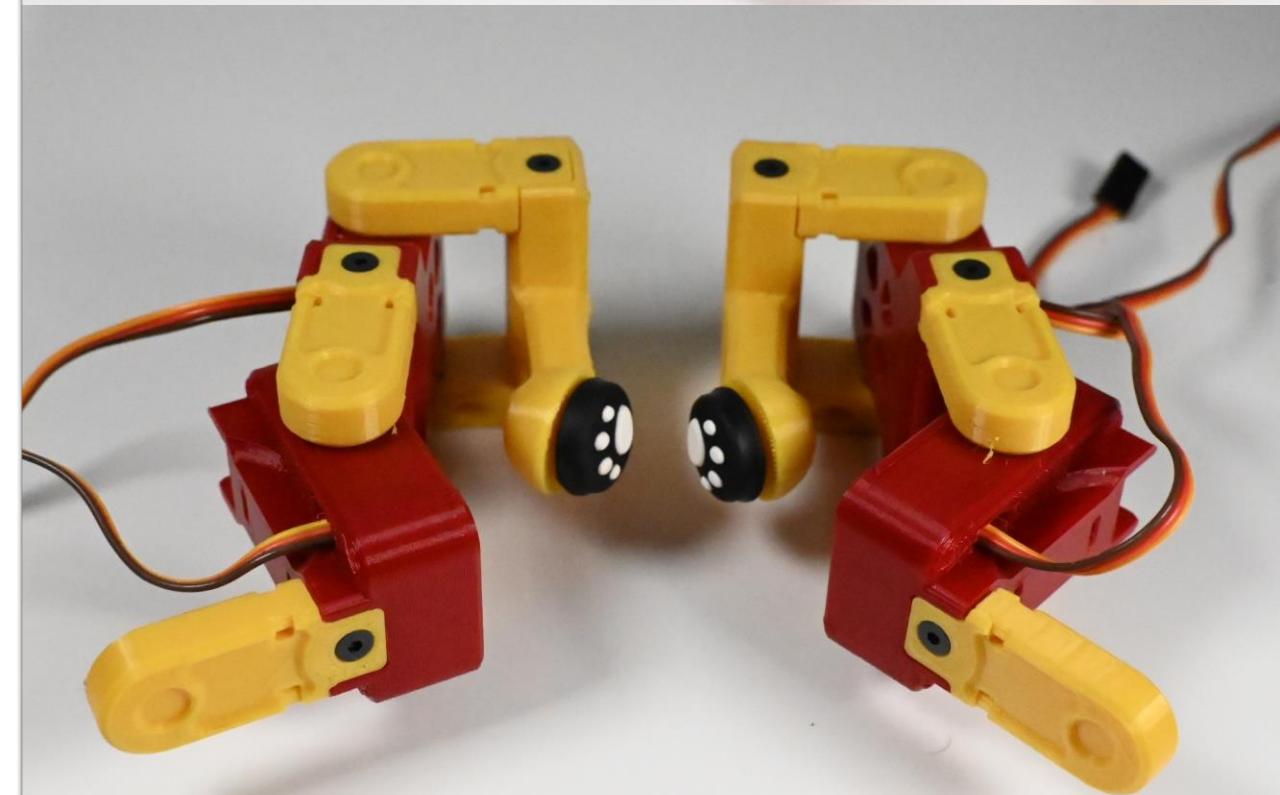
- Parts:
- Leg Assembly
- Foot cover

Slip the foot cover over the end of the foot. Make sure it is fully seated. Congrats the first leg is finished!



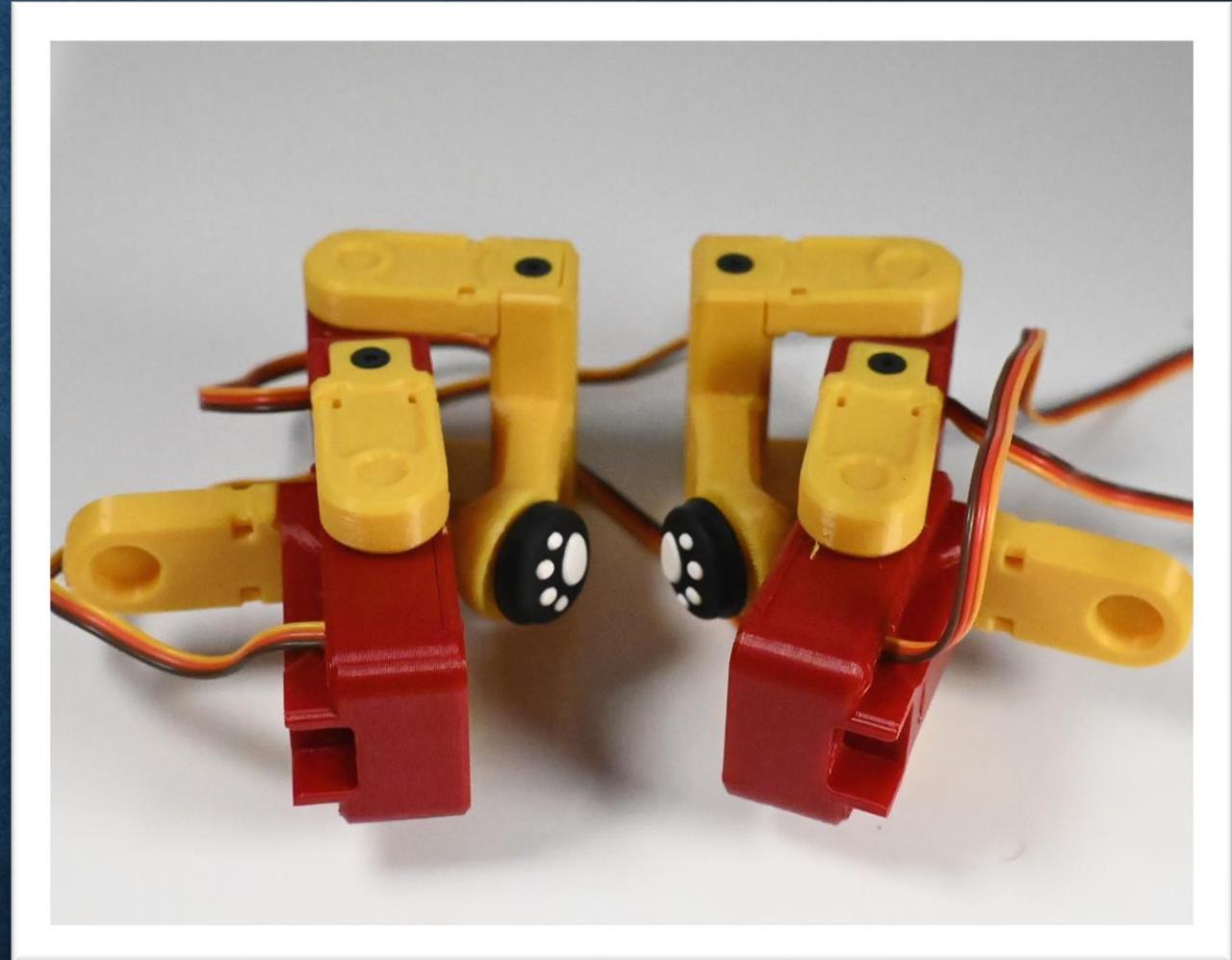
STEP 15

Repeat steps 1-14 using the right knee body and cover and right shoulder body. You will end up with a second leg that is a mirrored version of the first.



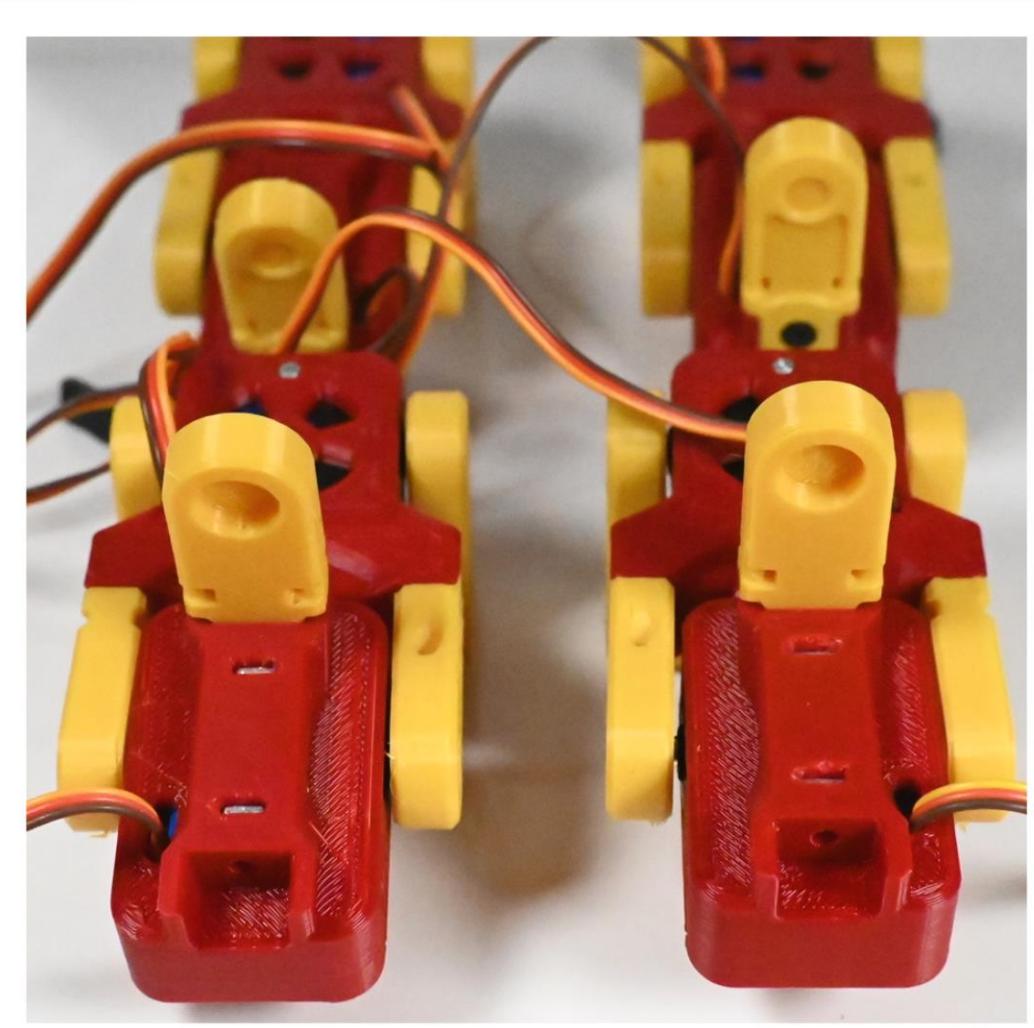
STEP 16

Repeat steps 1-14 using the right knee body and cover and right shoulder body. You will end up with a second leg that is a mirrored version of the first.



STEP 17

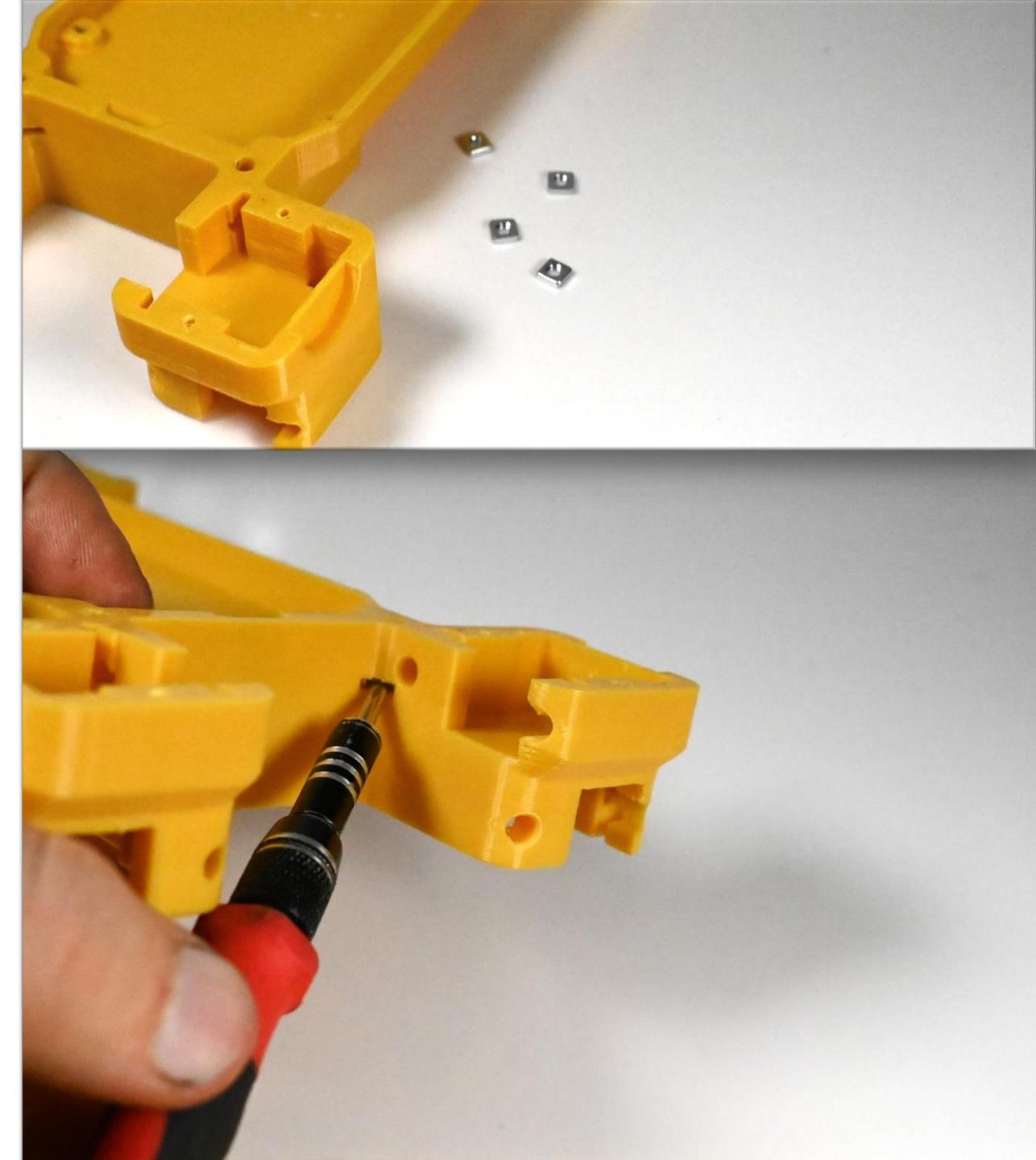
At this point you should have 4 legs.
Two mirrored copies with the idle links
in the front for two and the idle links in
the back for the other two.



STEP 18

- Parts:
- Smallkat Body
- x4 M3 Square Nut

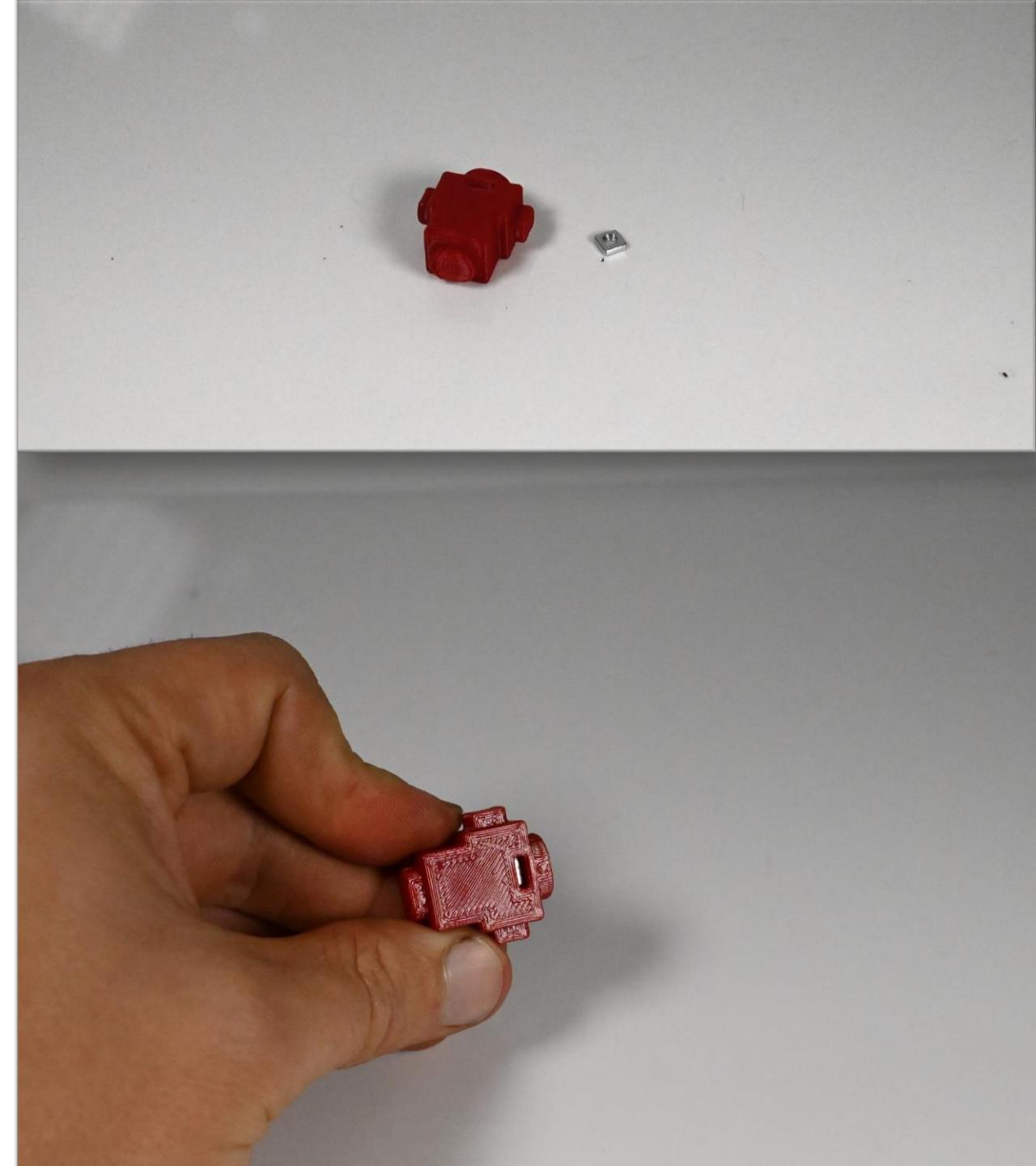
Press the square nuts into the slots in the inside corners of the body. Using a screwdriver can be helpful in making sure they are pushed in all the way.



STEP 19

- Parts:
- Wrist Center
- x1 M3 Square Nut

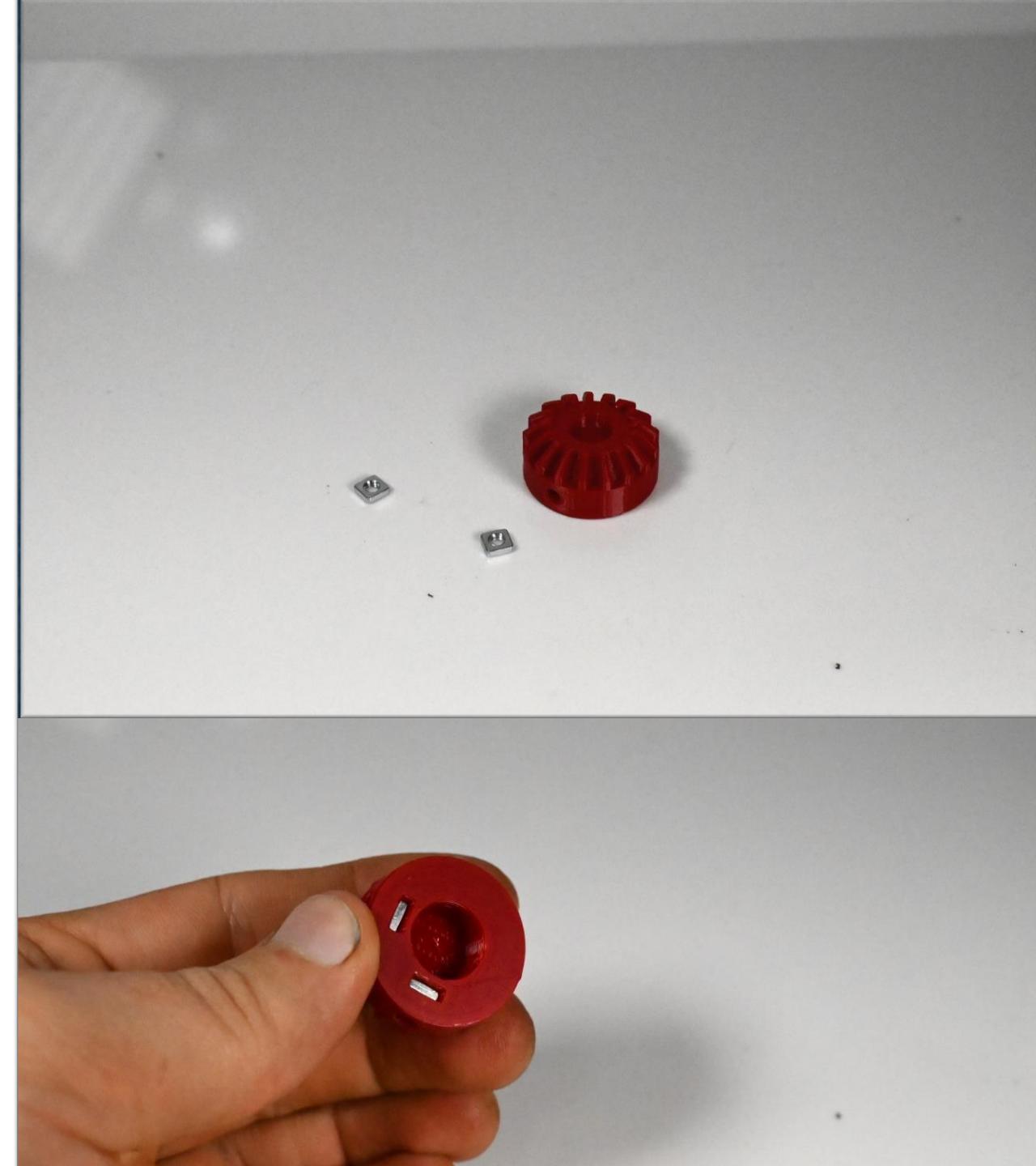
Press the square nut into the wrist center. Repeat this step for the second wrist center and then set them aside for now.



STEP 20

- Parts:
- Bevel Gear
- x2 M3 Square Nuts

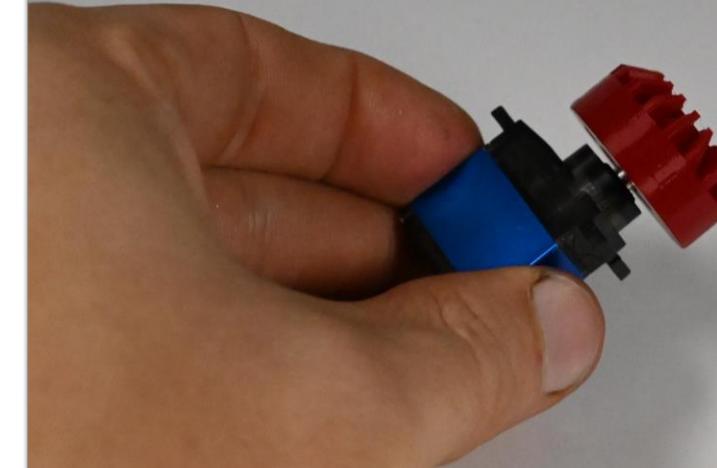
Press the square nuts into the slots of the bevel gear.



STEP 21

- Parts:
- MG92B Servo Assembly
- Bevel Gear

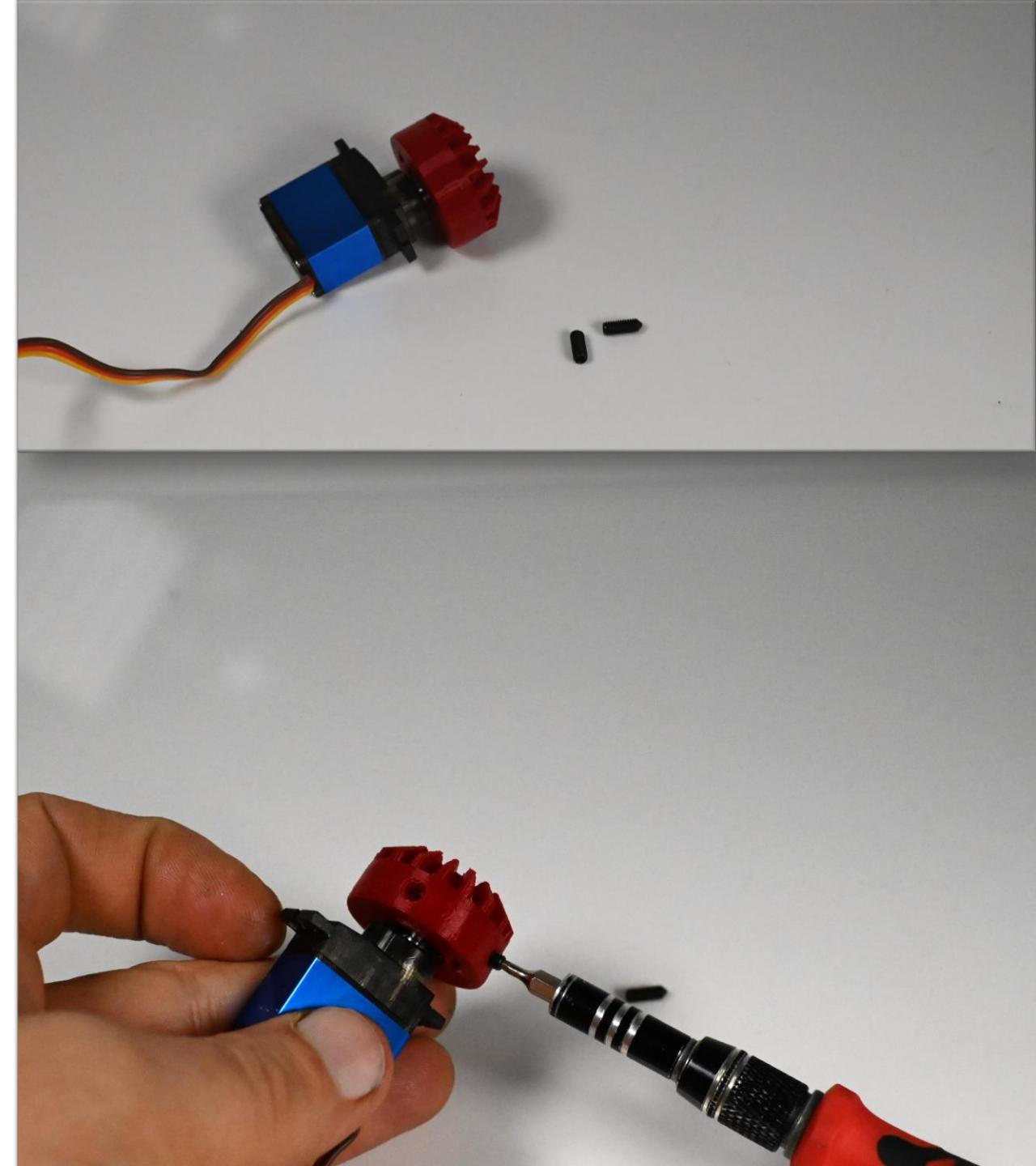
Press the bevel gear onto the servo.



STEP 22

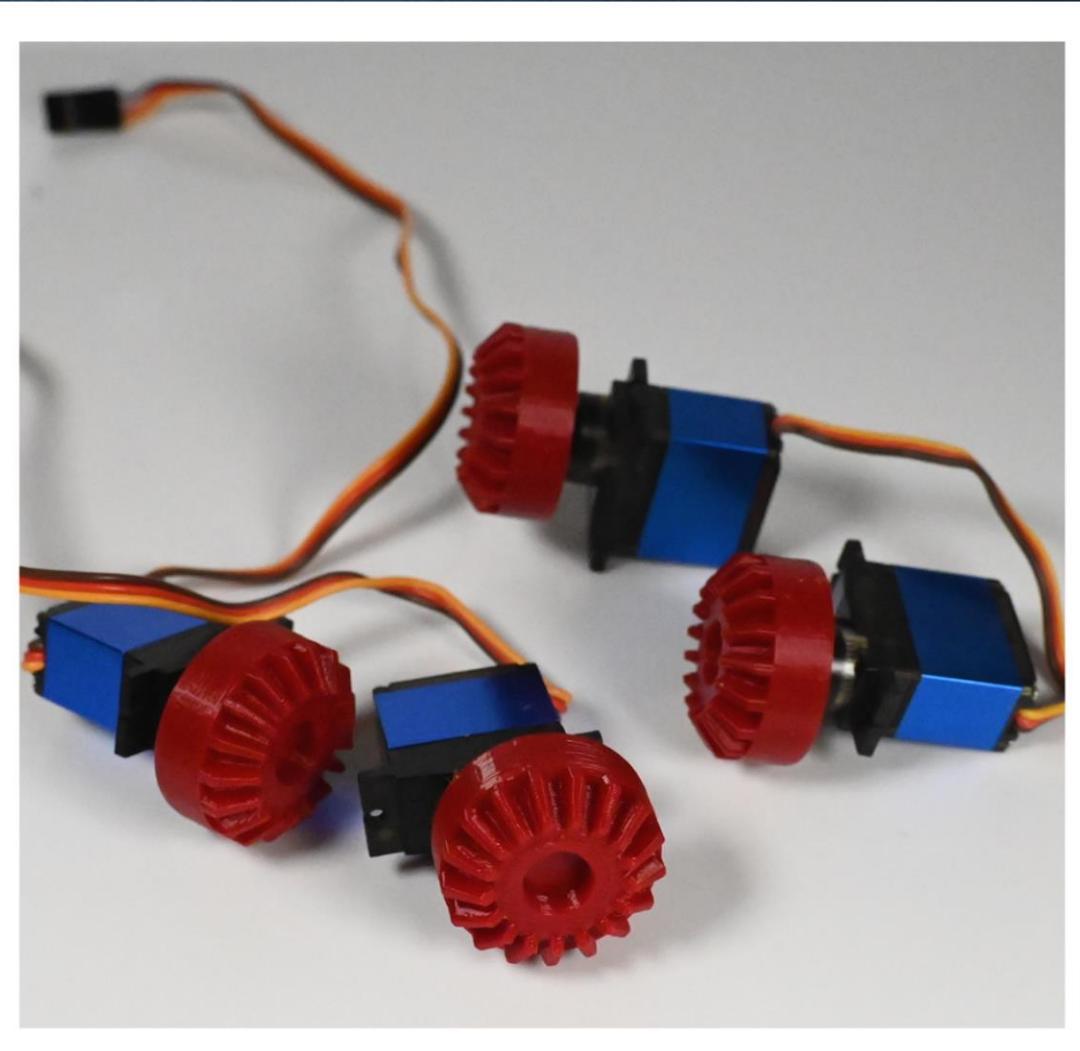
- Parts:
- MG92B Servo Assembly
- 2 M3x8mm Set Screw

Screw the set screws into the bevel gears. Just screw enough to thread into the square nut. Do not screw into the servo horn just yet.



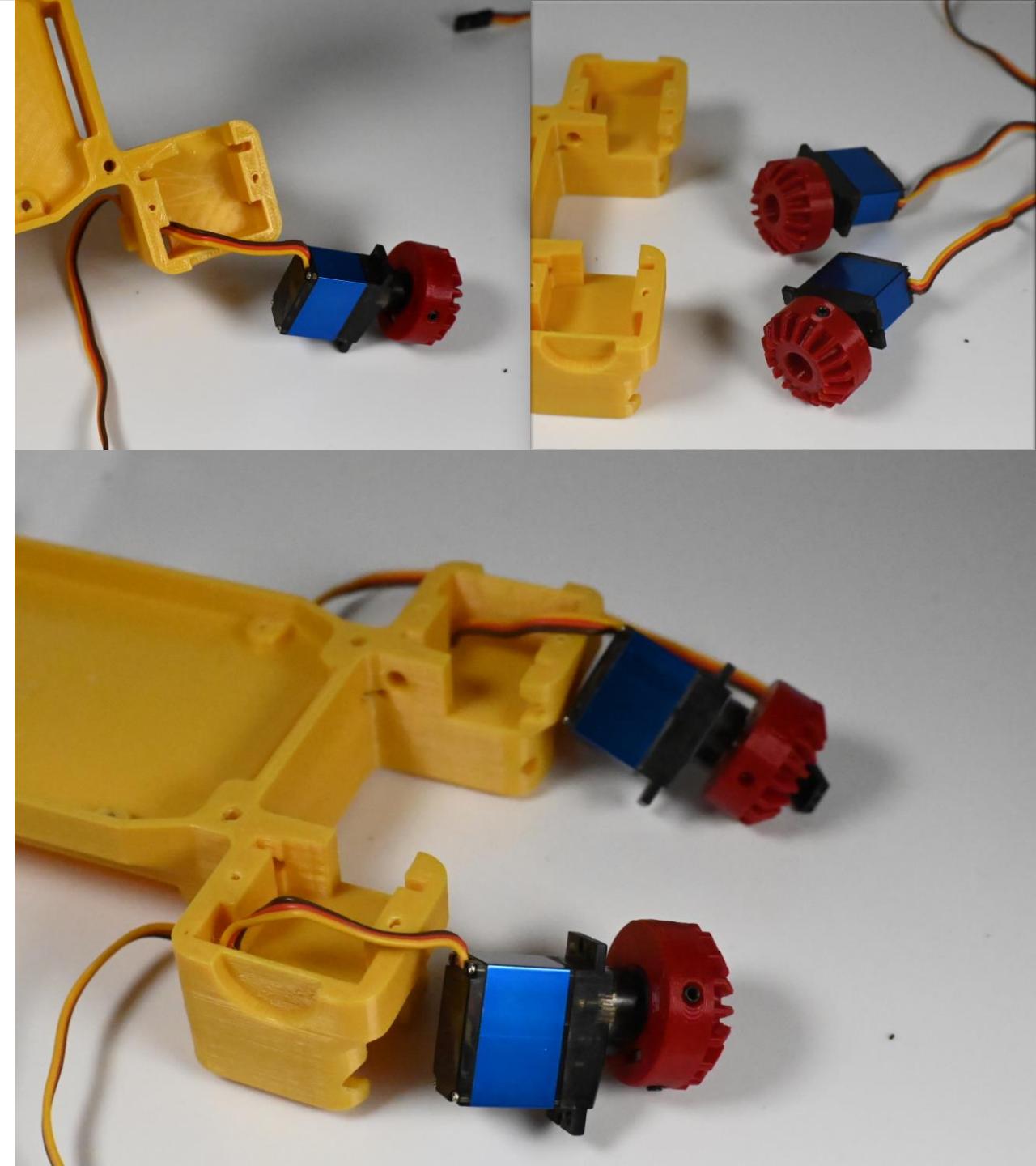
STEP 23

Repeat steps 24-26 3 more times for a total of 4 bevel gear assemblies. Put these aside for just a moment.



STEP 24

- Parts:
 - Smallkat Body
 - x2 Bevel Gear Assemblies
- Feed the wires of the servos into the holes in the body on the side with the rectangular hole without the indent on the inside of the body.

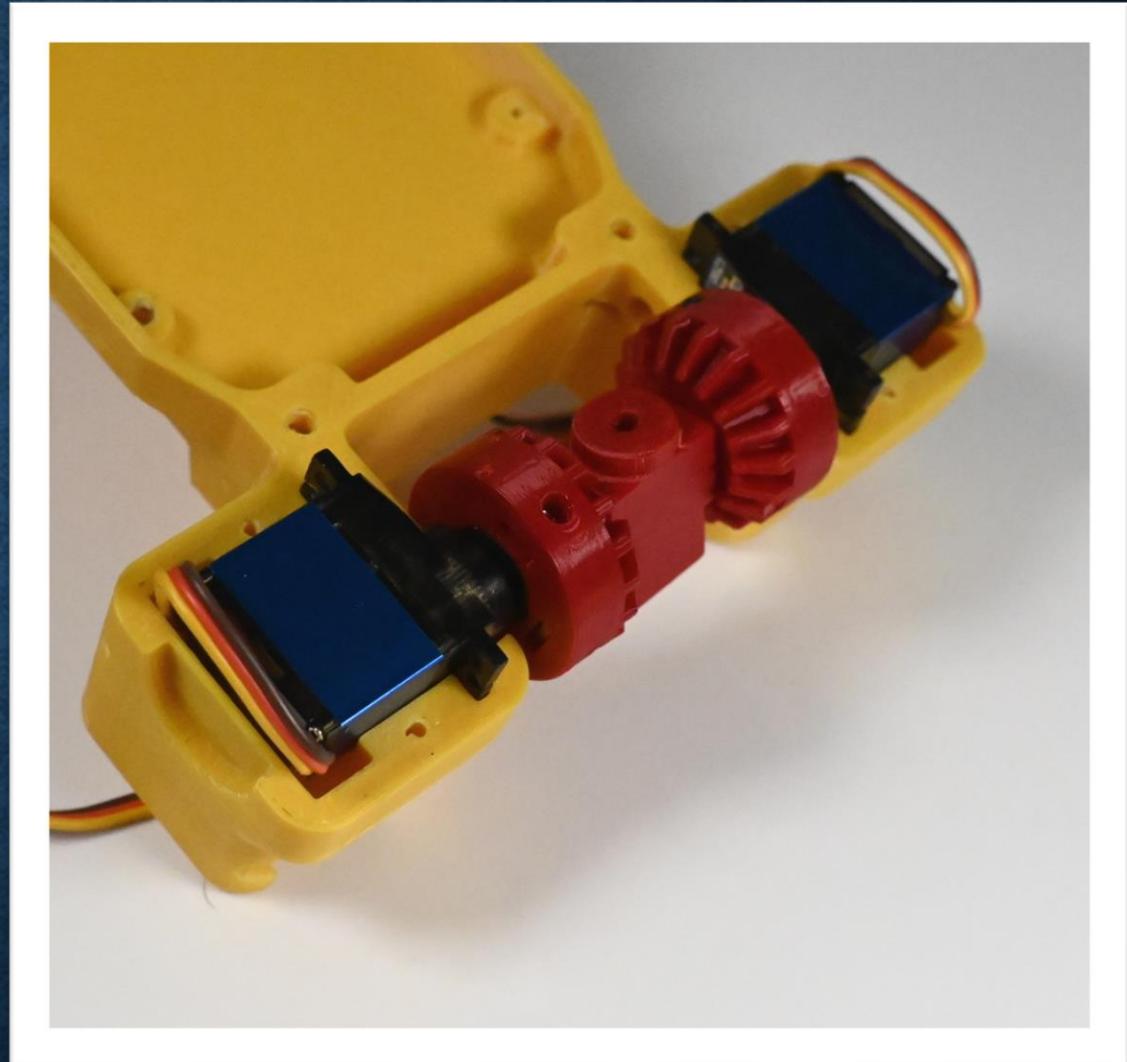


STEP 25

Parts:

- Smallkat Body
- Wrist center

Insert the wrist center in between the two bevel gears. The sides of the wrist center should fit inside the recesses of the bevel gears. Orient the whole assembly over the servo housings. The wires should not be under the servo.

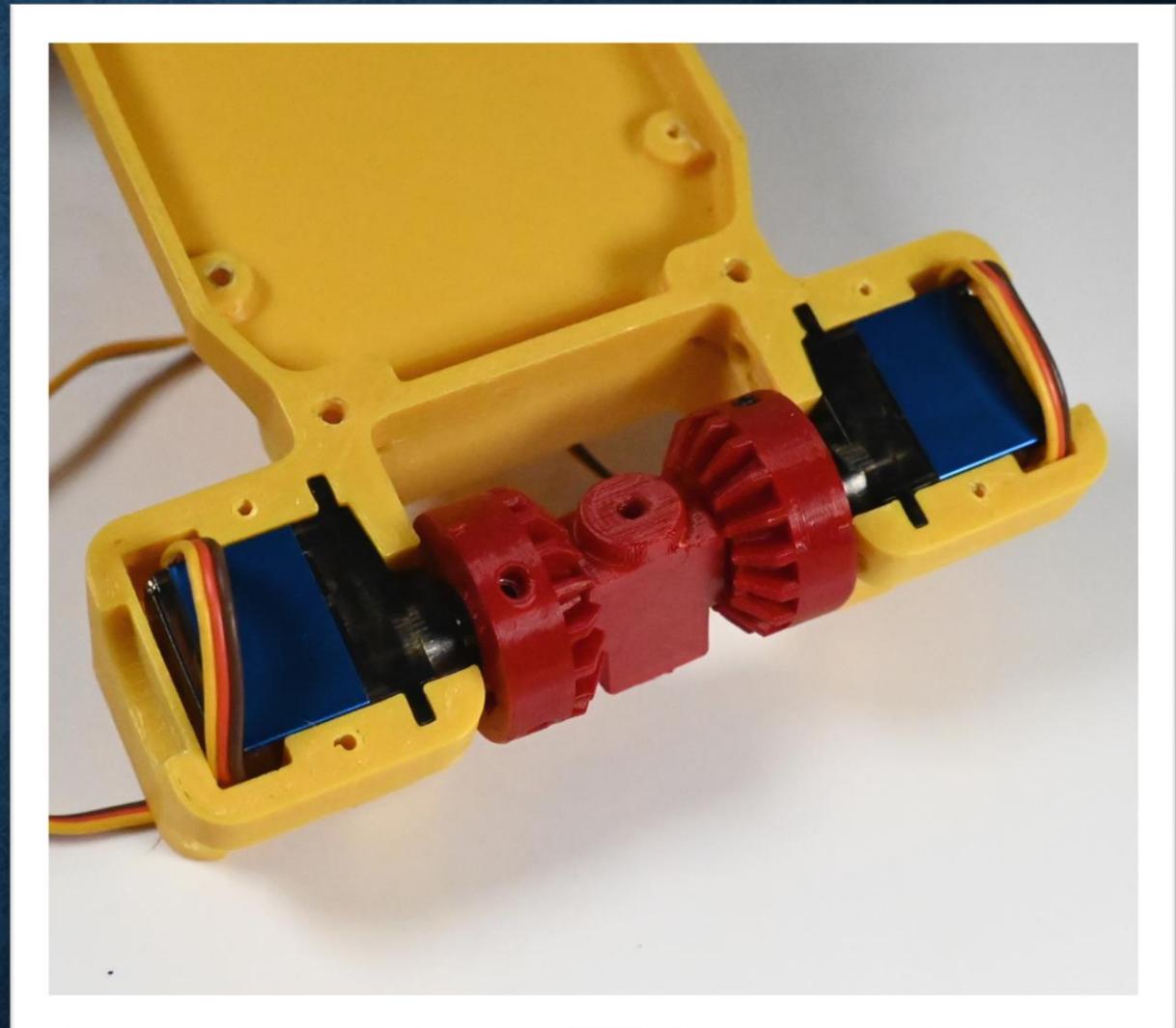


STEP 26

Parts:

- Smallkat Body

Carefully Press both servos into place. Careful not to pinch the wires while doing so. The servos should both slip into place at the same time. If you are struggling try pressing either side in a bit at a time. Make sure not to pinch the wires and that the wrist center doesn't fall out.

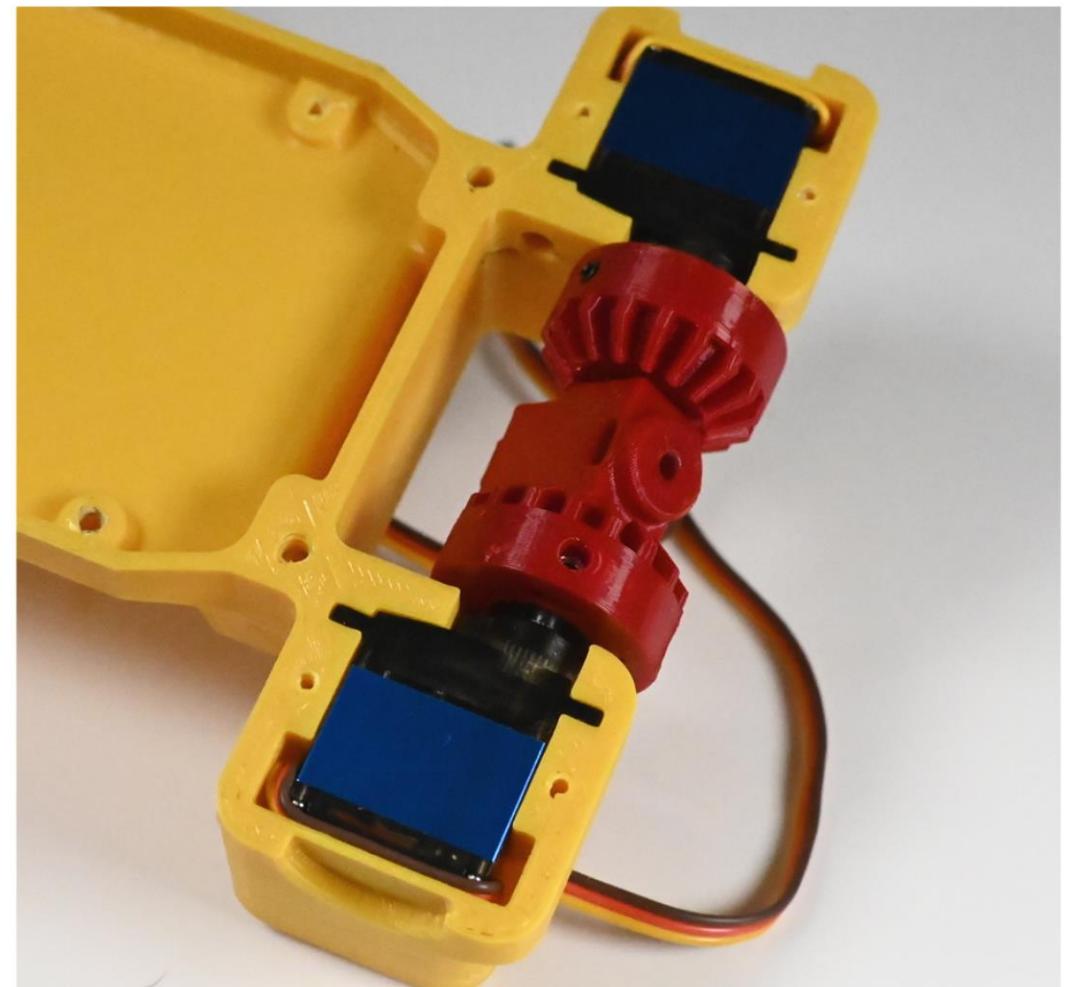


STEP 27

Parts:

- Smallkat Body

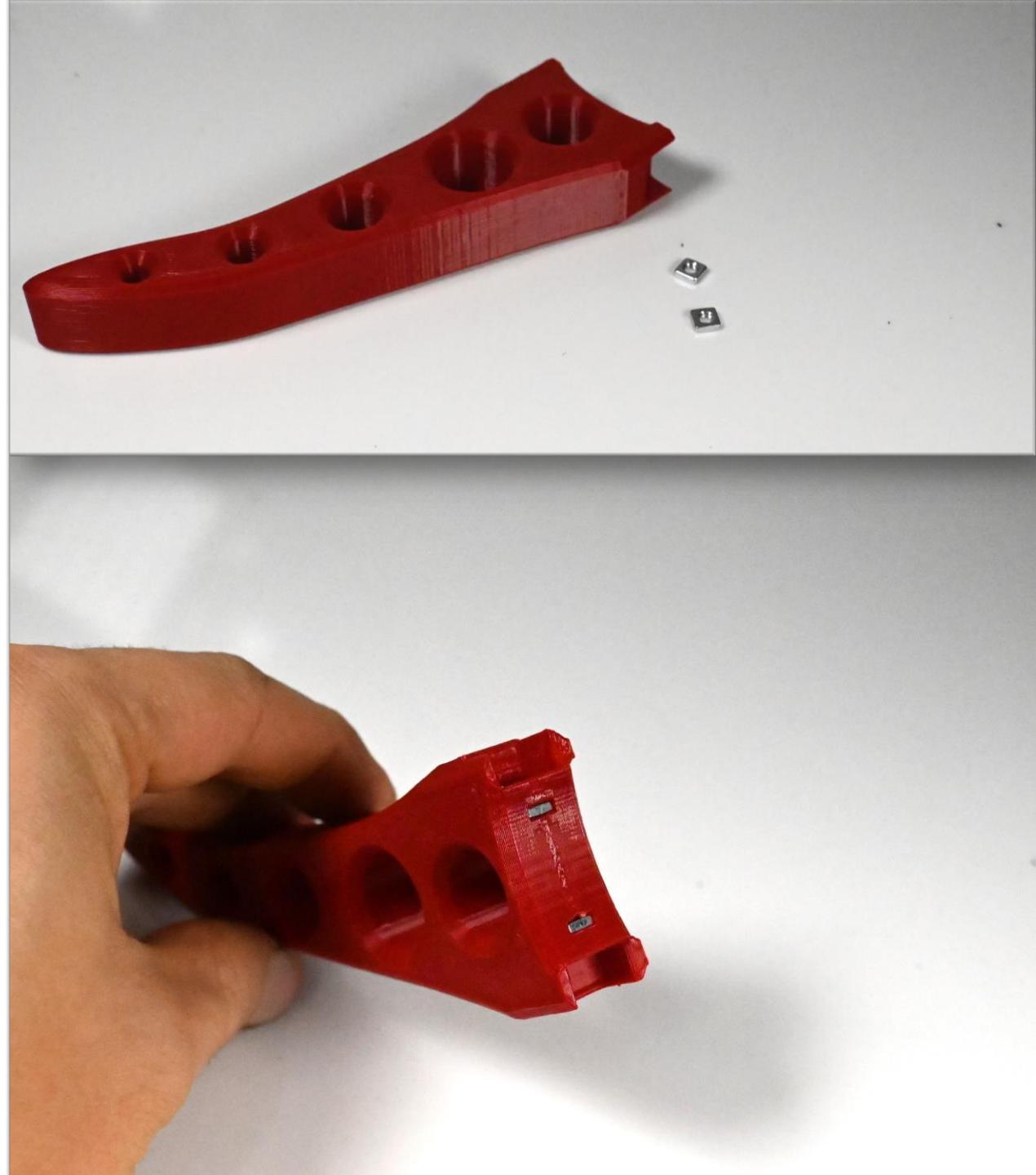
Press the wires in between the servo and plastic housing.



STEP 28

- Parts:
- Tail
- x2 M3 Square Nut

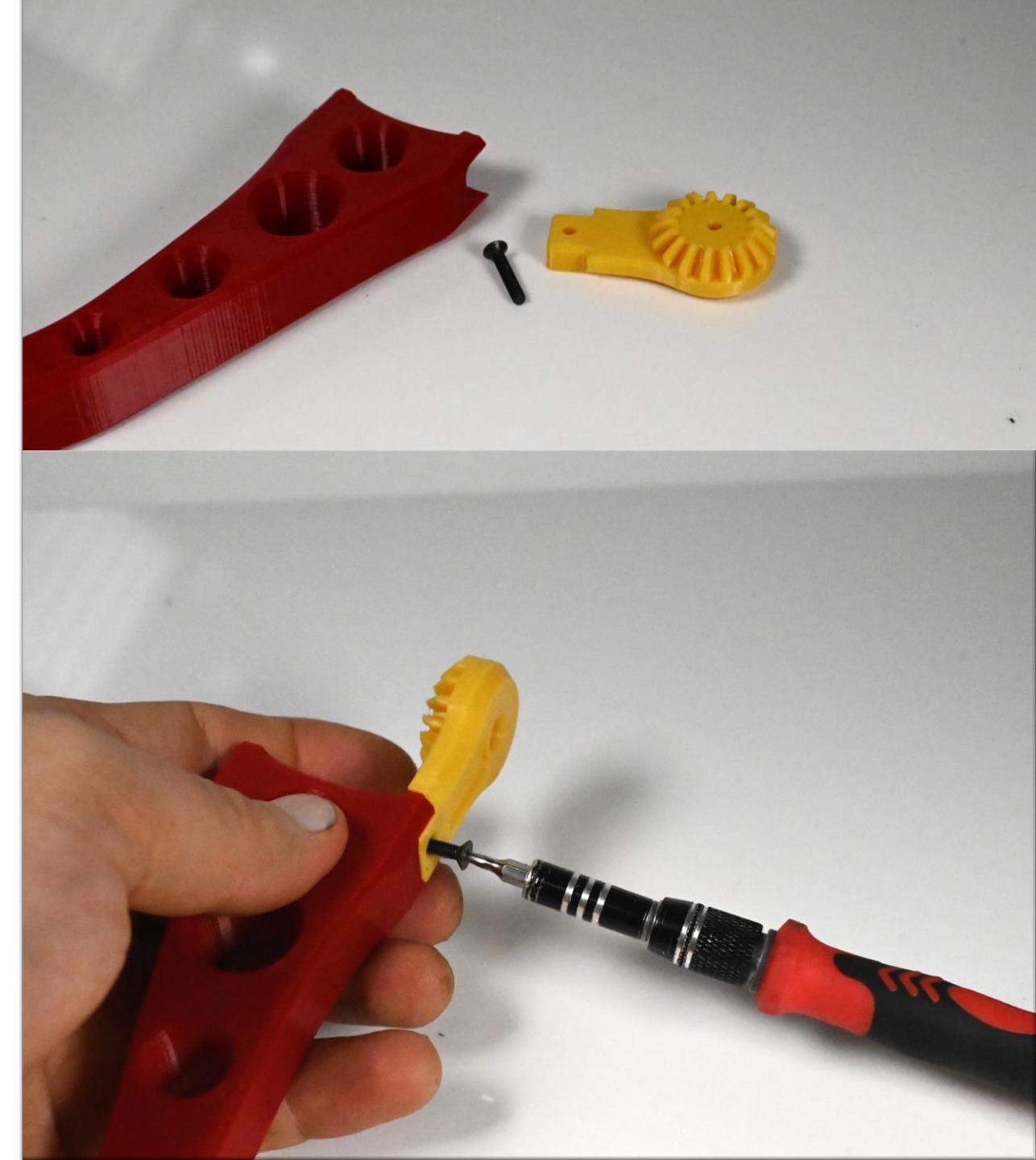
Press the square nuts into the two slots in the tail.



STEP 29

- Parts:
- Tail
- Bevel Gear Link
- x1 M3x16mm Bolt

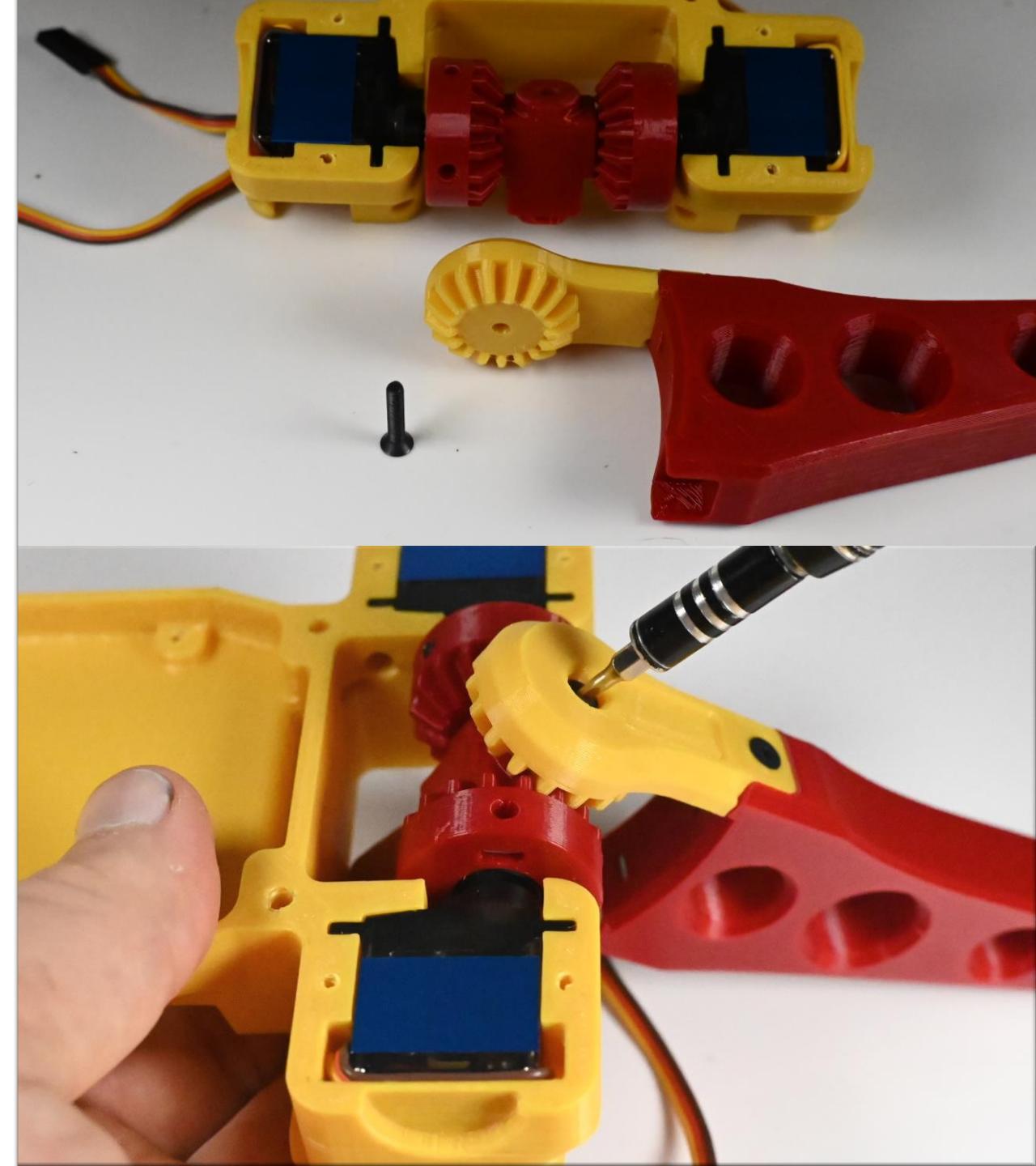
Screw the bevel gear into the top of the tail. The top is the side that curves up. Set this assembly aside for a moment.



STEP 30

- Parts:
- Smallkat Body
- Tail Assembly
- x1 M3x16mm Bolt

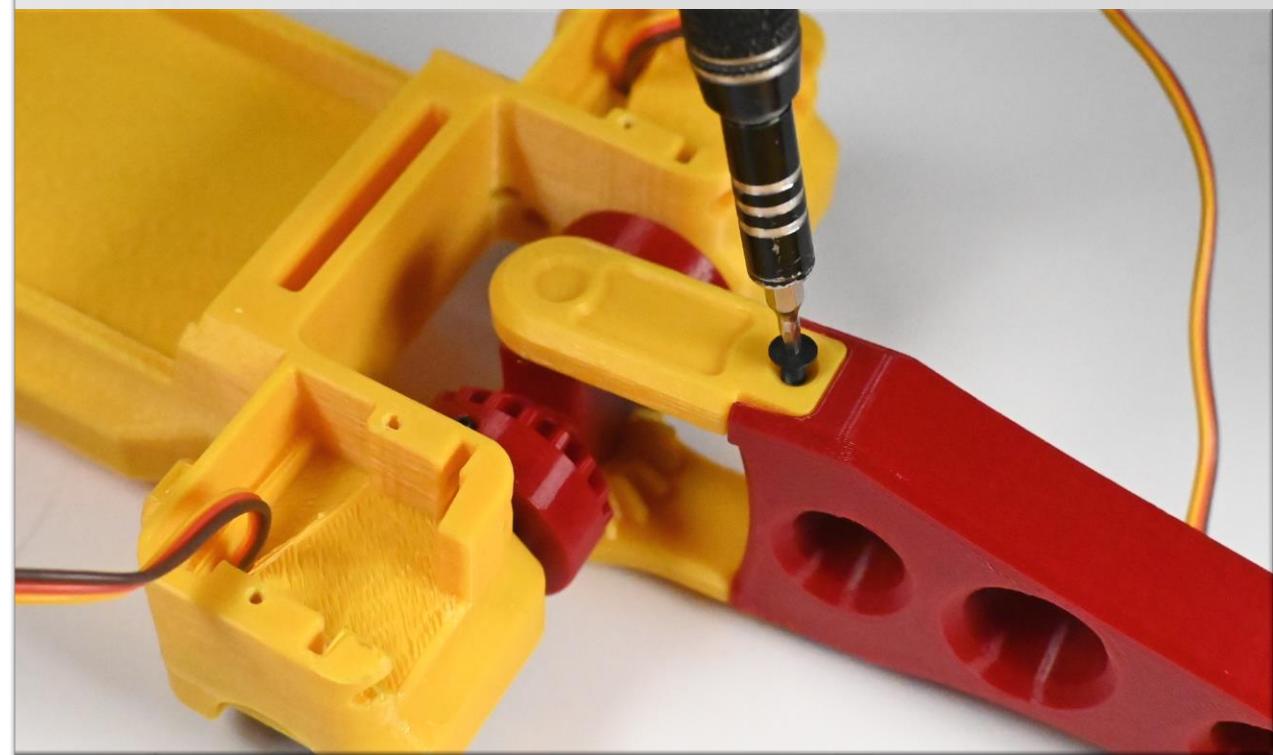
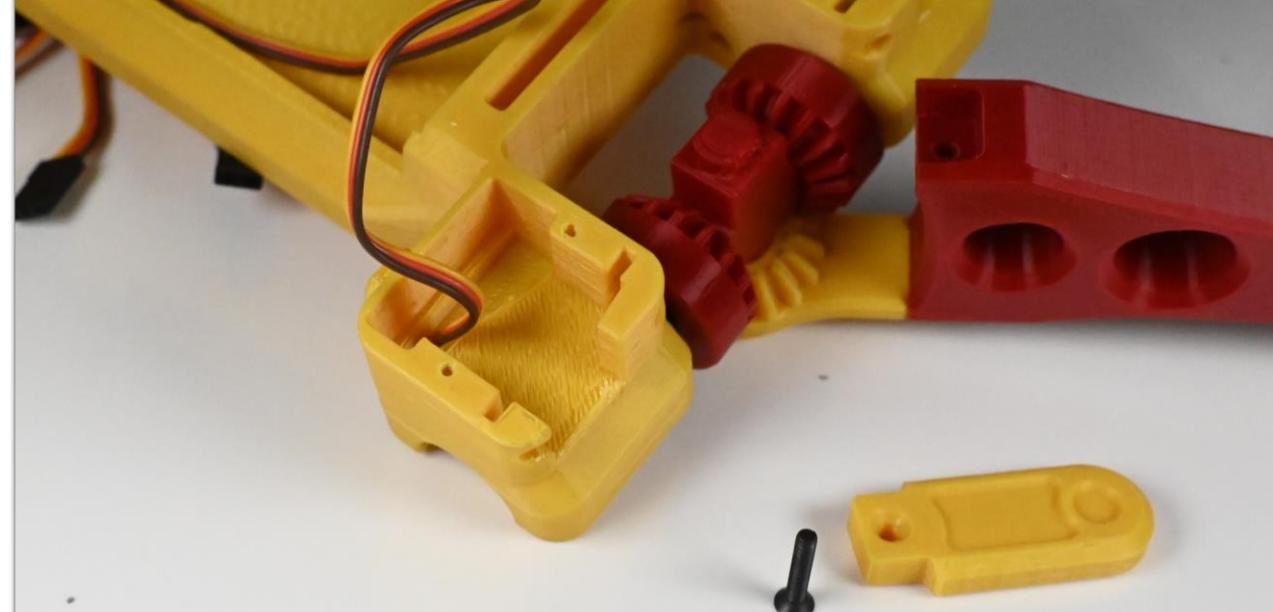
Screw the tail assembly into the wrist center. Do not overtighten this bolt the tail should be free to move freely.



STEP 31

- Parts:
- Smallkat Body
- Idle Link 2
- x1 M3x16mm Bolt

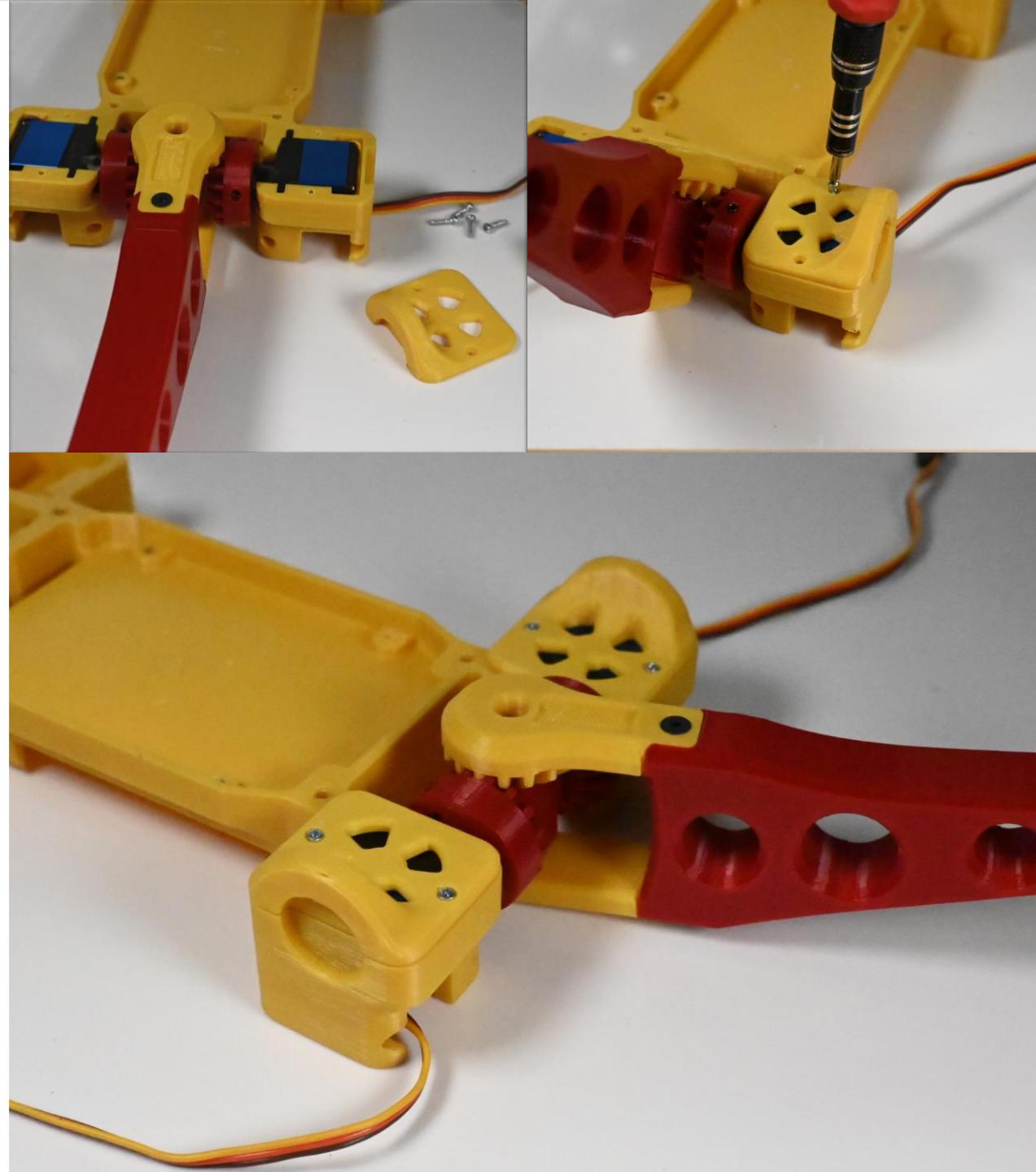
Flip the body over and screw the idle link into the tail using the M3x16mm bolt.



STEP 32

- Parts:
 - Smallkat Servo Body Covers Top
 - x2 M2x8mm Screws

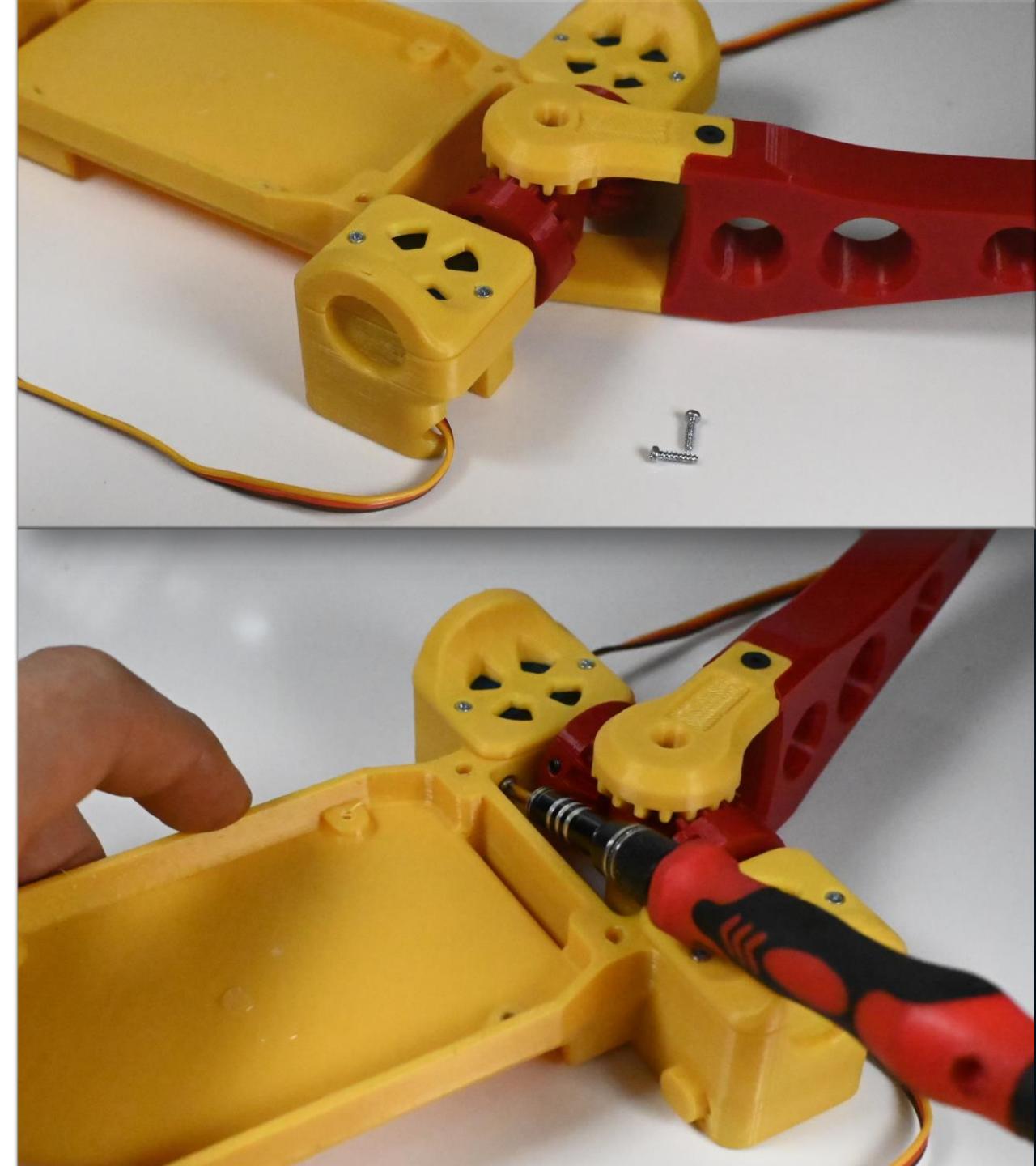
Screw the servo covers onto the body with the M2x8mm screws. Be careful not to overtighten.



STEP 33

- Parts:
- Smallkat Body Assembly
- x2 M2x8mm Screws

Screw the servos into place using the M2x8mm screws. You will only be able to access the most inner servo hole. The screwdriver will be at a slight angle. Be careful not to strip the screw head.



STEP 34

Repeat steps 24-33 with the head.

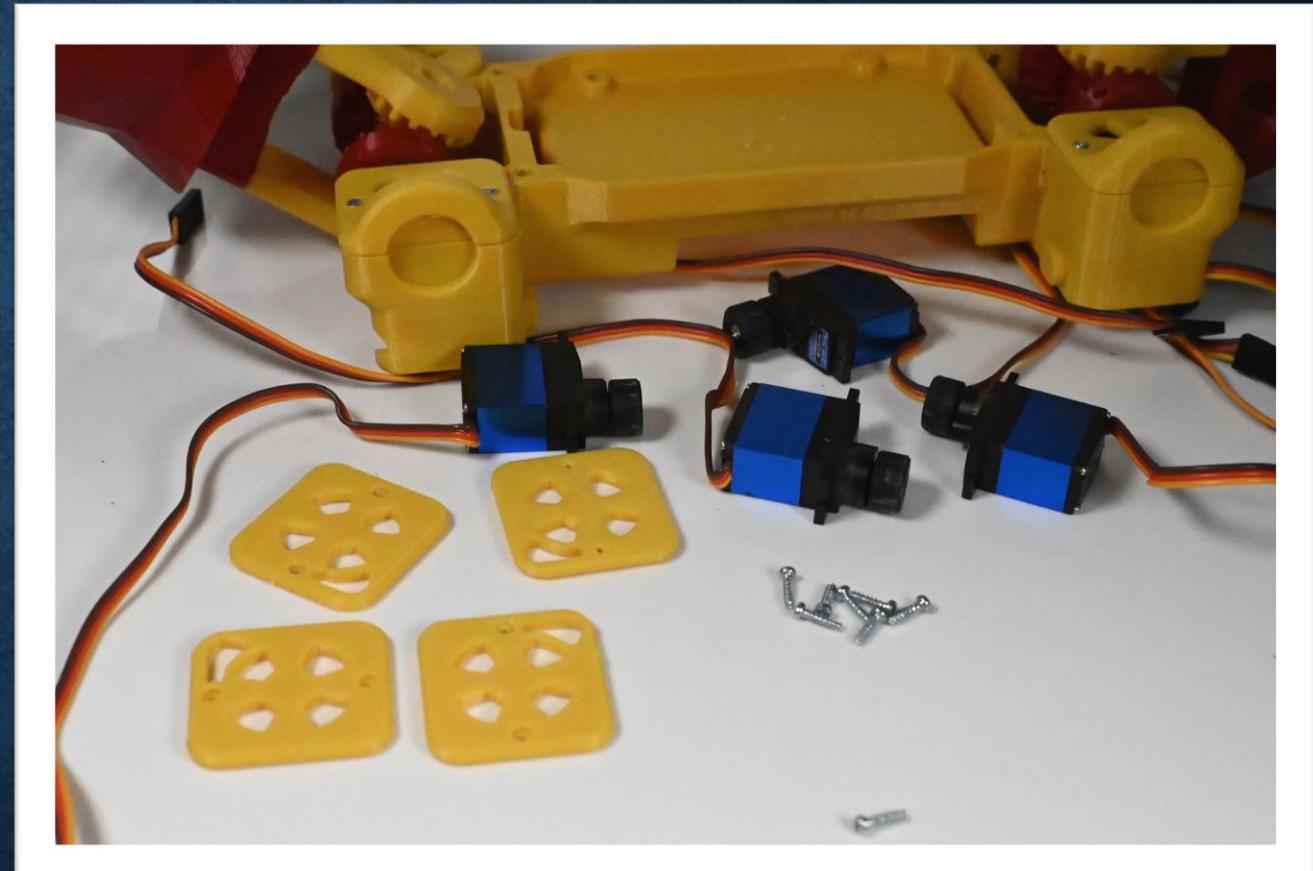


STEP 35

Parts:

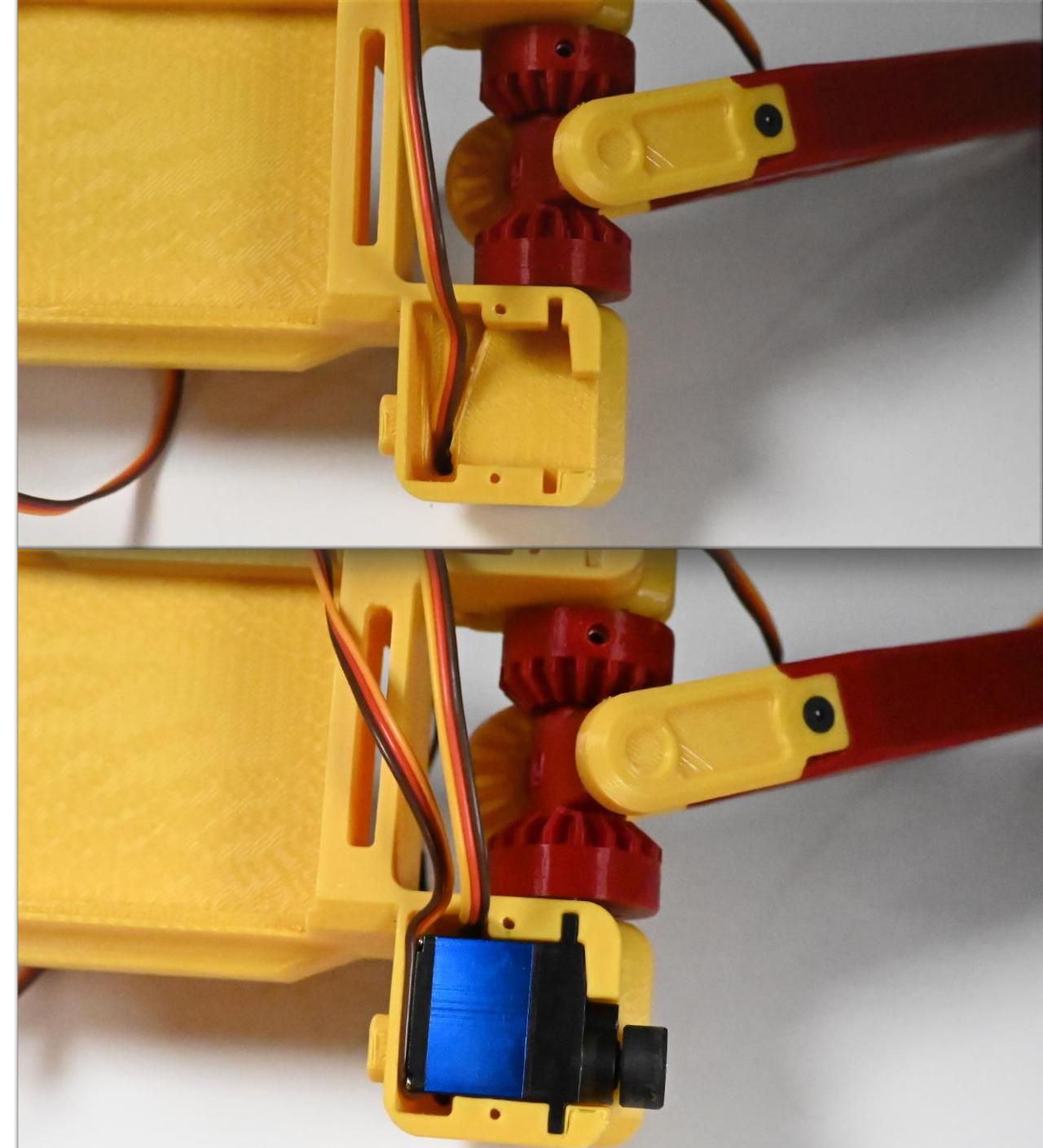
- Smallkat Body Assembly
- x4 MG92B Servo Assemblies
- x4 Body servo covers (2 regular, 2 mirror)
- x8 M2x8mm Screws

Gather all the parts for the next few steps



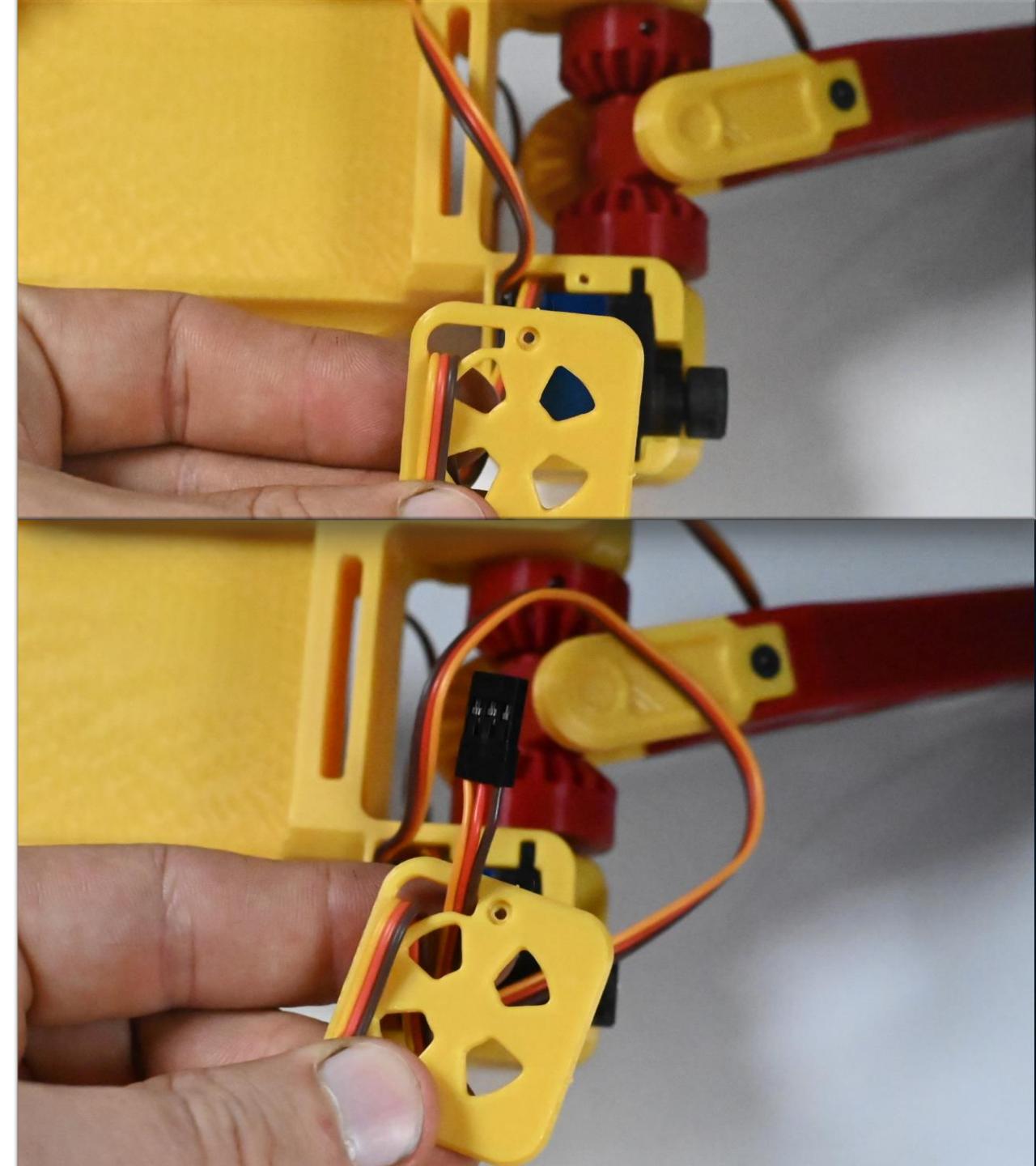
STEP 36

Make sure the bottom of the cat body is facing up. Run the wire from tail servo in the indent of the servo housing. Carefully press the servo assembly into place taking care not to pinch any wires. The servo wires will run behind the servo in between the plastic and the servo.



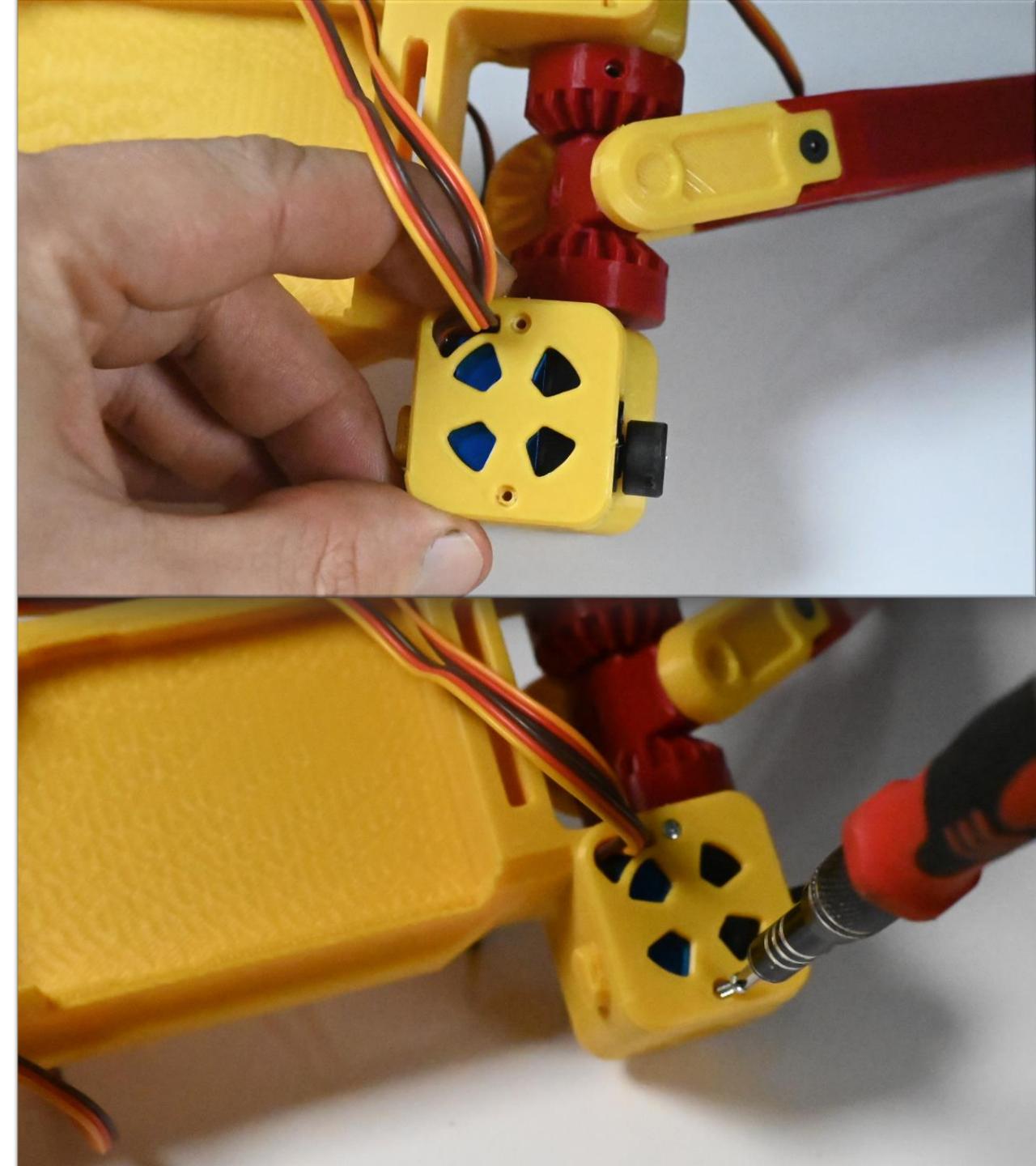
STEP 37

Make sure to grab the correct servo cover. The hole in the corner should face towards the inside center of the robot with the hole countersink facing up. Insert one of the wires through the hole and tuck it into the corner. Insert the second wire through the hole after.



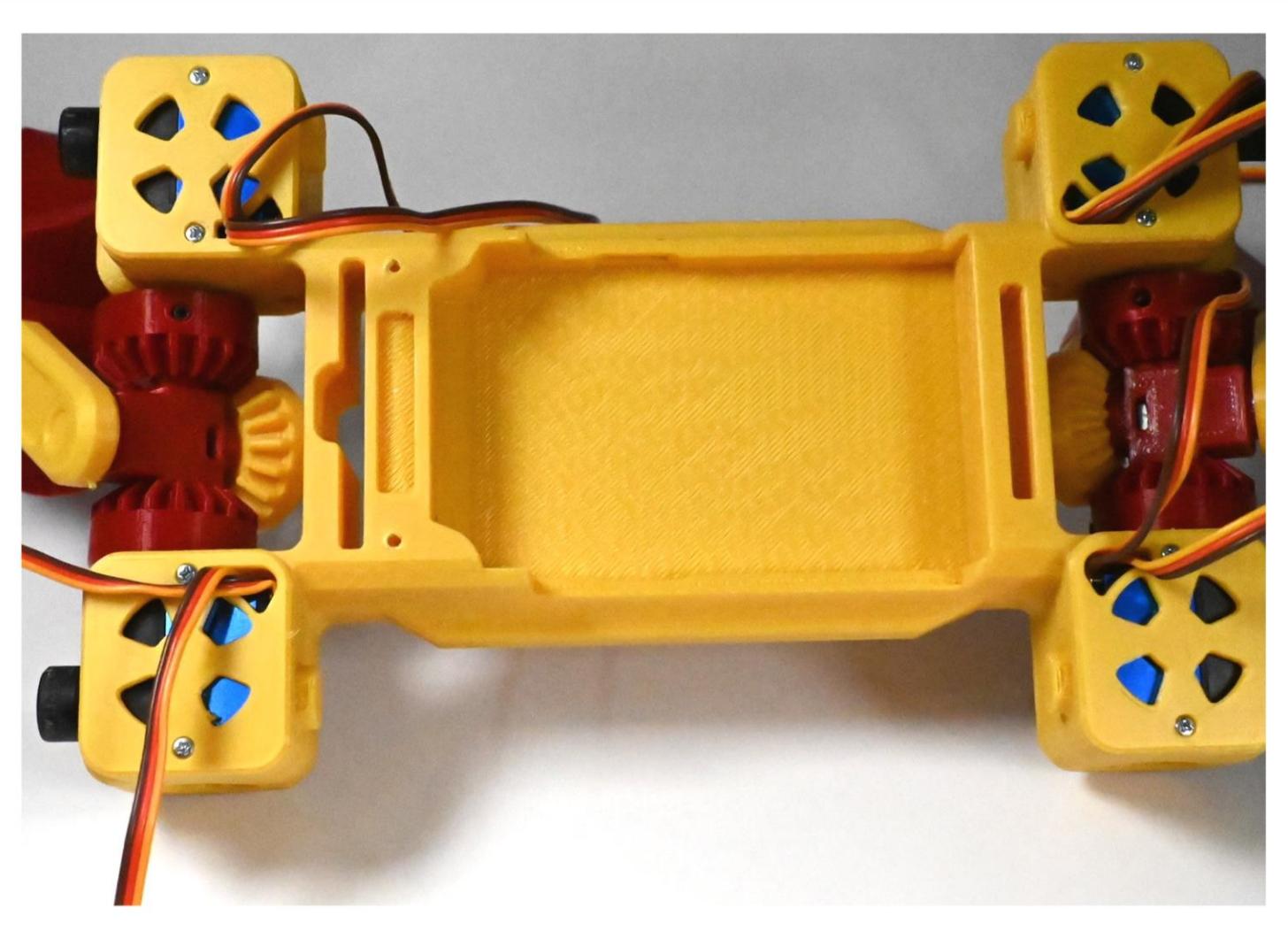
STEP 38

Slide the servo cover into place and screw into place with 2 M2x8mm screws. Be careful not to overtighten them



STEP 39

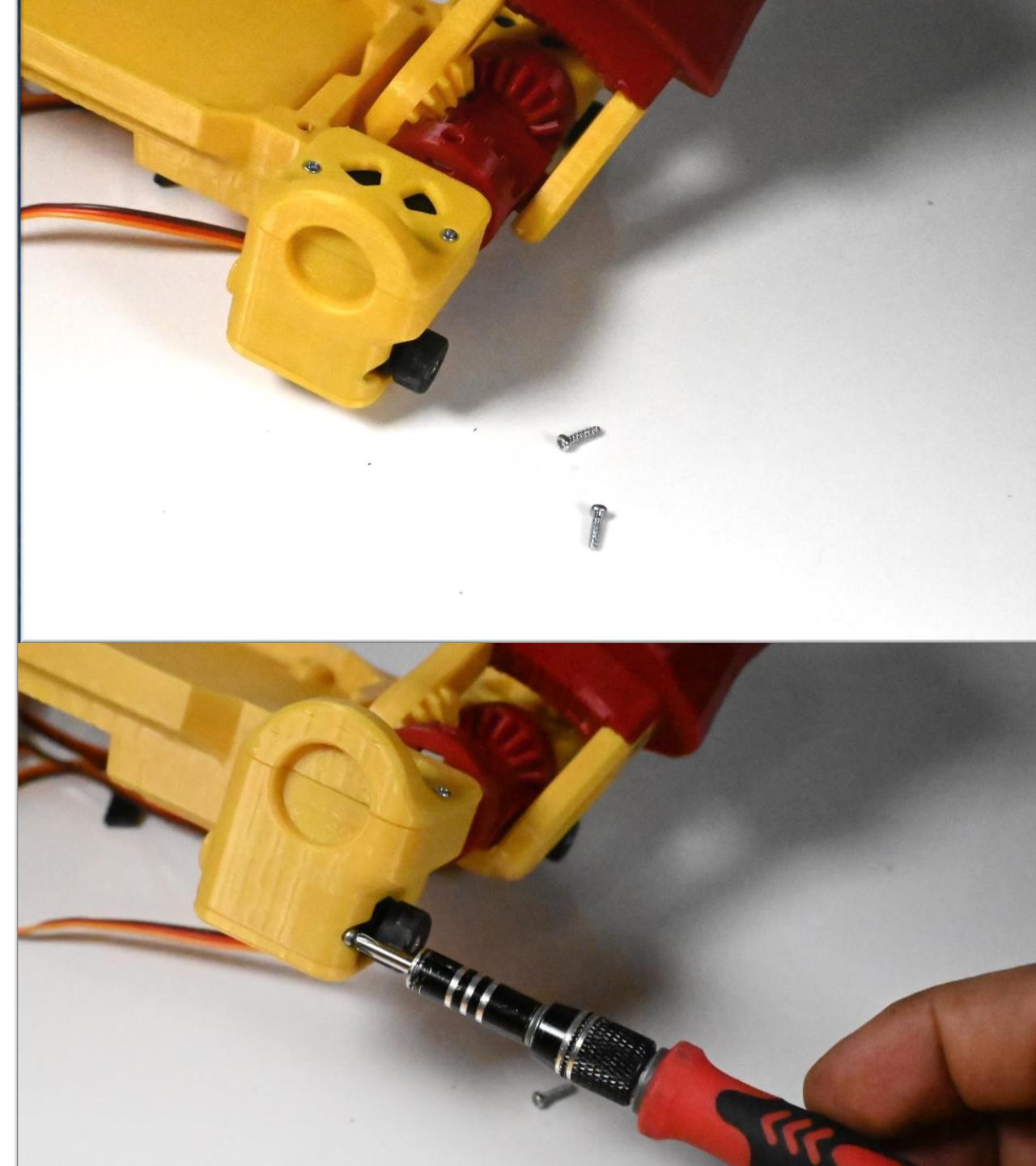
Repeat steps 38-40 for all 4 corners.



STEP 40

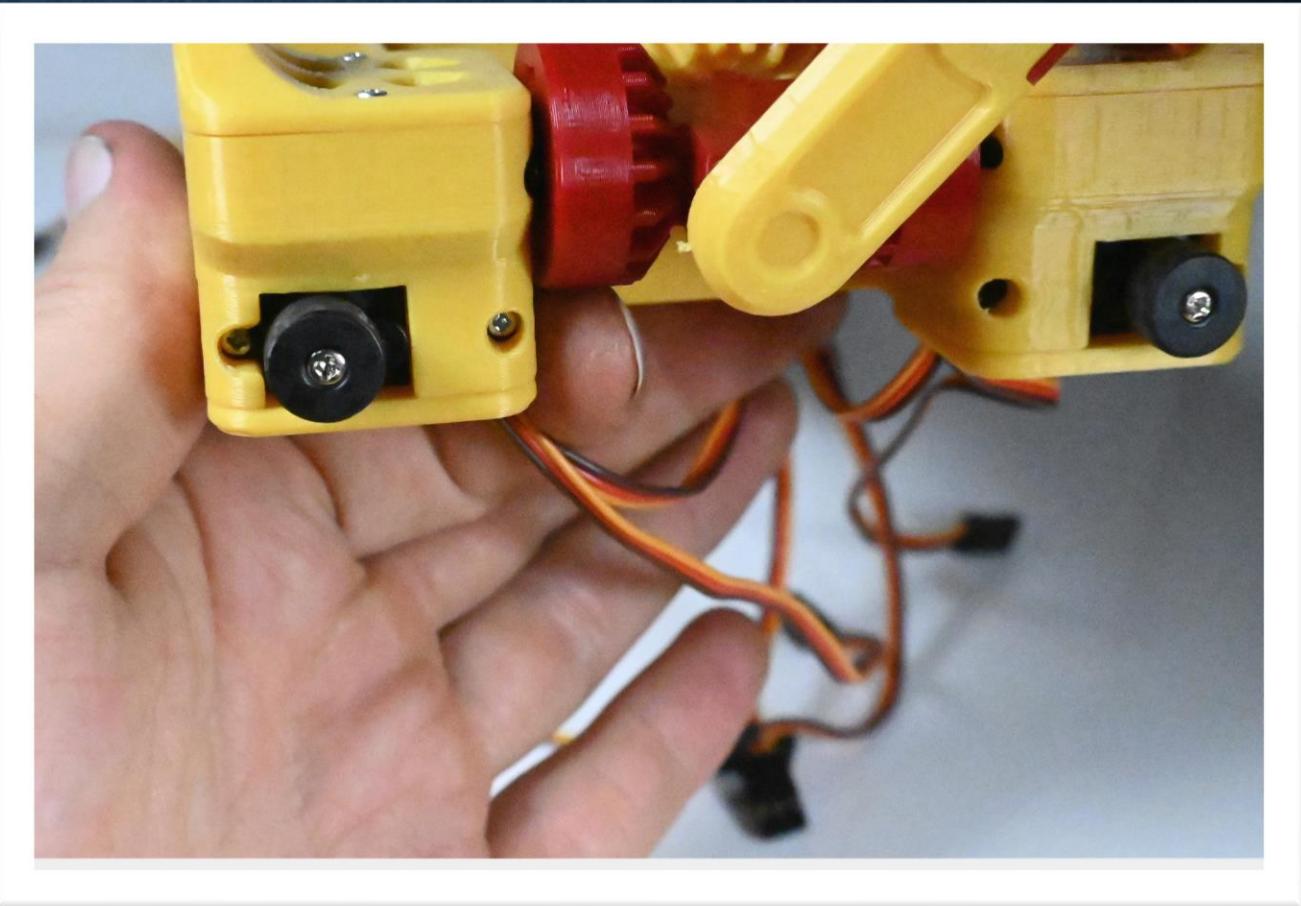
- Parts:
- Smallkat Body Assembly
- x2 M2x8mm Screws

Using the M2x8mm screws secure the shoulder servos into place. Be careful not to overtighten



STEP 41

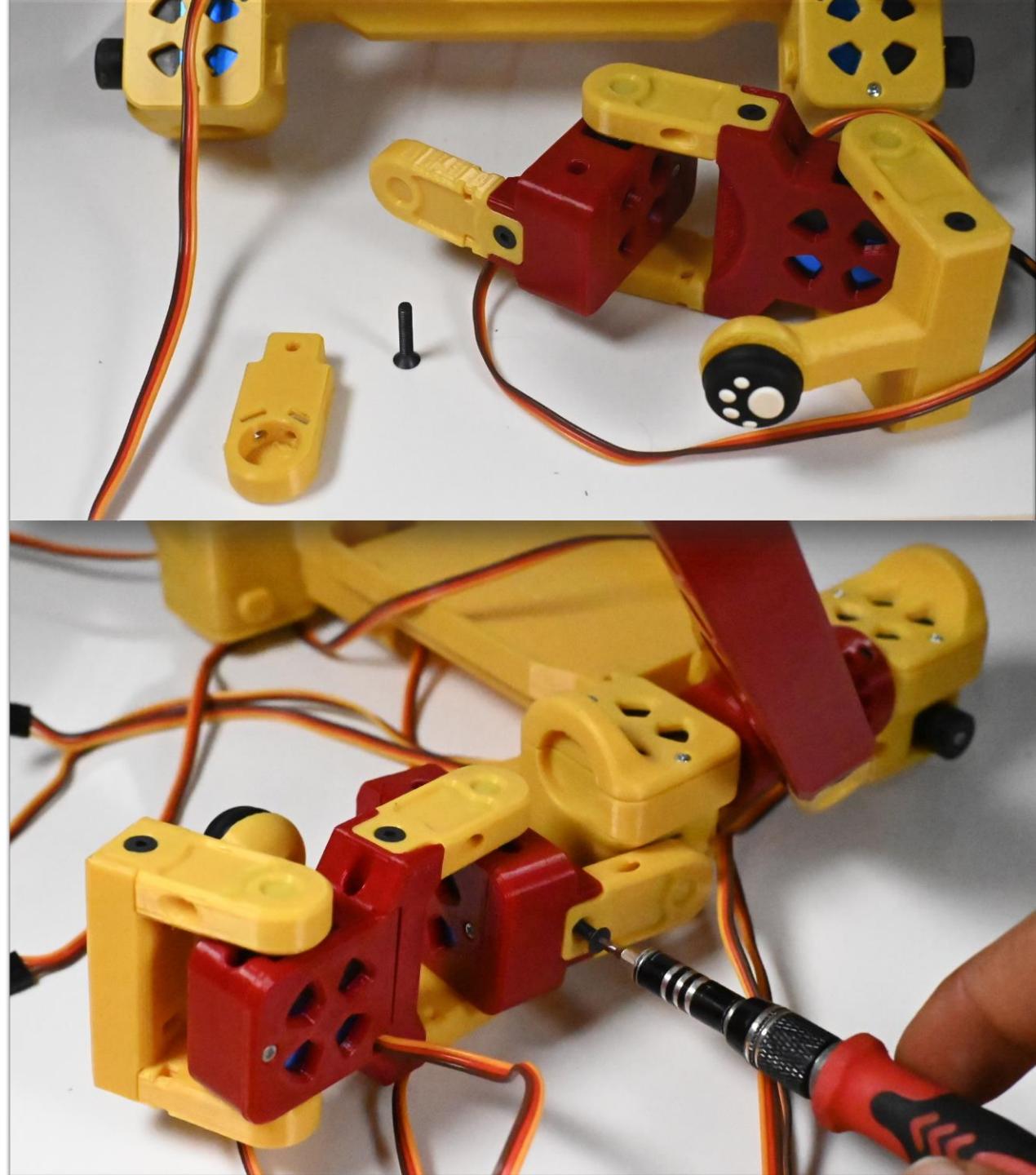
Repeat step 42 for each corner.



STEP 42

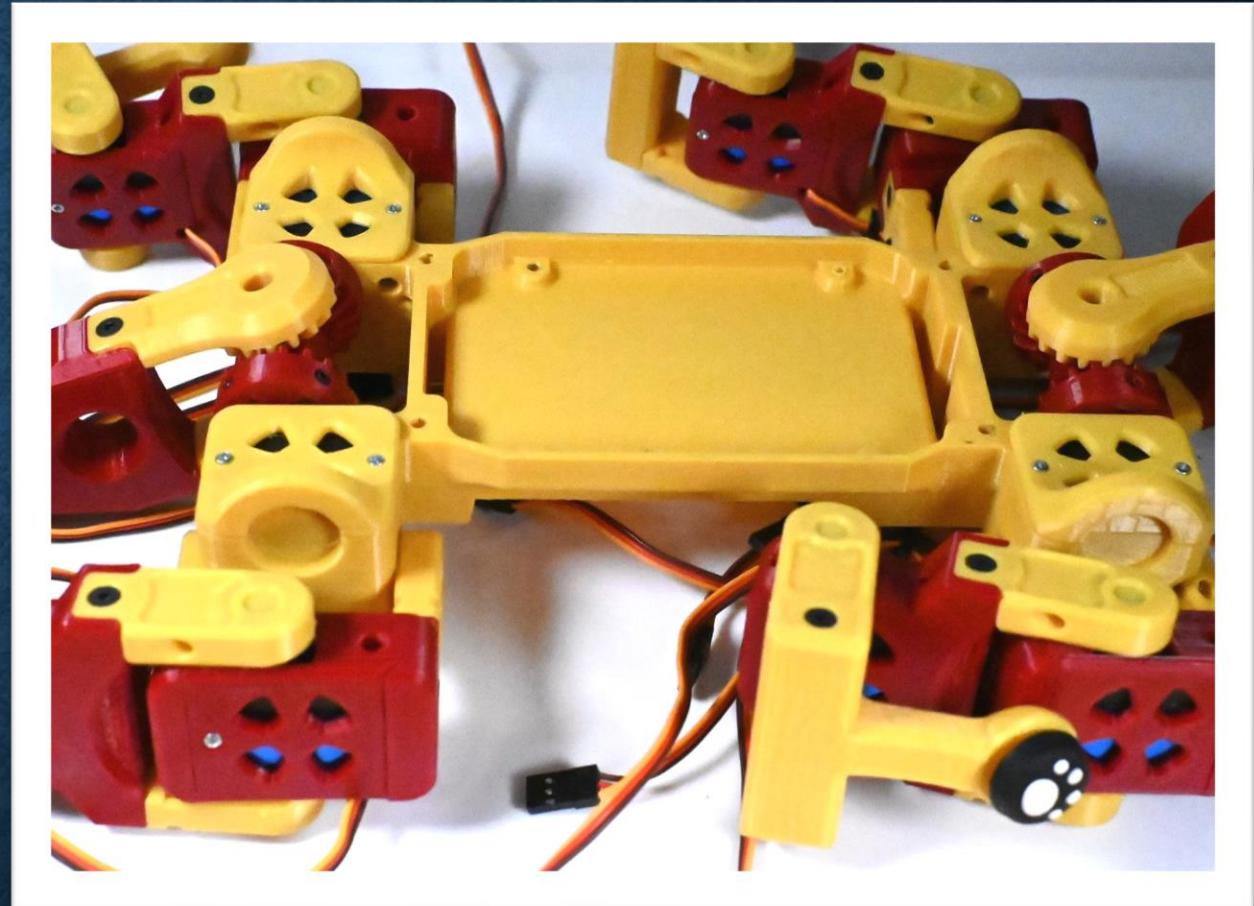
- Parts:
 - Smallkat Body Assembly
 - x1 Back Leg Assembly (idle link in front)
 - x1 Calibration Link
 - x1 M3x16mm Bolt

Using the M3x16mm screw secure the leg in place by mounting the idle link on the shoulder and pressing the calibration link over the servo horn. Make sure to use the correct leg assembly. The back legs have the idle links facing the inside of the robot.



STEP 43

Mount the other 3 legs the same way. The front legs will have the idle link on the back of the shoulder again facing the inside of the robot.

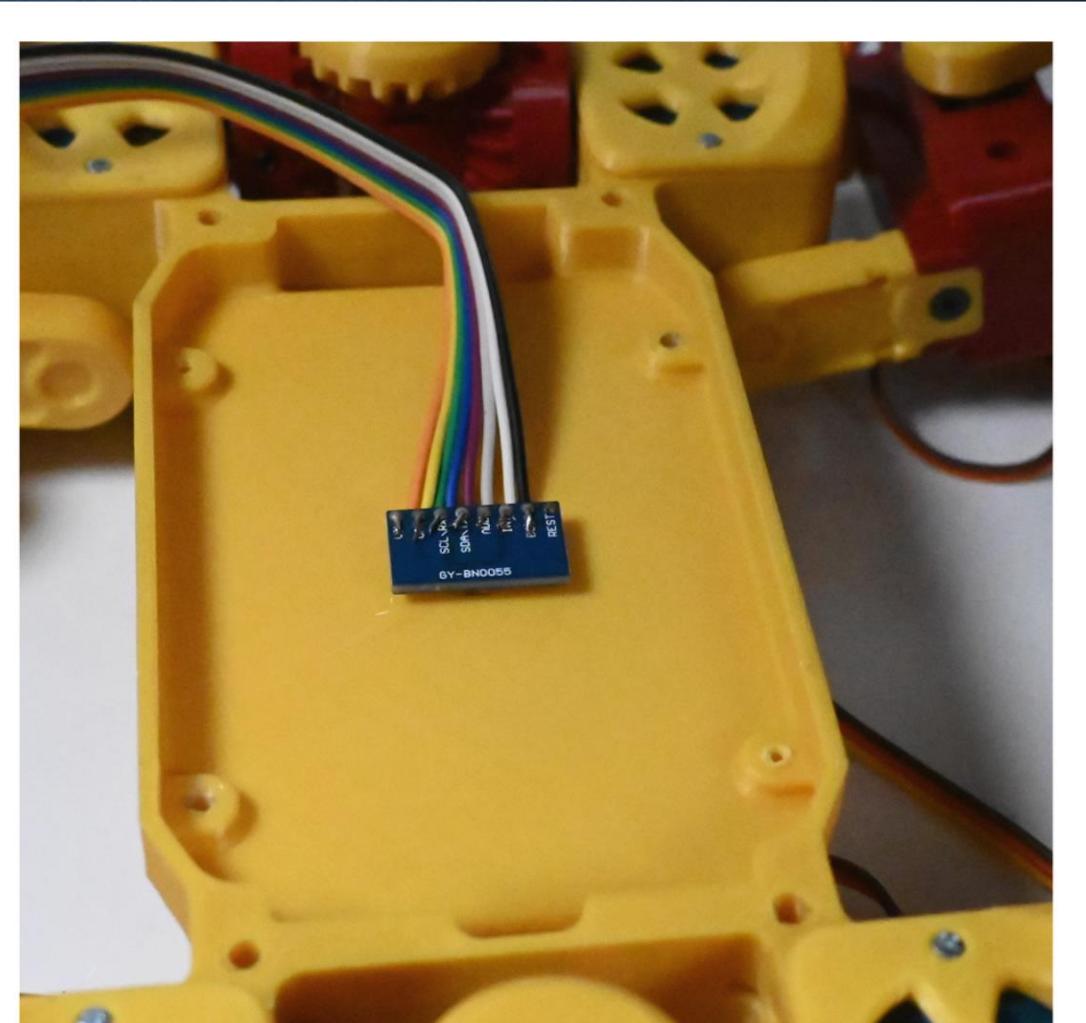


STEP 44

Parts:

- Smallkat Body Assembly
- x1 bno055 IMU

If your IMU is separate from the main board mount it now in the center of the body. A dab of hot glue or double sided tape can help keep the board in place

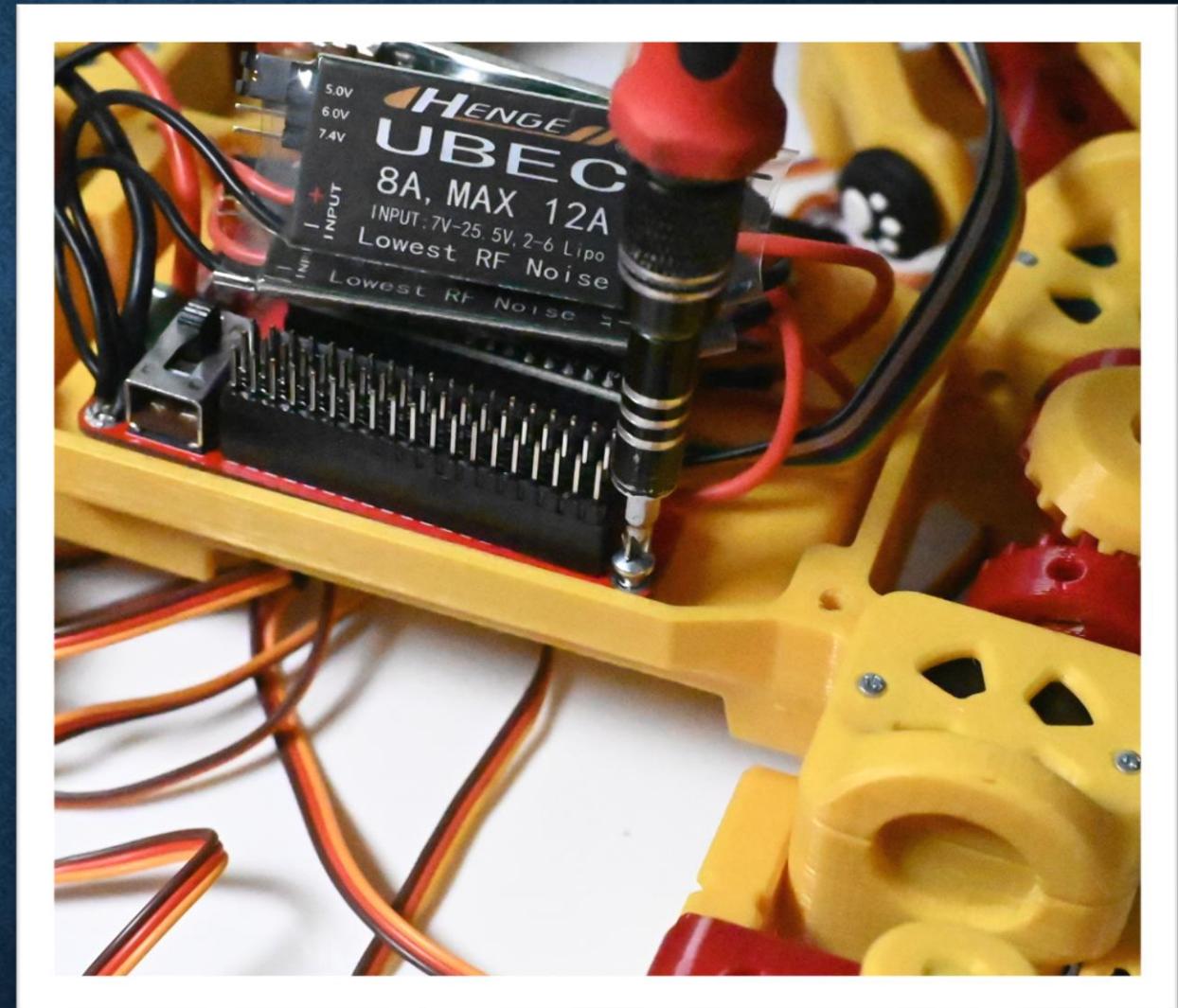


STEP 45

Parts:

- Smallkat Body Assembly
- x1 Motherboard
- x2 M3x6mm Plastic Screw

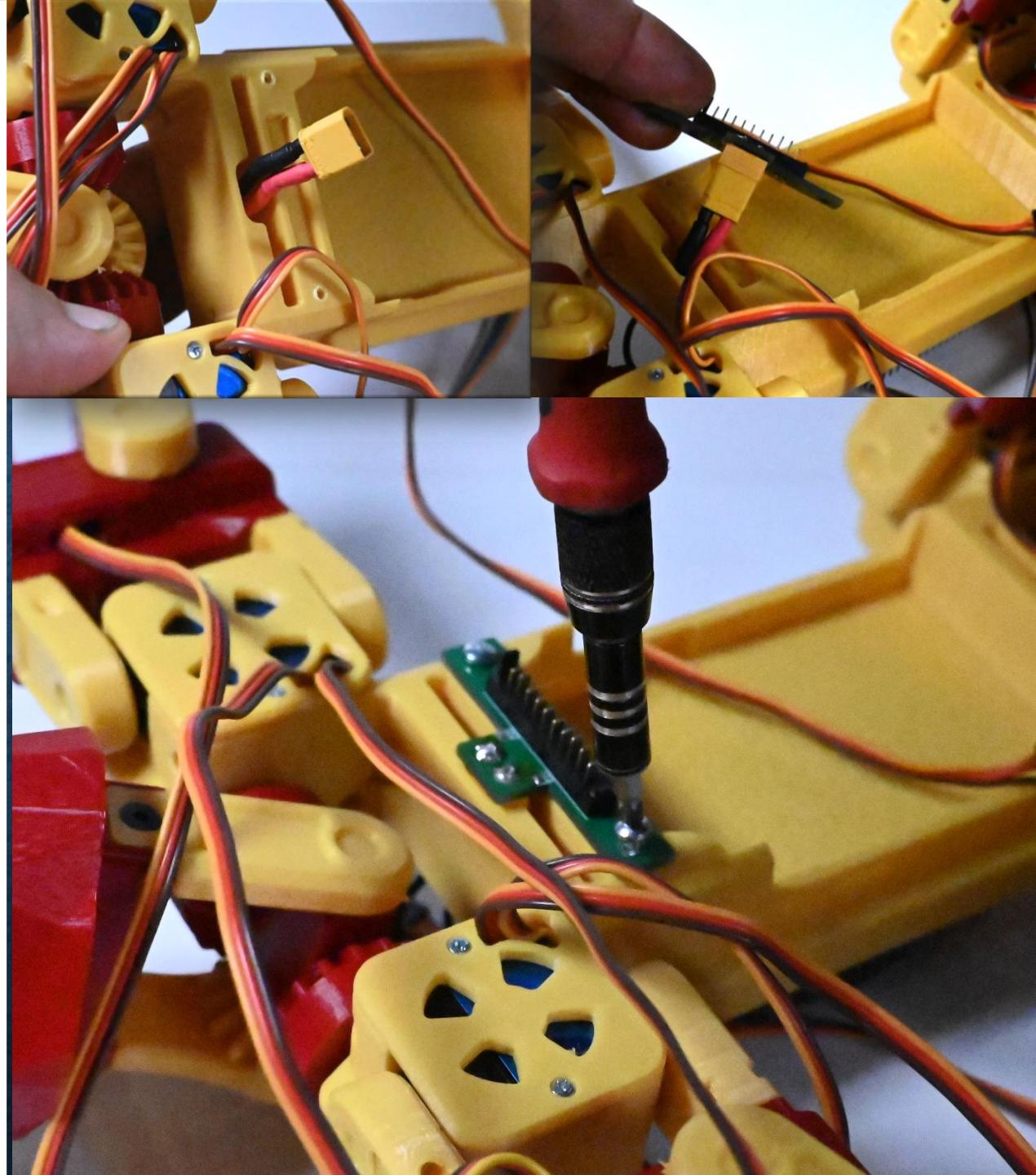
Mount the Mother board to the body using the two rear screw holes. If your motherboard has integrated power regulators you can use all four screw holes.



STEP 46

- Parts:
- Smallkat Body Assembly
- x1 battery board
- x2 M2x8mm Plastic Screw

Feed the xt30 cable through the body. Connect the battery board to the cable. Make sure the battery connection is facing towards the center of the body. Screw the board into place using the two M2x8mm screws.



STEP 47

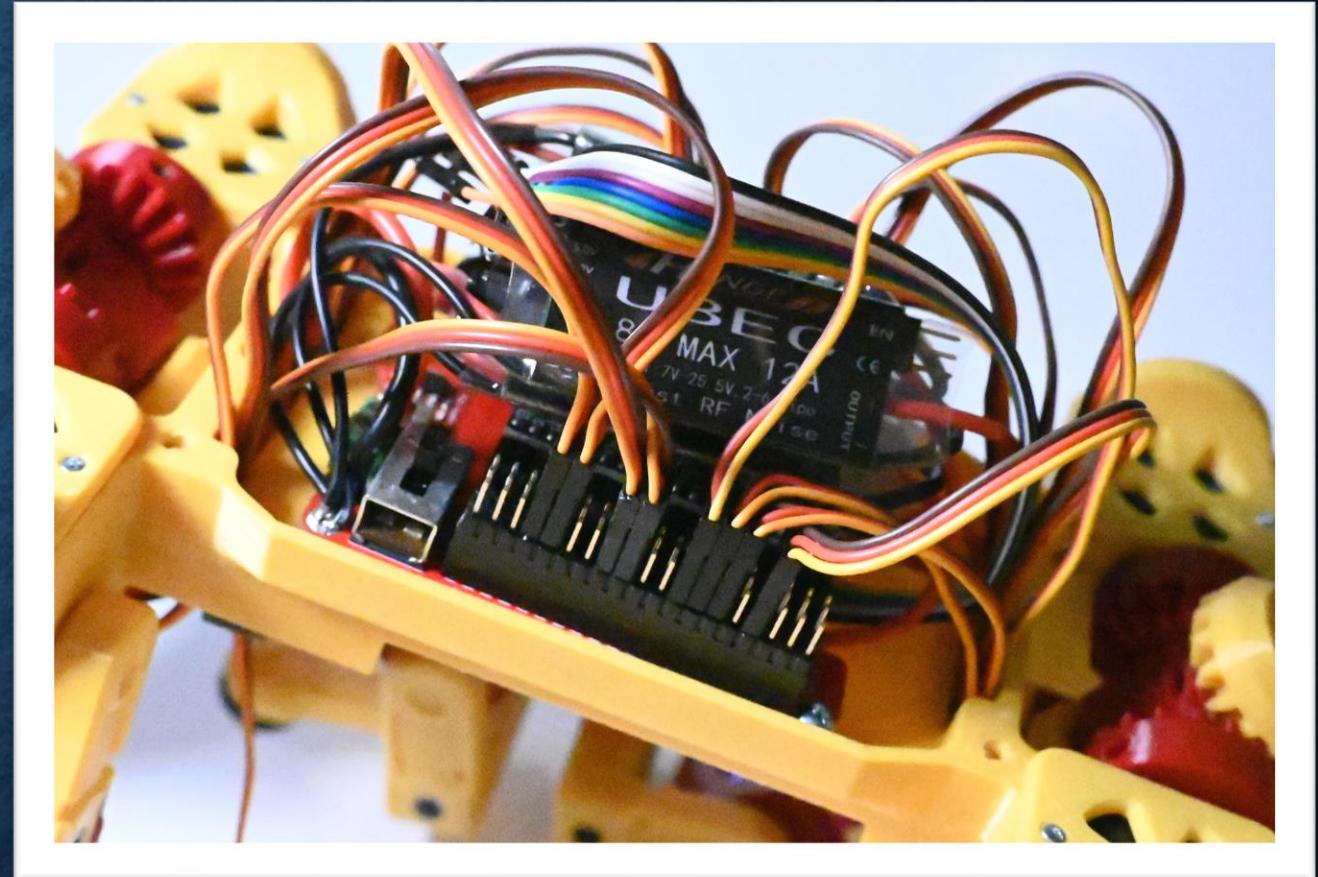
Feed all the servo wires through the slots in the body to the other side of the robot. In the next step we will connect the servos to the motherboard. It may be helpful to skip this step and feed the servos in one at a time to make sure you are connecting the correct servo. Or you can label the wires to make debugging and wire identification easier in the future.



STEP 48

Using the pinout map on the next slide connect the servos to the corresponding pins.

Note: It is not crucial to use the pinout below as you can change this later on. If you choose to use your own pinout make note of where each servo is plugged into.



STEP 48 CONT.

| Servo | Motherboard Pin//Servo Number |
|-------|-------------------------------|
|-------|-------------------------------|

FRONT_RIGHT_NECK 23 //0

FRONT_LEFT_NECK 32 //1

REAR_RIGHT_TAIL 15 //2

REAR_LEFT_TAIL 13 //3

FRONT_RIGHT_SHOULDER_TILT 19 //4

FRONT_RIGHT_SHOULDER_FORWARD_BACKWARD 18 //5

FRONT_RIGHT_ELBOW 5 //6

FRONT_LEFT_SHOULDER_TILT 33 //7

FRONT_LEFT_SHOULDER_FORWARD_BACKWARD 25 //8

FRONT_LEFT_ELBOW 26 //9

REAR_RIGHT_SHOULDER_TILT 2 //10

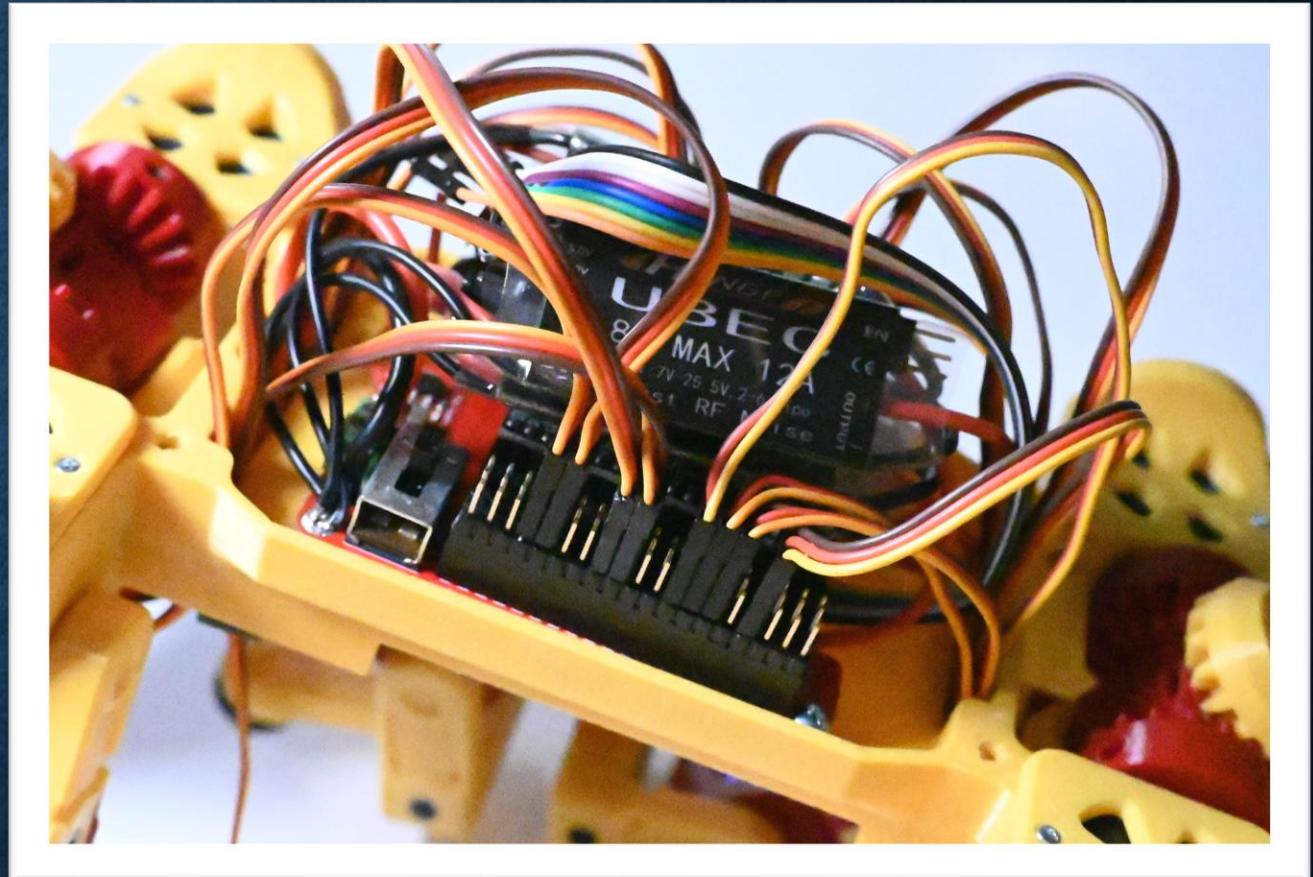
REAR_RIGHT_SHOULDER_FORWARD_BACKWARD 4 //11

REAR_RIGHT_ELBOW 16 //12

REAR_LEFT_SHOULDER_TILT 12 //13

REAR_LEFT_SHOULDER_FORWARD_BACKWARD 14 //14

REAR_LEFT_ELBOW 27 //15

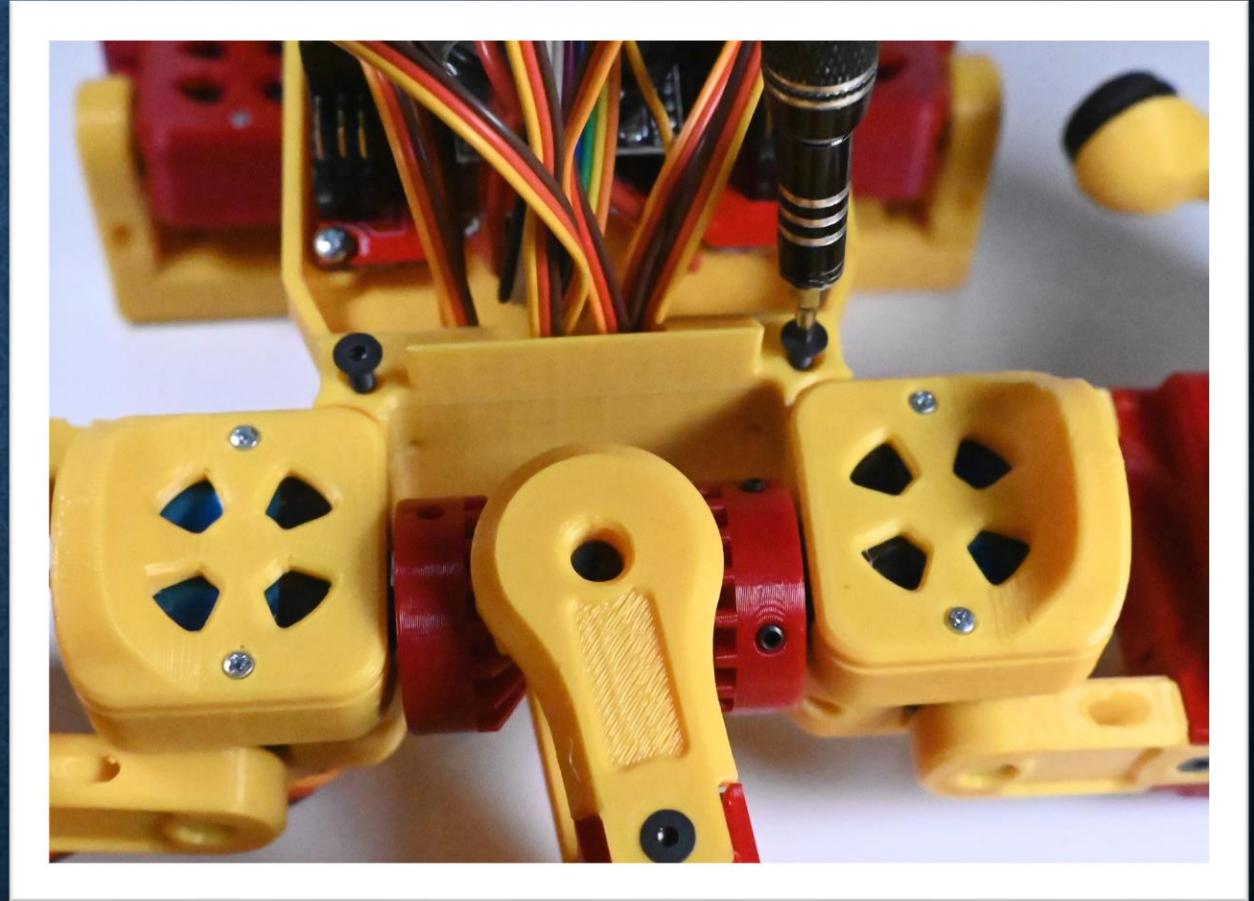


STEP 49

Parts:

- Smallkat Body Assembly
- x1 Latch
- x2 M3x16mm Bolts

Mount the latch onto the back of the body using two M3x16mm bolts. Be careful not to pinch any of the wires.

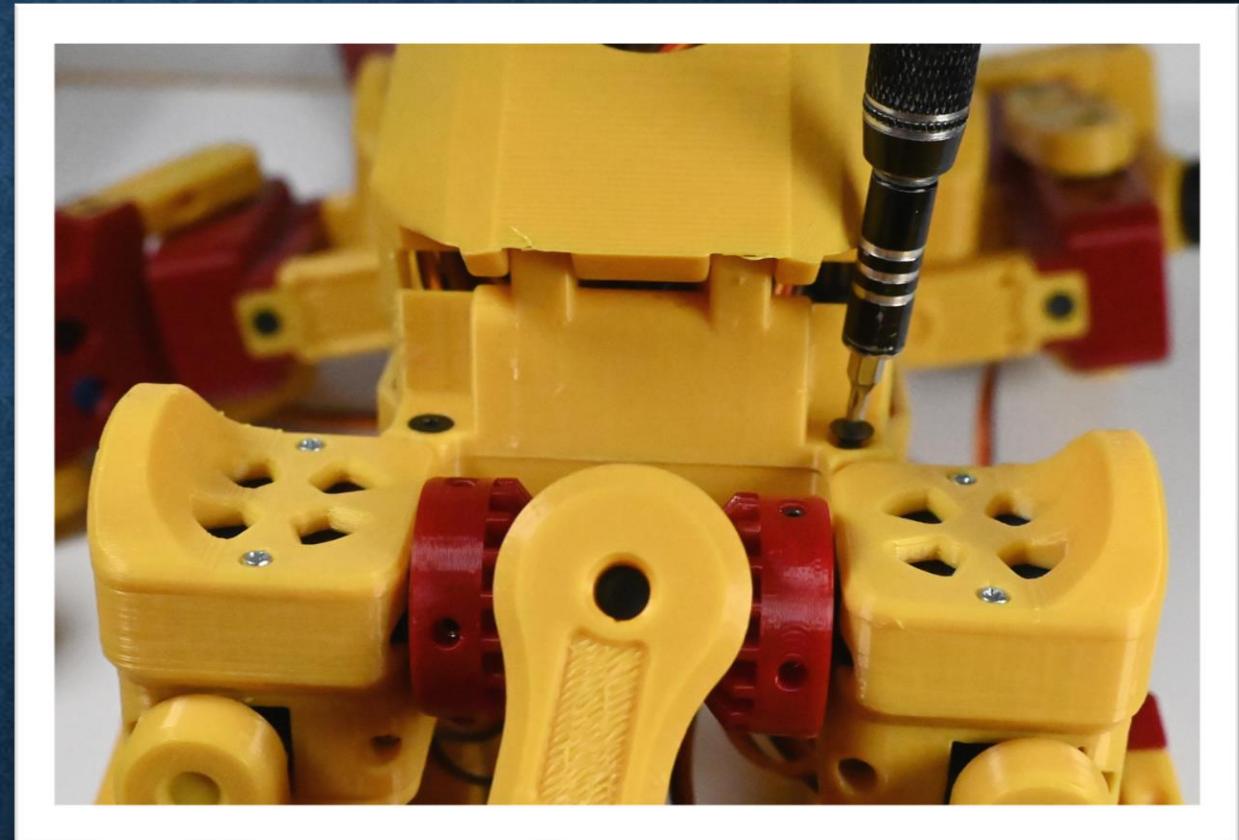


STEP 50

Parts:

- Smallkat Body Assembly
- x1 Body Cover
- x2 M3x16mm Bolts

Mount the body cover onto the back of the body using two M3x16mm bolts. Be careful not to pinch any of the wires.



STEP 51

Make sure the body cover latches into place.
Gather all the wires underneath and be sure not
to pinch any wires.

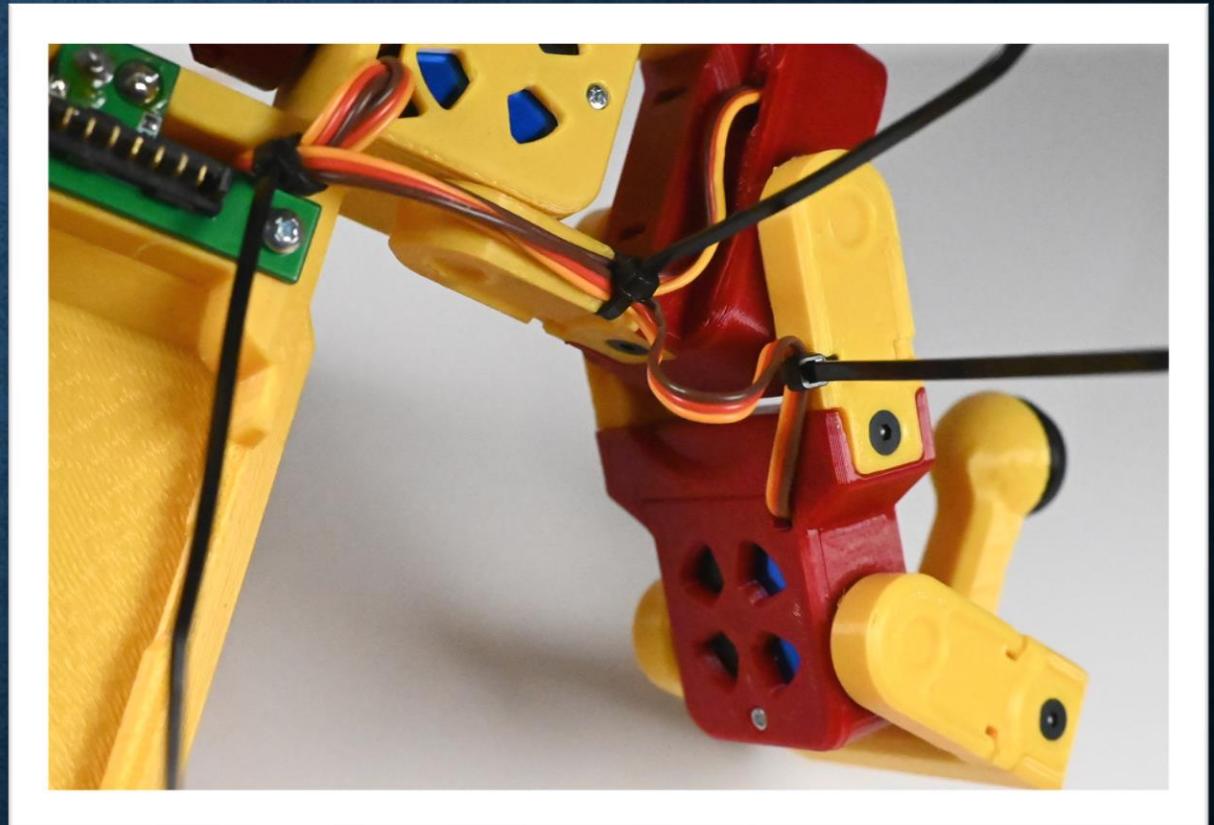


STEP 52

Parts:

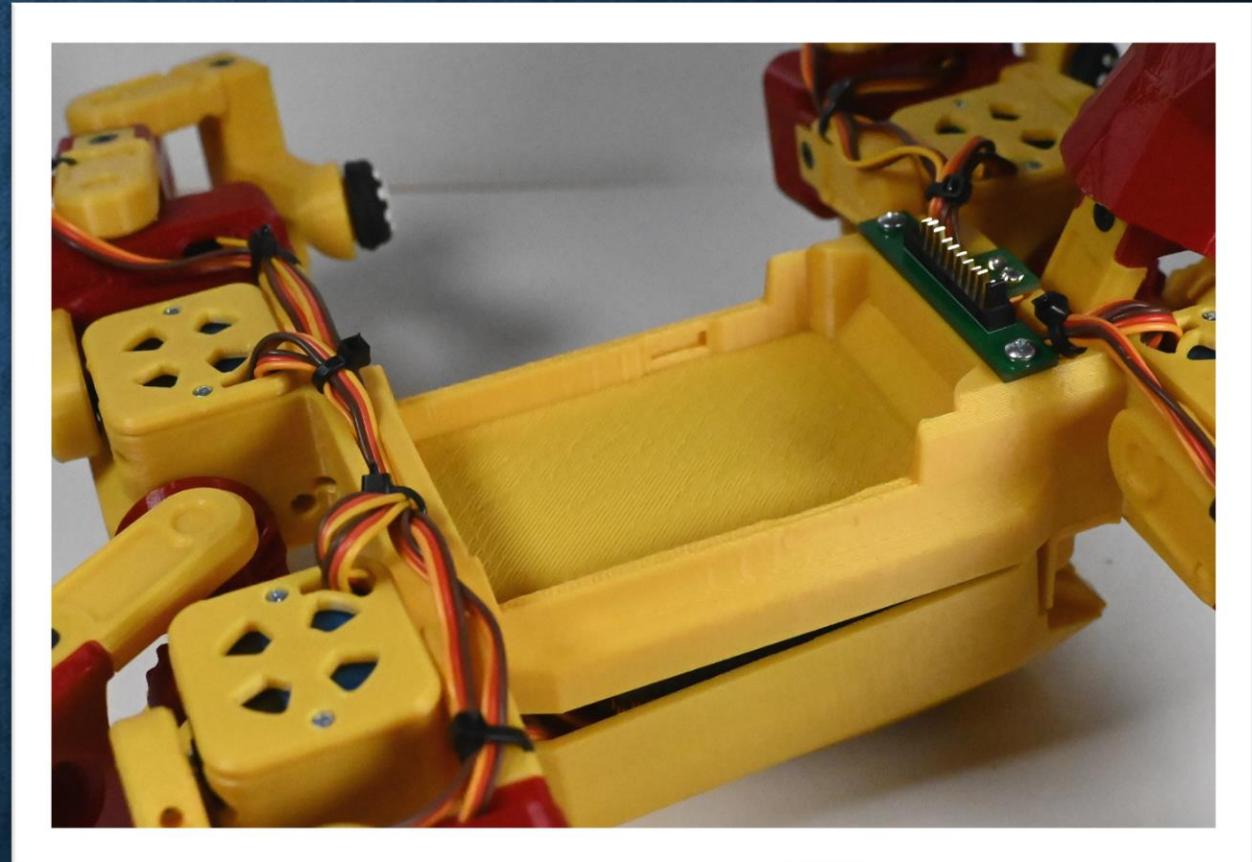
- Smallkat Body Assembly
- x3 Zip Ties

Using the holes in the idle links zip tie the wires into place as shown in the picture. Do not overtighten the zip tie and pinch the wires. Make sure to leave enough extra wire to allow the servos to move through their full ranges. You may have to adjust the position of the wires going into the body or make sure they aren't tangled or pinched if they are coming up short. Clip the excess zip ties when done. If you have to remove the zip ties, use a pair of flush cutters and be careful not to cut the wires.



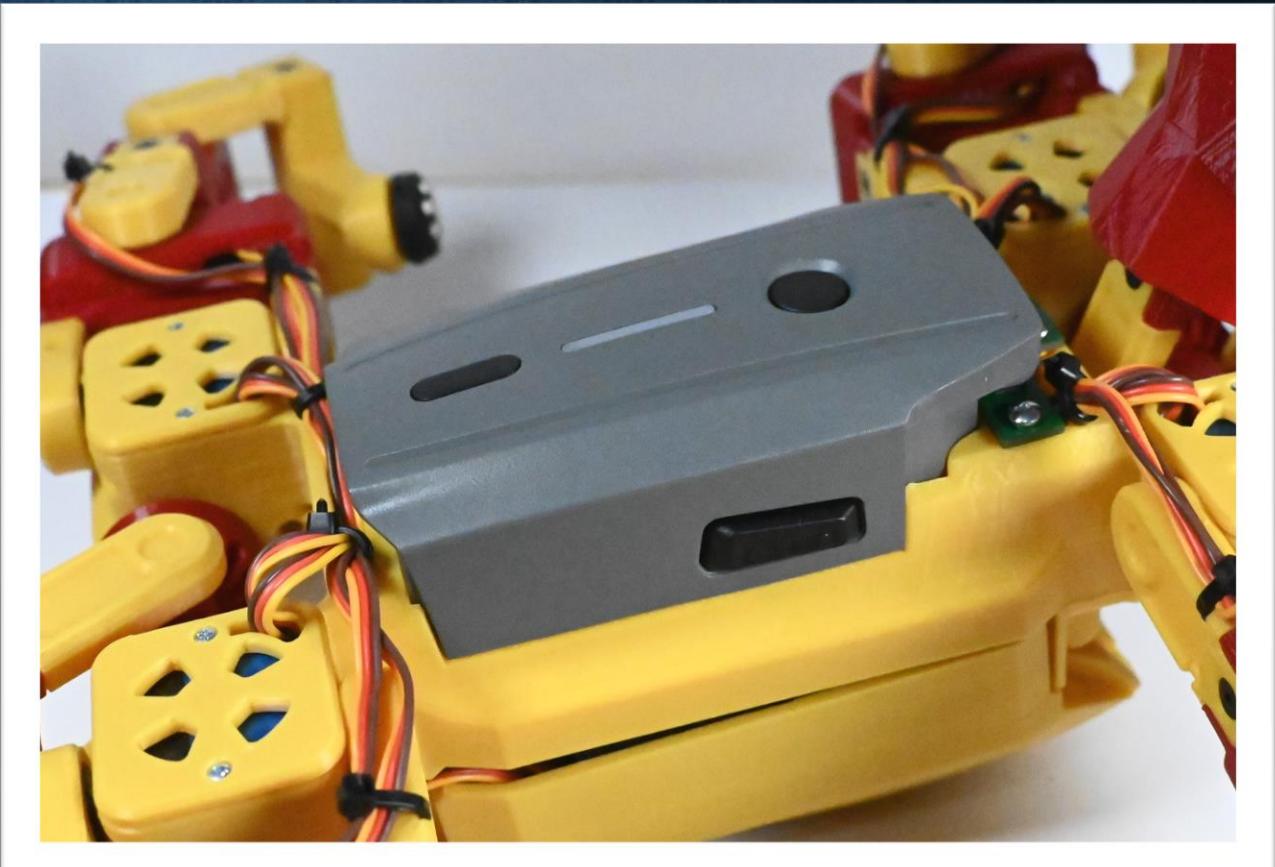
STEP 53

Repeat step 53 for all 4 corners.



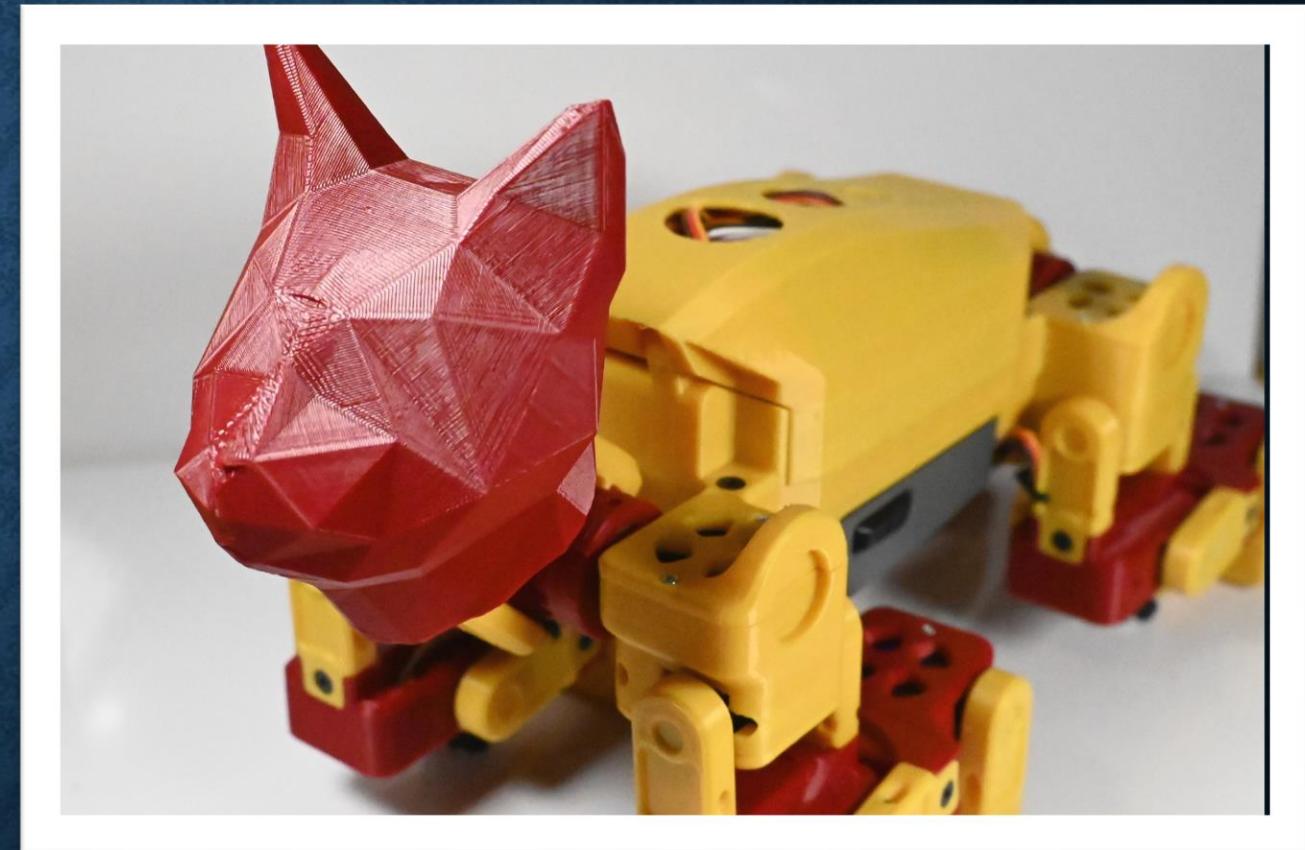
STEP 54

Press the battery into the body. It should snap into place with the two clips and connect into the battery board.



CONGRATS!

Your smallkat is assembled. You can now move onto calibration and get it walking!



AMENDMENTS

DIY CALIBRATION LINK

STEP 1:

- Parts:
- Flush Cuts
- Nylon Servo Horn

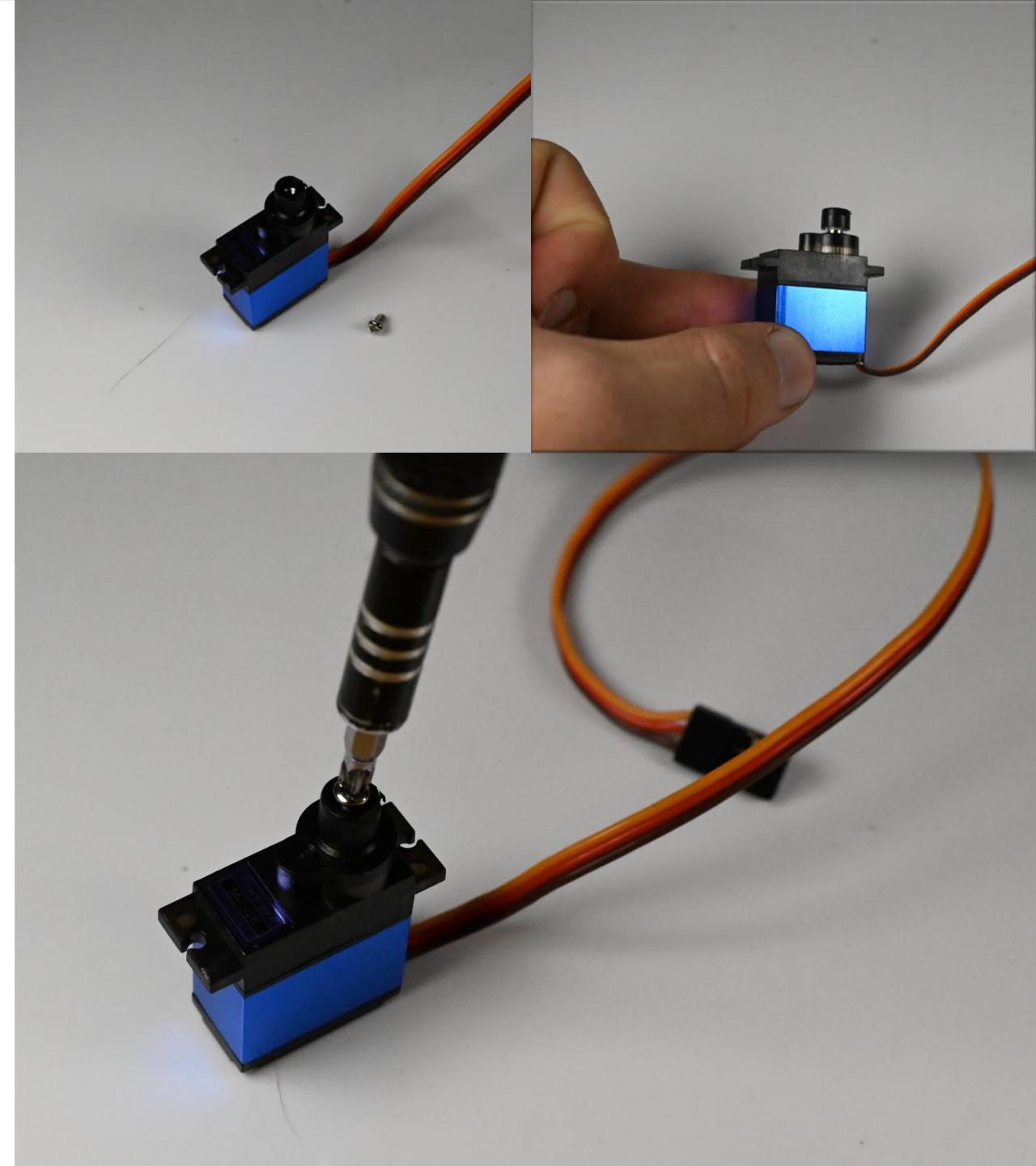
Using a pair of flush cutters trim the arms off of one of the servo horns that come with the MG92B servos. You should end up with a round servo horn.



DIY CALIBRATION LINK STEP 2:

- Parts:
- Nylon Servo Horn
- MG92B Servo
- M2.5mmx3mm

Connect the servo horn to the servo using the M2.5mmx3mm screw. Repeat steps 1-3 for the other 15 servos.



DIY CALIBRATION LINK STEP 3:

- Parts:
- DIY Calibration Link
- x2 M3 Square Nut
- x2 M3x8mm set screw

Insert the square nuts into the slots in the calibration link. Screw the set screws into the side. Screw the setscrew just past the M3 nut for now. We will tighten them later. Repeat this step for the other 11 calibration links.

