4 Control the Robot Arm by the wired Handle controller

Table

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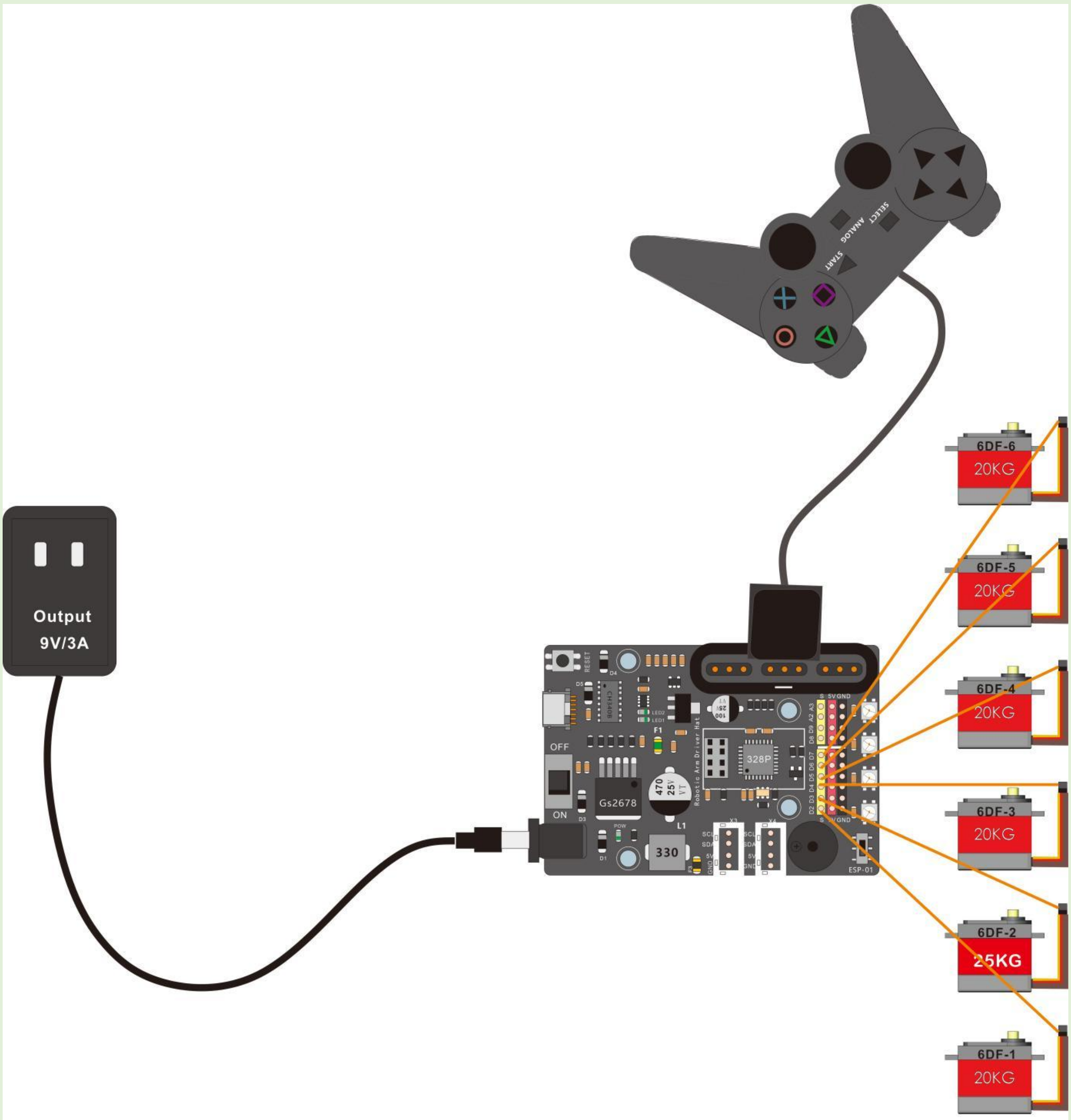
1. Wiring and assembly inspection

After assembling the robotic arm, do not immediately turn on the power or upload the code, but first check whether the wiring of the robotic arm and the assembly of each component are correct.

1.1Wiring inspection

Please refer to the following wiring diagram to check if the 6 servos are connected to the correct positions. Firstly, confirm that the signal pin of the servos is connected to the signal pin on the Robot Arm Hat instead of GND. Secondly, confirm if each servos is connected to the corresponding pin position on the Robot Arm Hat.



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Six servos are labeled with 6DF-1,6DF-2,6DF-3,6DF-4, 6DF-5, and 6DF-6 for easy differentiation
The signal pins of the 6 servos correspond to the signal pins on the Robot Arm Hat as shown in the table below.

Servo No.	Signal Pin of Robotic Arm Hat
6DF-1	D2
6DF-2	D3
6DF-3	D4
6DF-4	D5
6DF-5	D6
6DF-6	D7

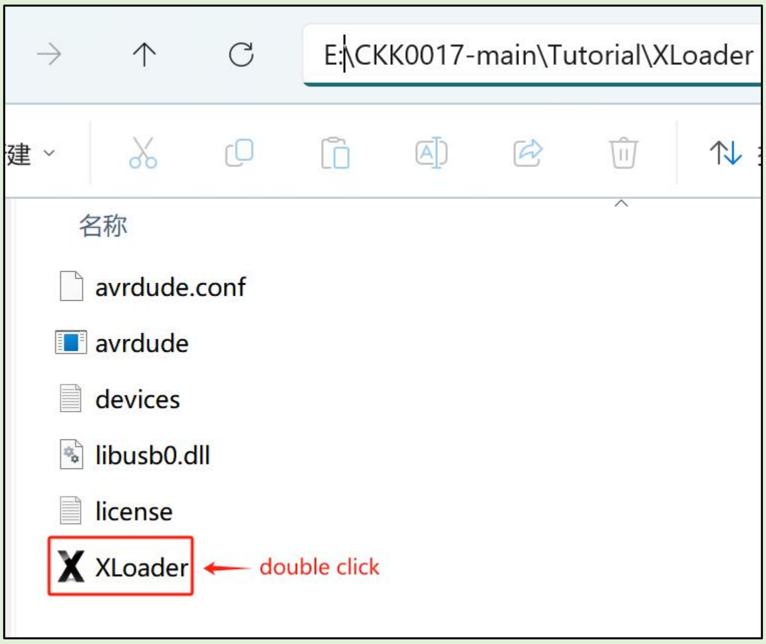
1.2 Structural inspection

Manually rotate the various axis parts of the robotic arm without turning on the power, and confirm that each axis rotates smoothly without any jamming or mechanical obstruction. If there are any problems, please carefully check where the assembly is wrong according to the assembly steps.

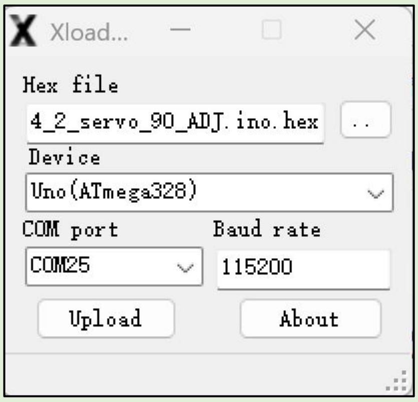
2. Upload the "7_1_Handle_Control_Arm.ino.hex" to control board

2.1 Open the upload tool "XLoader"

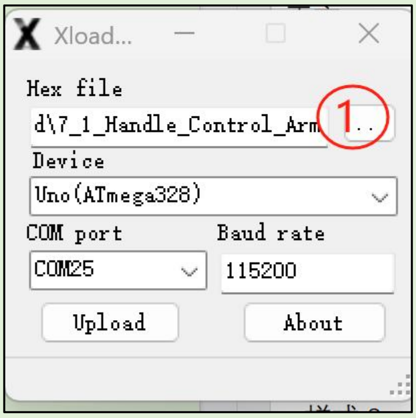
The "XLoader" is in this path E:\CKK0017-main\Tutorial\XLoader



2.2 Double click "XLoader" with the mouse to open the tool interface as follows

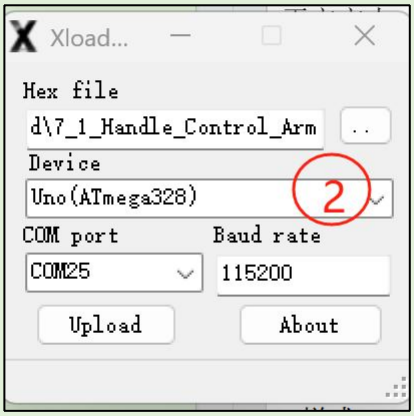


2.3 As shown in the figure, at position 1 of the XLoader tool interface, click with the mouse to select the file "7_1_Handle_Control_Arm.ino.hex".



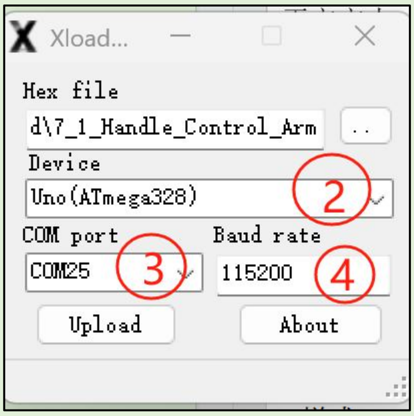
The file "7_1_Handle_Control_Arm.ino.hex" is in this path:
E:\CKK0017-main\Tutorial\sketches\7_1_Handle_Control_Arm\build

2.4 As shown in the figure, click on "Uno (ATmega328)" with the mouse at position 2 of the XLoader tool interface.

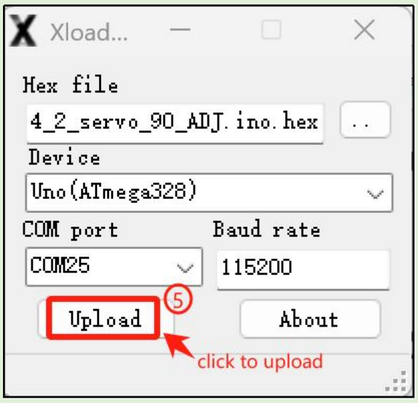


2.5 As shown in the figure, at position 3 of the XLoader tool interface, click and select the COM port of the control board with the mouse. The COM port is basically different on each computer. On my computer, it is COM25, so you can choose the corresponding port on your computer.

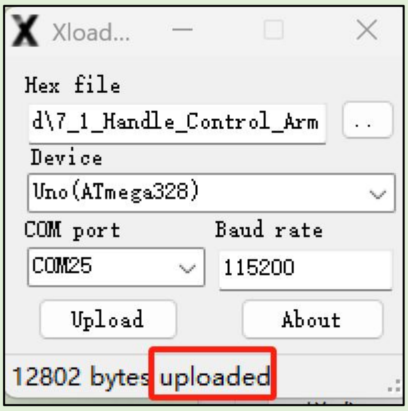
At position 4 of the interface, change the baud rate to 115200



2.6 As shown in the figure, at position 5 of the XLoader tool interface, click "Upload" once with the mouse to upload the code to the control board.



2.7 Upload successfully displays' **uploaded** '.



3. Safety and Precautions(important)

This metal robotic arm stands at a height of 45cm when fully standing, with a maximum swing arm length of 36cm. Adopting 5 maximum torques of 20KG CM and a maximum torque of 25KG CM's servo motor. Therefore, this metal robotic arm has a relatively large range of travel and rotational force during operation. When it is working, we need to be careful to keep our bodies away from its range of motion and avoid being touched by the moving robotic arm.

Before turning on the power to the control board, first hold the robotic arm upright by hand. This way, after turning on the power, the initialization action of the robotic arm will be relatively small.

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When using the Handle controller to control the robotic arm, the body should maintain a distance of at least 0.5 meters from the robotic arm. When the robotic arm is in motion, hands or other parts of the body should not approach the robotic arm, and the body should not touch the joints of the robotic arm to prevent collision or self injury.

When there is a malfunction in the operation of the robotic arm, such as being entangled in joints by wires, tapes, or other similar objects, it is necessary to first turn off the power switch on the robotic arm control board before dealing with obstacles on the robotic arm.

This robotic arm is suitable for teenagers aged 15 and above to learn and use.

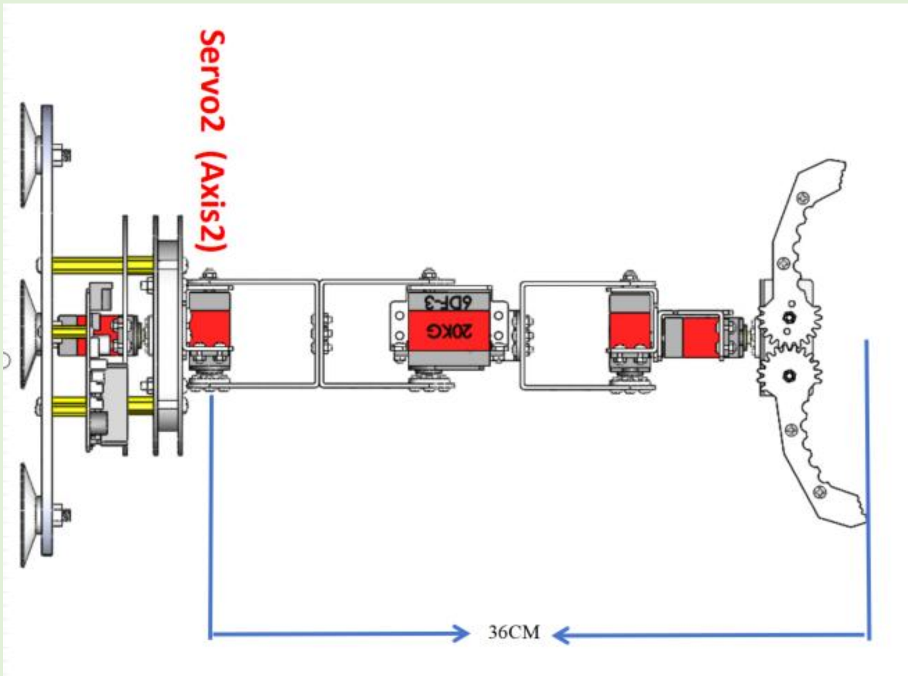
Children aged 8-15 need to use this robotic arm under adult supervision.

Children under 8 years old are not allowed to use it and it needs to be kept out of their reach.

4. Maximum weight of grasped object

According to physics analysis, the maximum force point of this metal robotic arm during operation is on the Servo2 gear. Therefore, we only need to analyze the weight of the object that the claws can grasp when Servo2 is in the longest arm state.

As shown in the figure below, with Servo2 as the base point, the longest force arm from Servo2 to the claw is 36CM.



Servo2 is the servo with the highest torque among the six servos on the entire robotic arm, with a static torque of 25Kg-CM and a dynamic torque of 9Kg-CM.

The formula for calculating torque is as follows:

Torque = Force * Lever Arm

Assuming Servo2 is the base point and the middle part from the base point to the claw is considered as a weightless arm, the weight that the claw can grasp is:

Force (weight)=Torque / Lever Arm

Weight=9KG-CM/36CM=0.25Kg

The structural component between Servo2 and the claw actually has a certain weight, which also applies a torque to Servo2. This weight is named structural weight, and the torque applied to Servo2 by structural weight is about 6.4KG-CM.

So the actual weight of the object that Servo2 can grasp with its claws in the longest arm state is:

Object weight=(dynamic torque - structural torque)/lever arm

Object weight=(9KG-CM) - (6.4KG-CM)/36CM=0.1KG

Therefore, when Servo2 is in the longest state of the robotic arm force arm, it can withstand a weight of 0.1KG for objects grabbed by the claws.

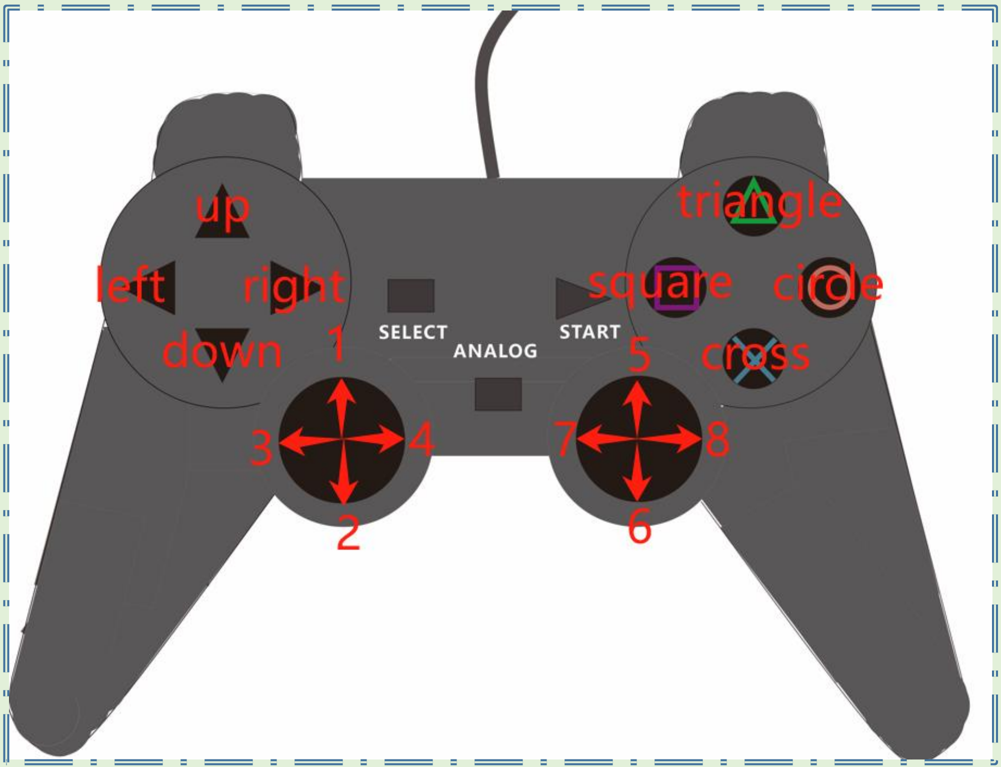
Suggestion: The weight of using this robotic arm to grab objects should not exceed **0.1KG**.

5. How to control the robotic arm by the Handle controller

There are buttons and joysticks on the Handle controller. We have defined the servos and actions controlled by each button/joystick in the code, so that the robotic arm can be controlled through the Handle controller.

5.1 Understand the buttons and joystick on the Handle controller

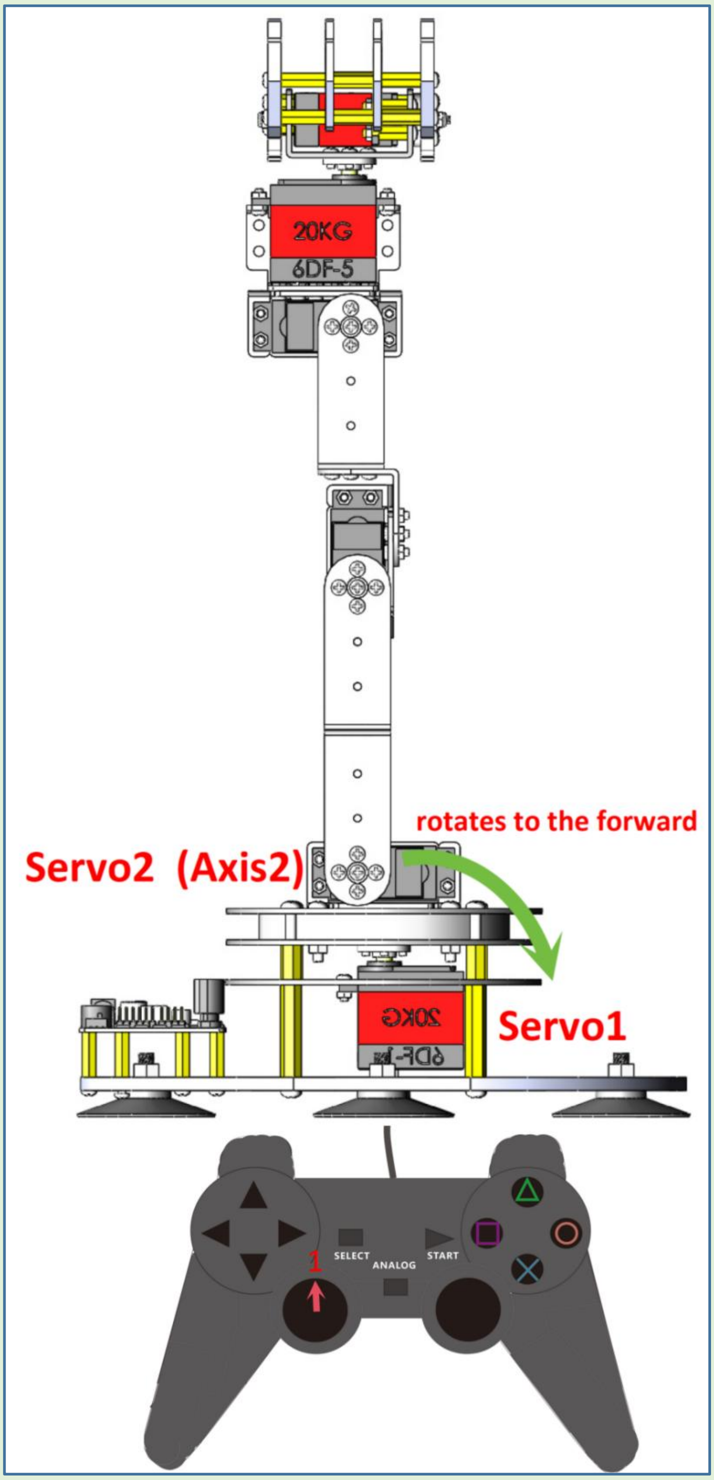
The Handle controller has left and right joysticks, each of which is divided into four control directions: front, back, left, and right. For the convenience of distinction, we use the number 1 to represent the front (control direction) of the left joystick, the number 2 to represent the back (control direction) of the left joystick, the number 3 to represent the left (control direction) of the left joystick, the number 4 to represent the right (control direction) of the left joystick, the number 5 to represent the front (control direction) of the right joystick, the number 6 to represent the back (control direction) of the right joystick, the number 7 to represent the left (control direction) of the right joystick, and the number 8 to represent the right (control direction) of the right joystick. The buttons include up, down, left, right, triangle, cross, square, circle, as shown in the following figure:



In the code, it is defined that the joystick controls the actions of servo2 (6DF-2) in the 1 and 2 directions, servo1 (6DF-1) in the 3 and 4 directions, servo3 (6DF-3) in the 5 and 6 directions, servo4 (6DF-4) in the up and down buttons, servo5 (6DF-5) in the left and right buttons, and servo6 (6DF-6) in the 7 and 8 directions.

5.2 Analysis of the actions of each button and joystick controlling the servo

Number 1(Direction of joystick push): Control the servo2, move the Axis 2 forward while keeping the other axes stationary, so that the robotic arm moves forward along the Axis 2.



Number 2(Direction of joystick push): Control servo motor 2 to move the Axis backwards while keeping the other axes stationary, so that the robotic arm moves backwards along the Axis.

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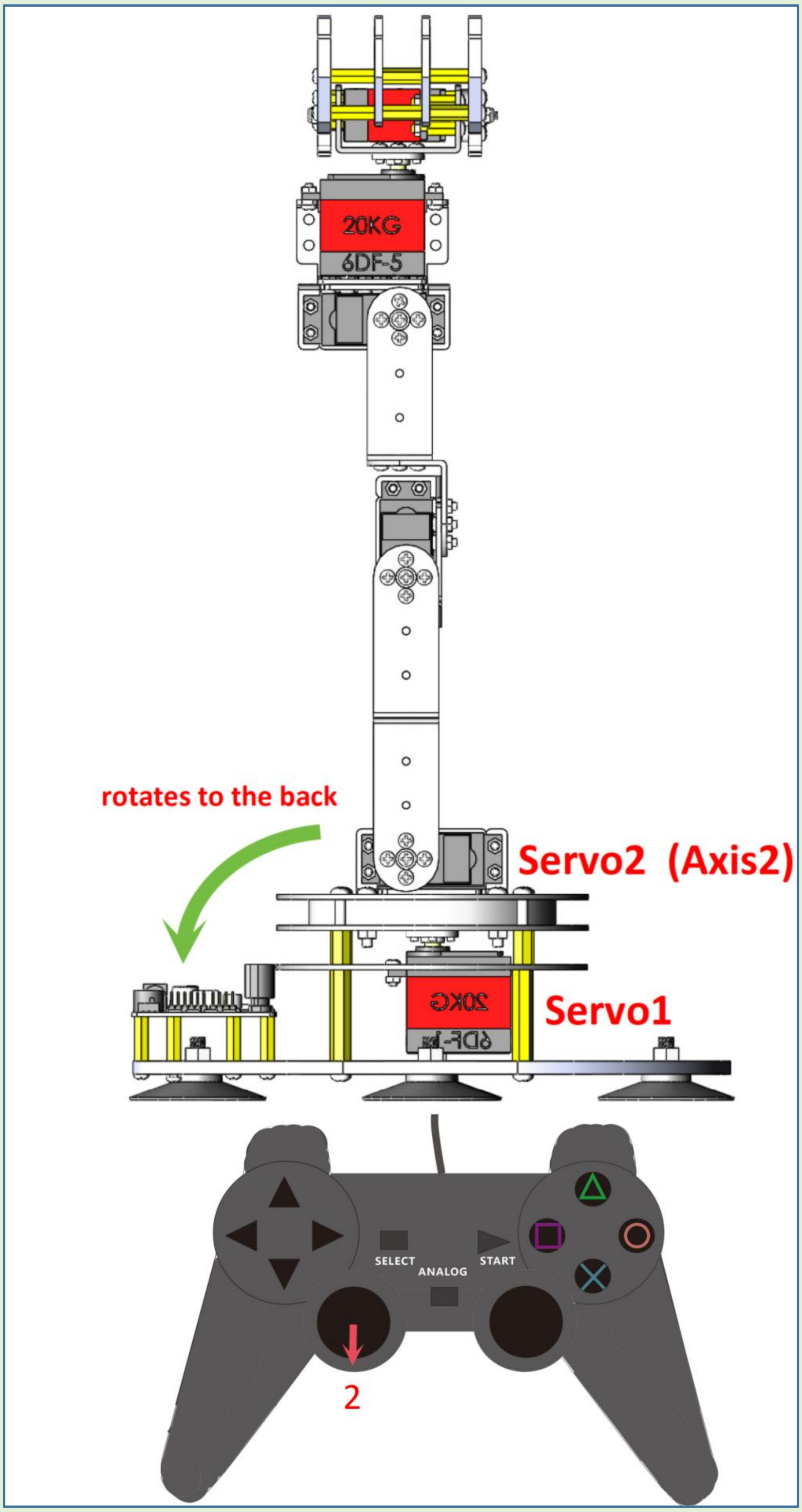
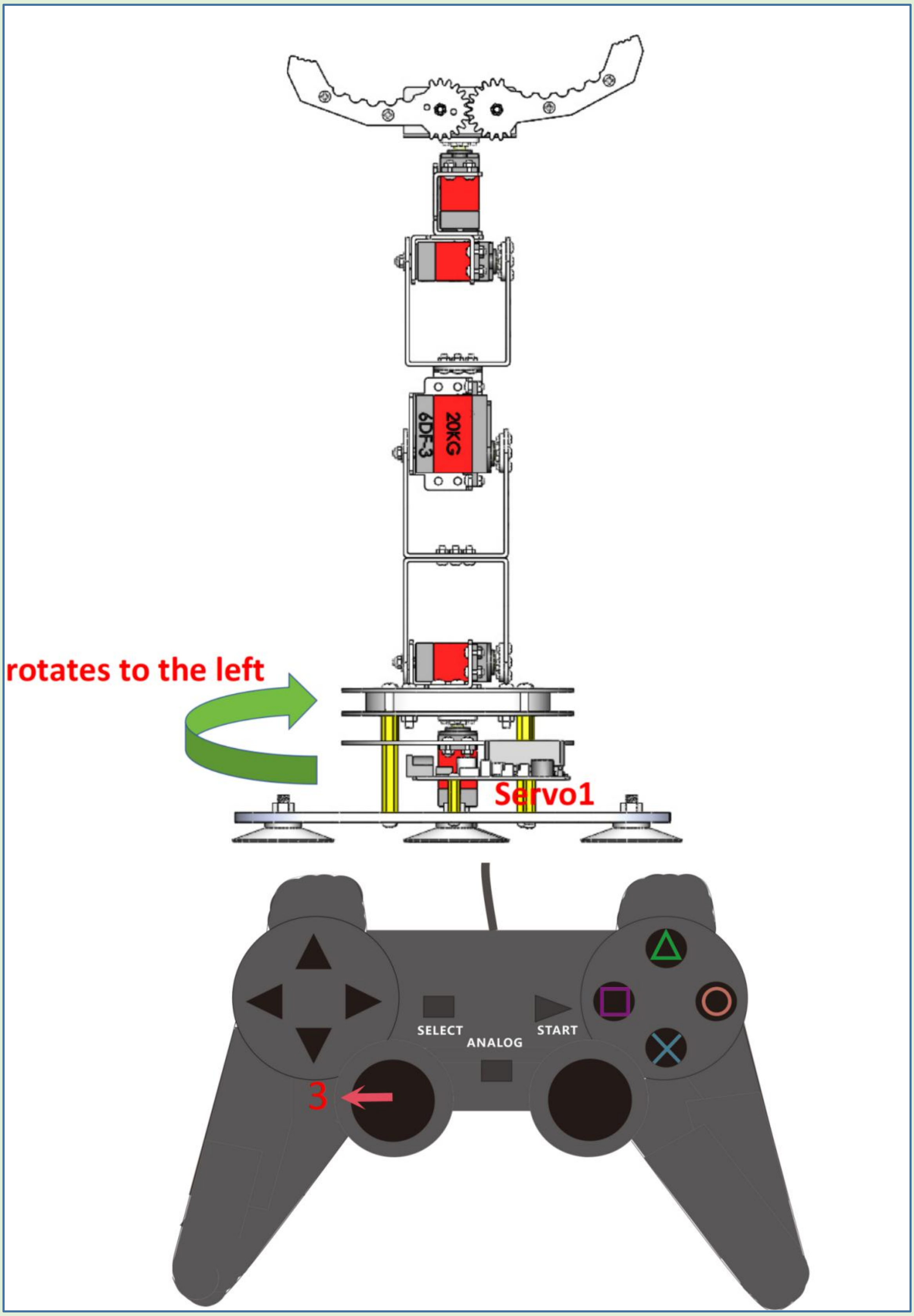


Number 3(Direction of joystick push): Control servo1 to rotate the base of the robotic arm to the left.



Number 4(Direction of joystick push): Control servo 1 to rotate the base of the robotic arm to the right.

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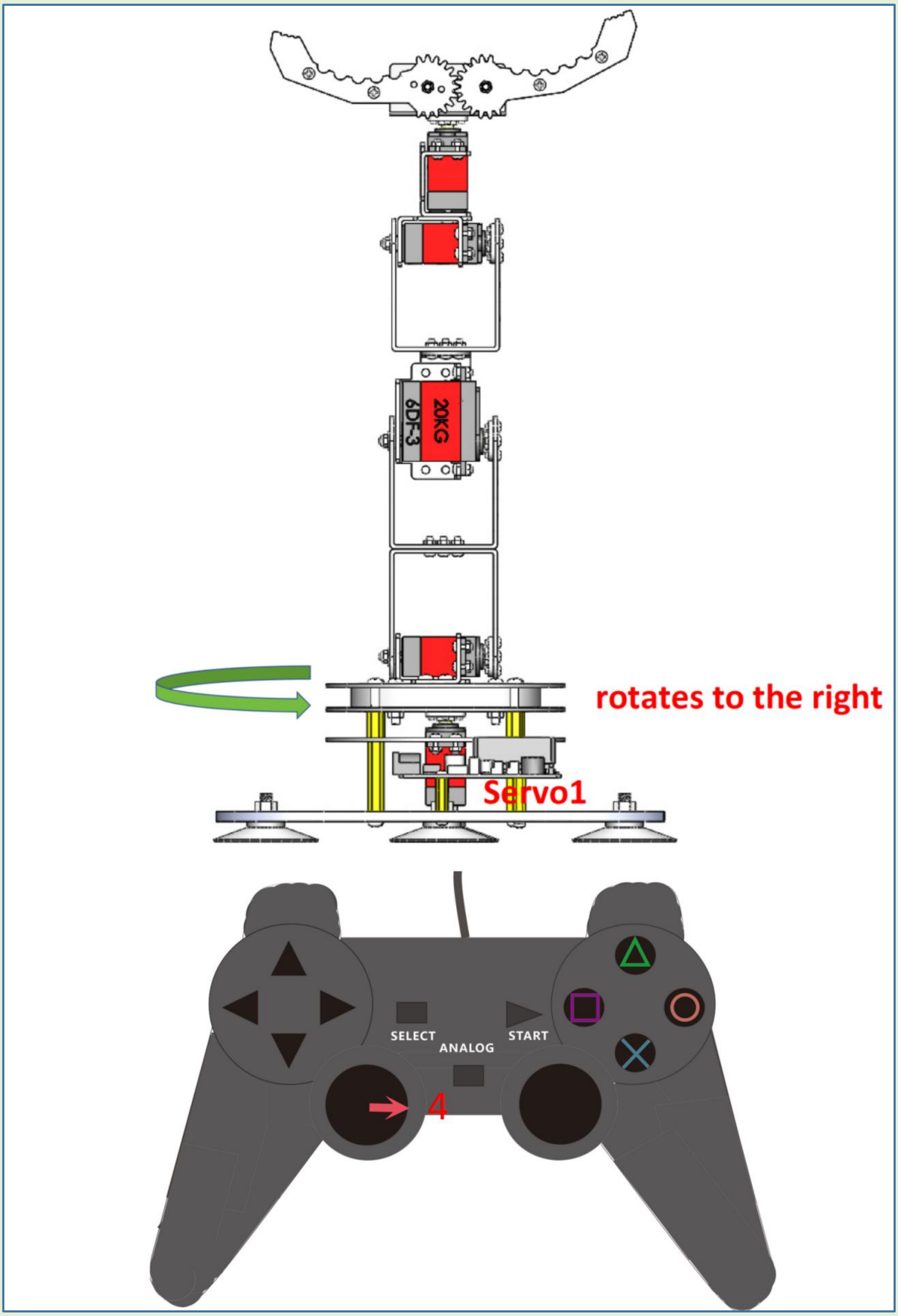
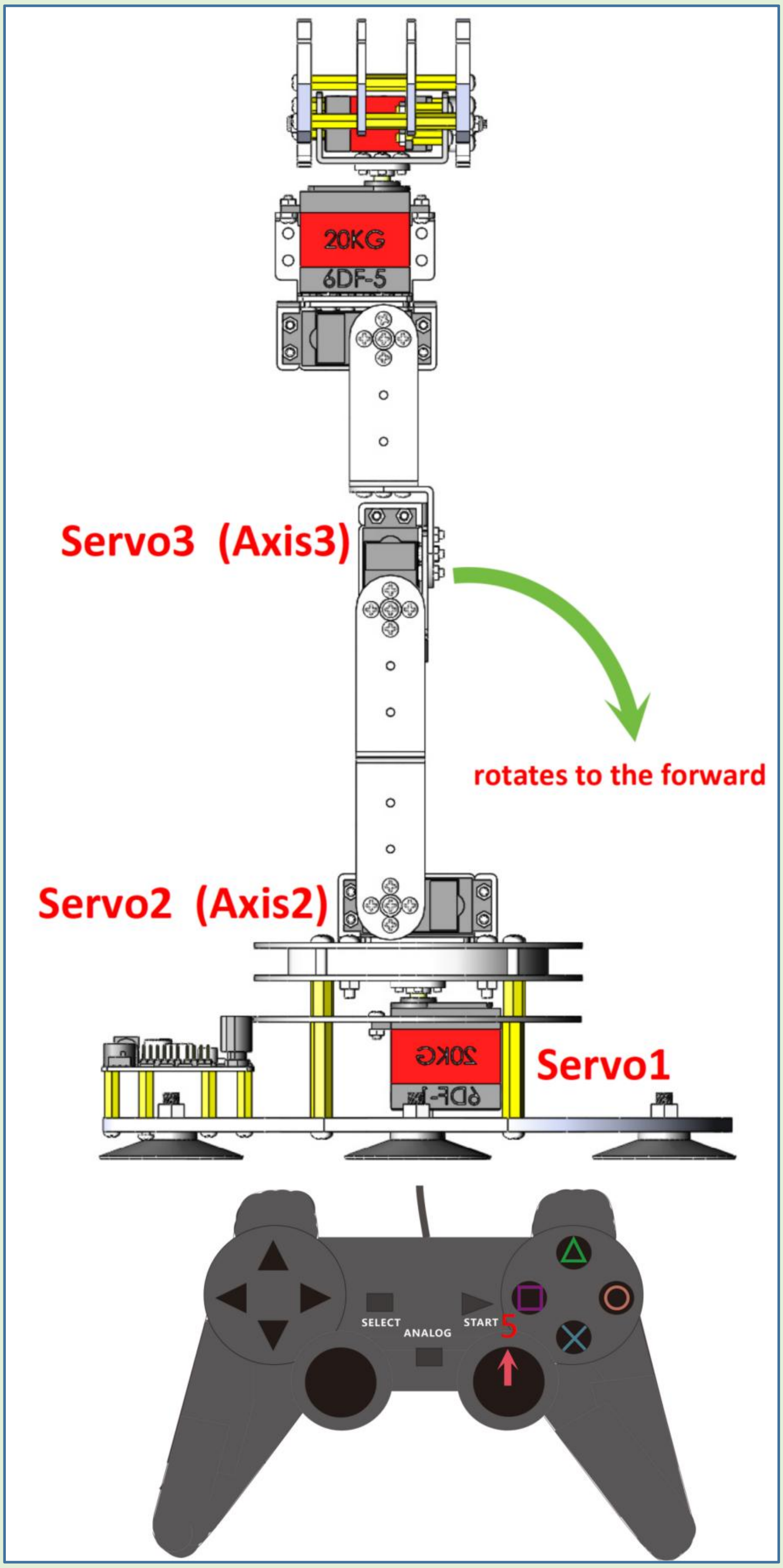

20KG
6DF-3
rotates to the right
Servo1
SELECT
ANALOG
START
4

Number 5(Direction of joystick push): Control the servo3, with Axis 3 moving forward and the other axes remaining stationary.



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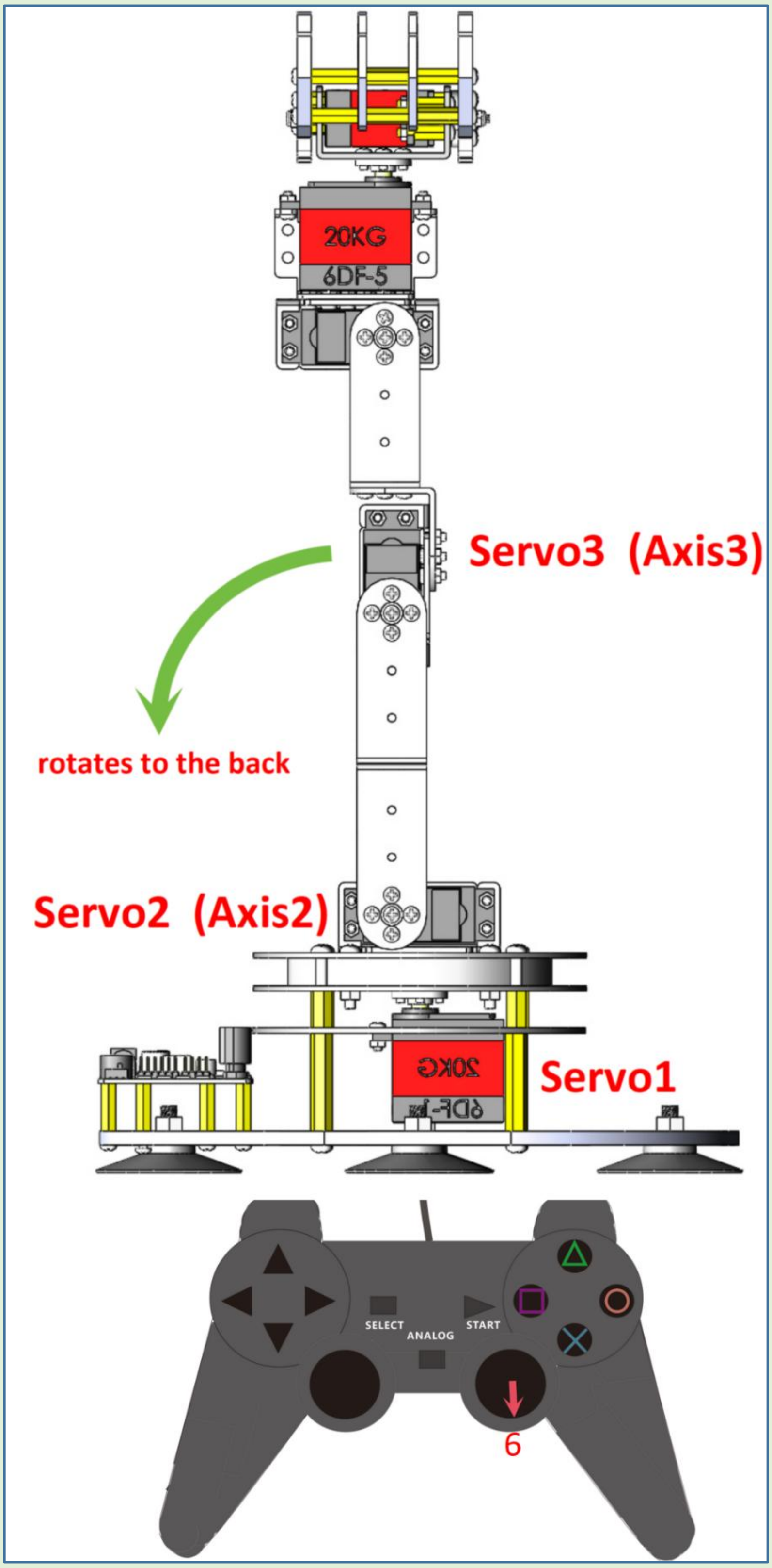
Number 6(Direction of joystick push)： Control the servo3, with Axis 3 moving backwards and the other axes remaining stationary.



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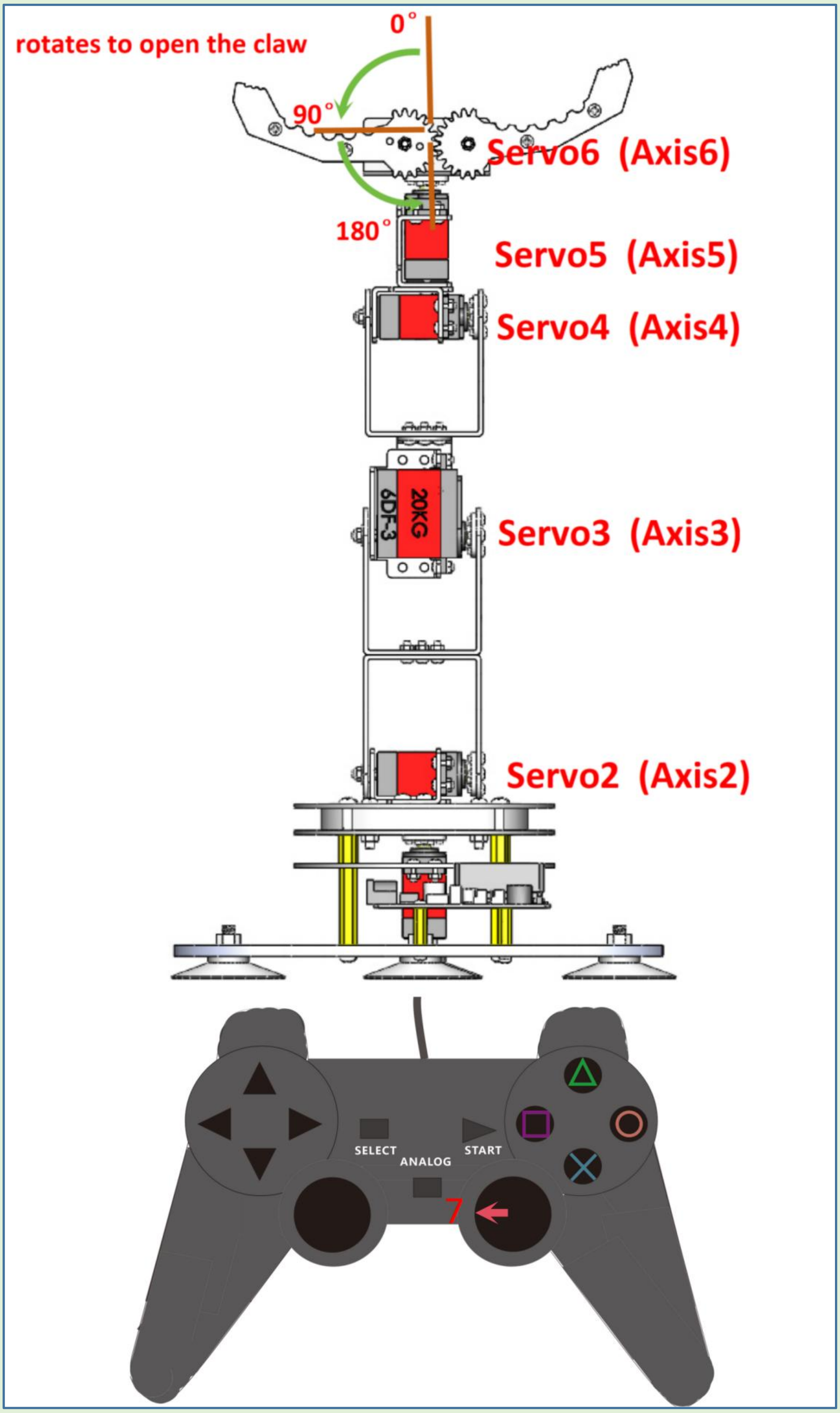
Number 7(Direction of joystick push): Control servo 6, open the claws, and keep the other axes stationary.

Due to structural interference, the claws can be opened up to a maximum of 120 ° position.



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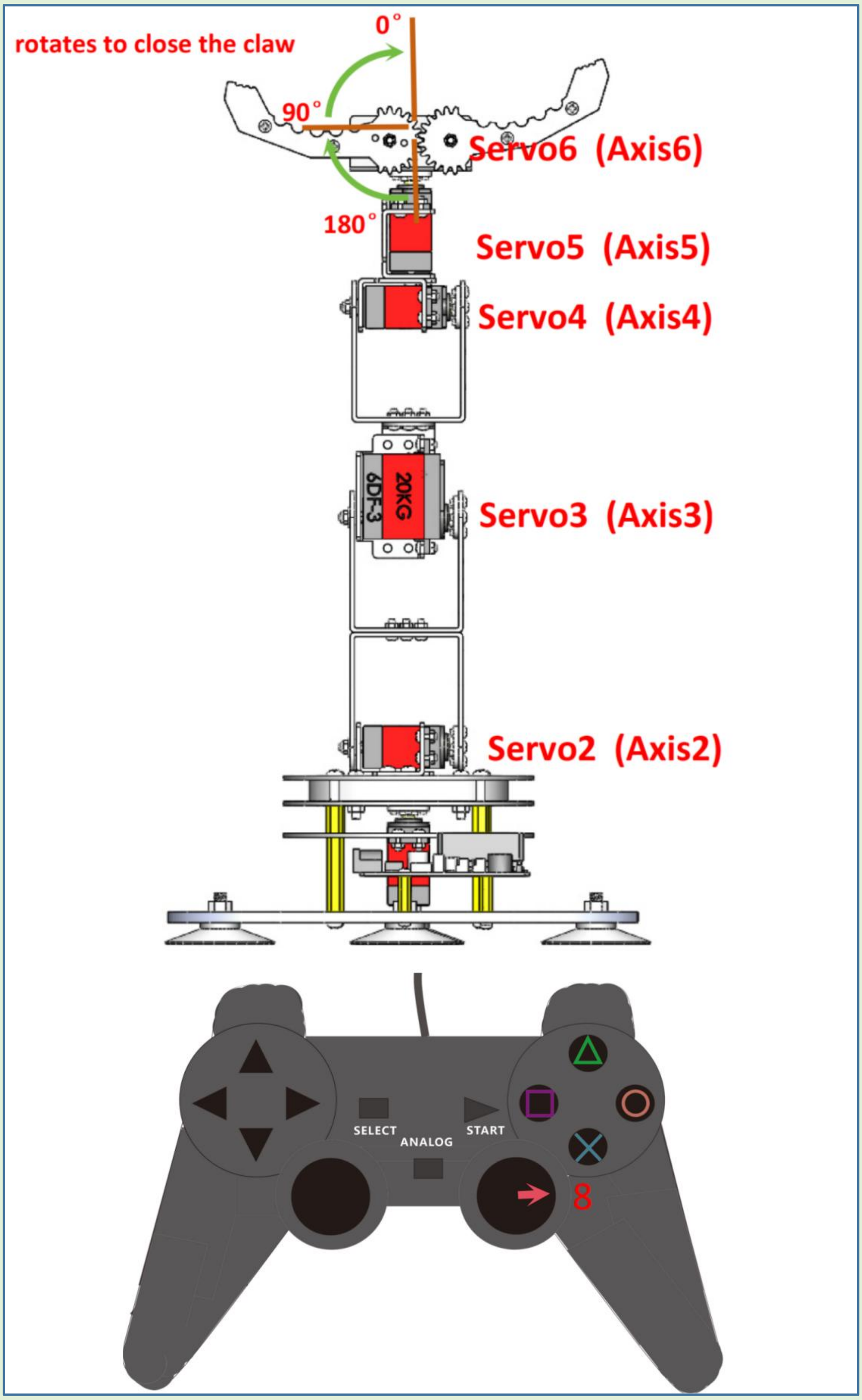
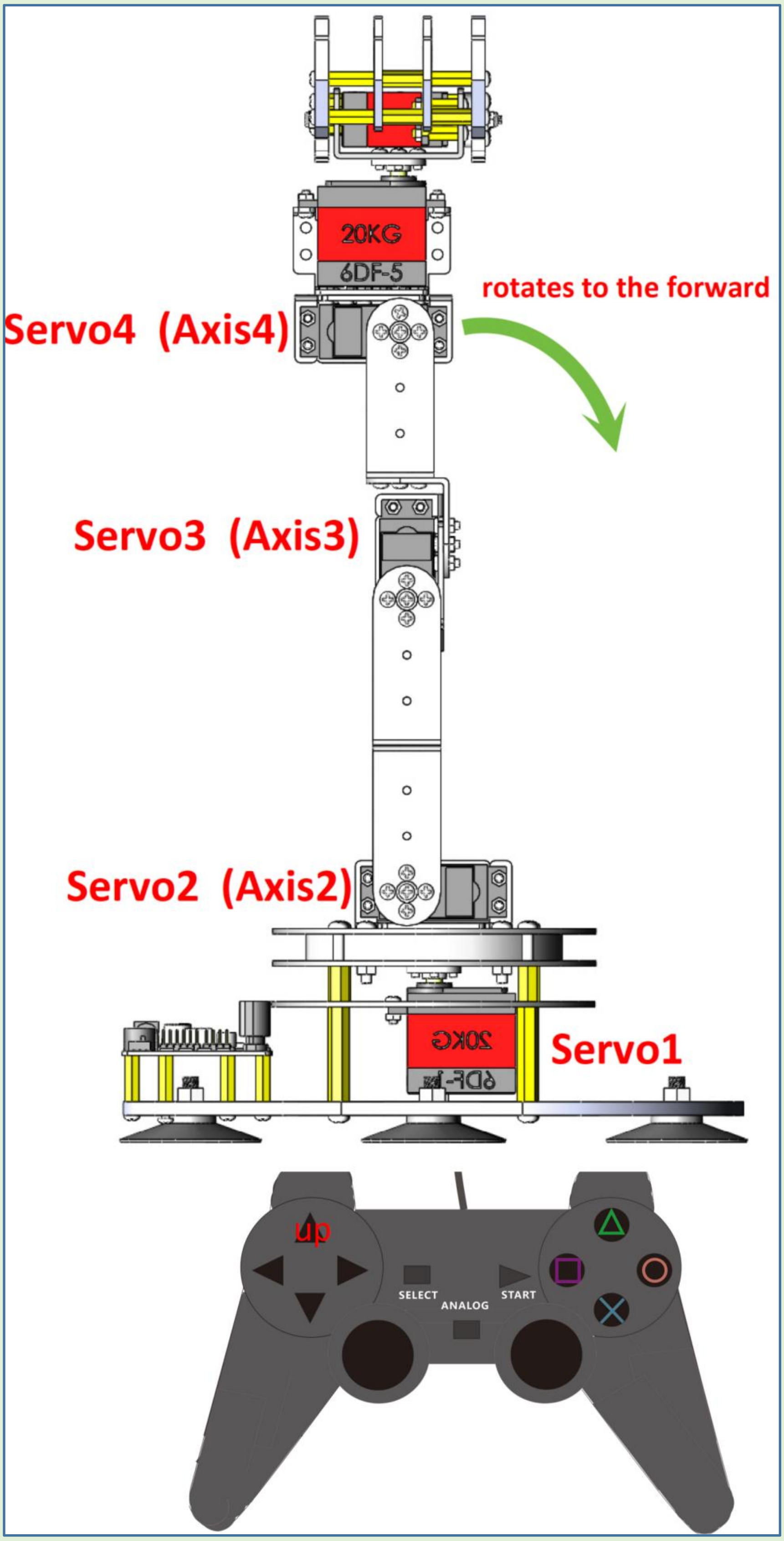
Number 8(Direction of joystick push): Control servo 6, turn off the claws, and keep the other axes stationary.



"up" button:Press and hold the up button to control servo4, Axis4 moves forward while the other axes remain stationary. After releasing the button, servo4 stops moving.。



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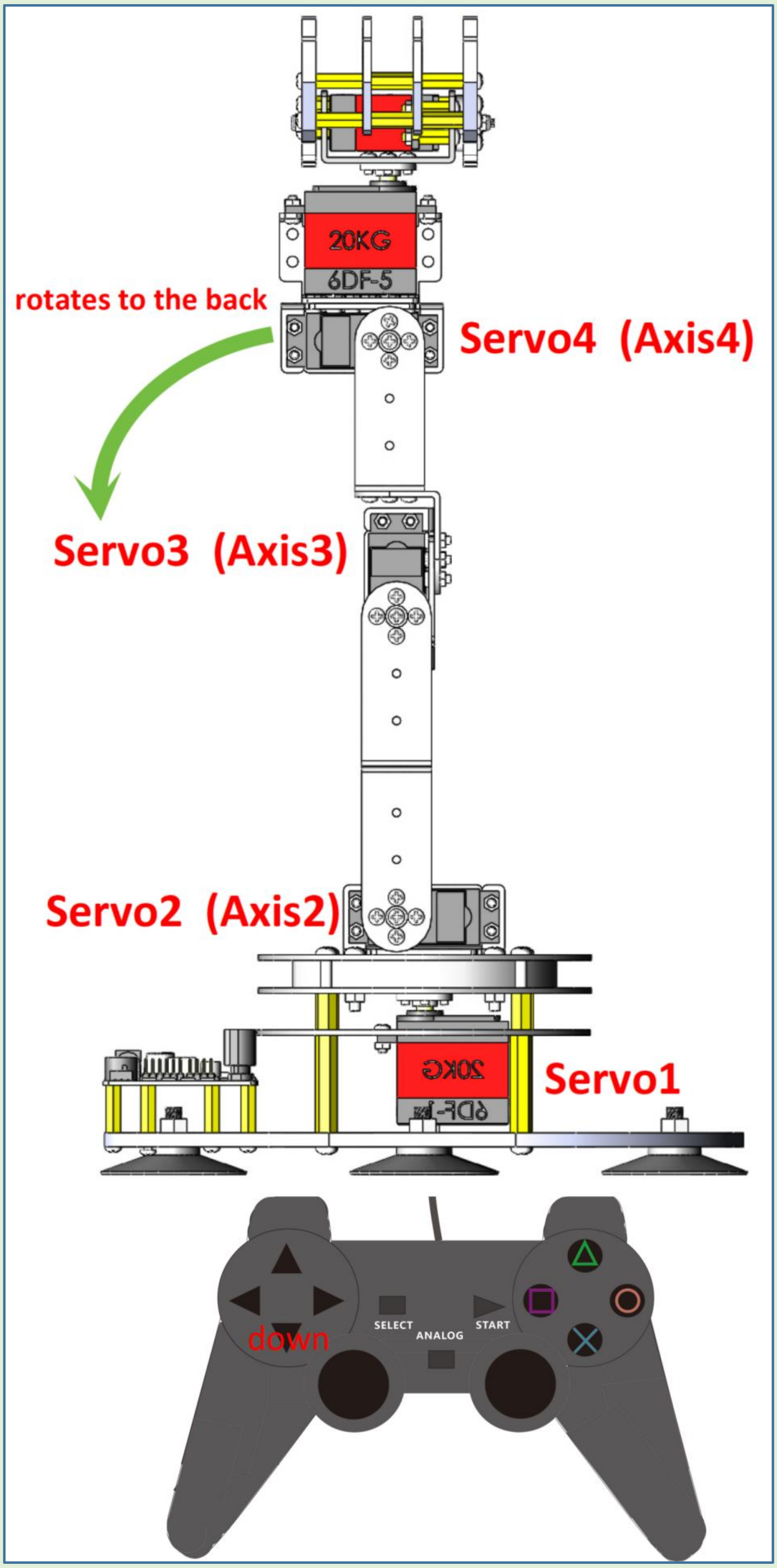
"down" button:Press and hold the down button to control servo 4. Axis 4 moves backwards while the other axes remain stationary. After releasing the button, servo 4 stops moving.



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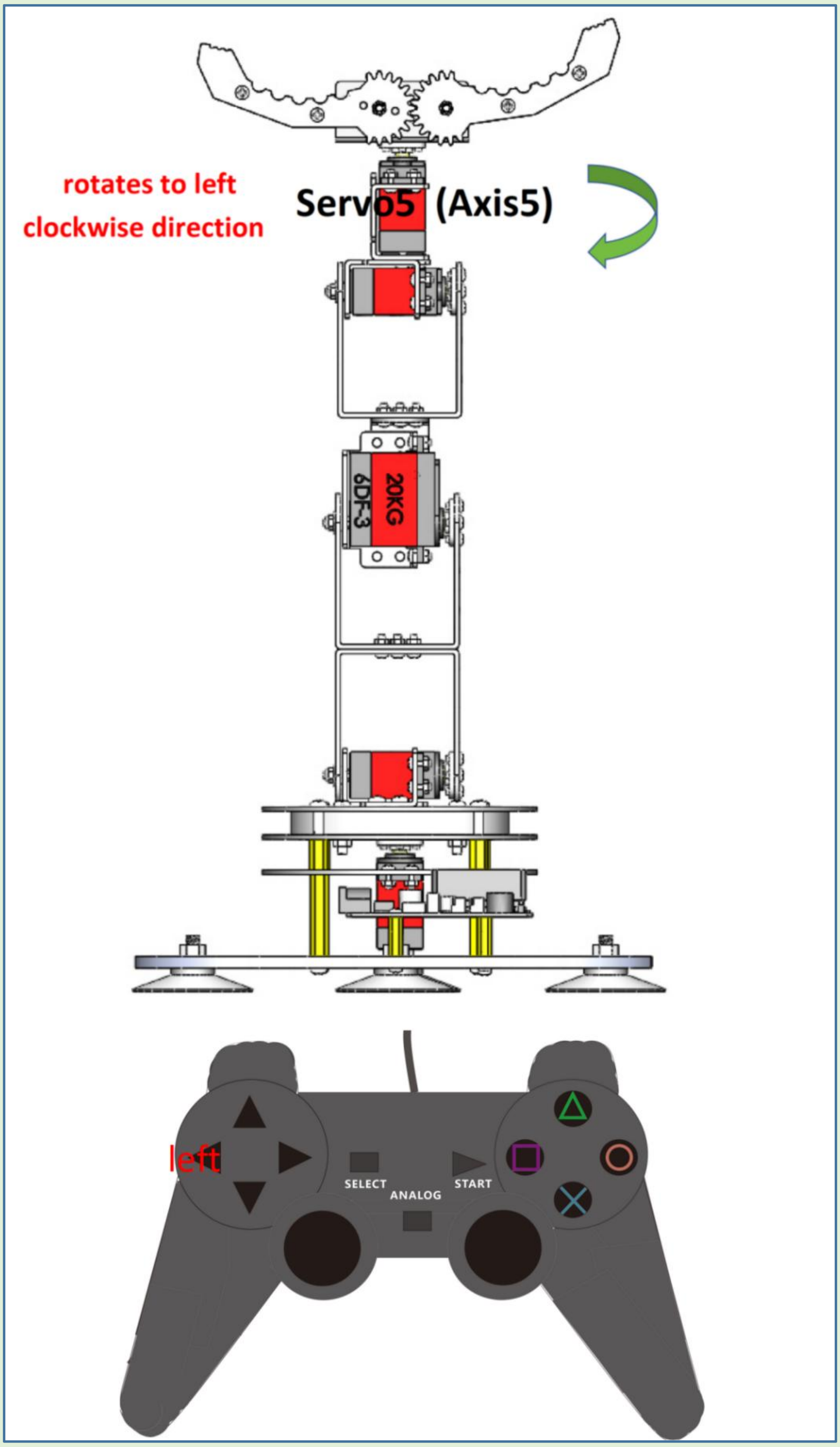
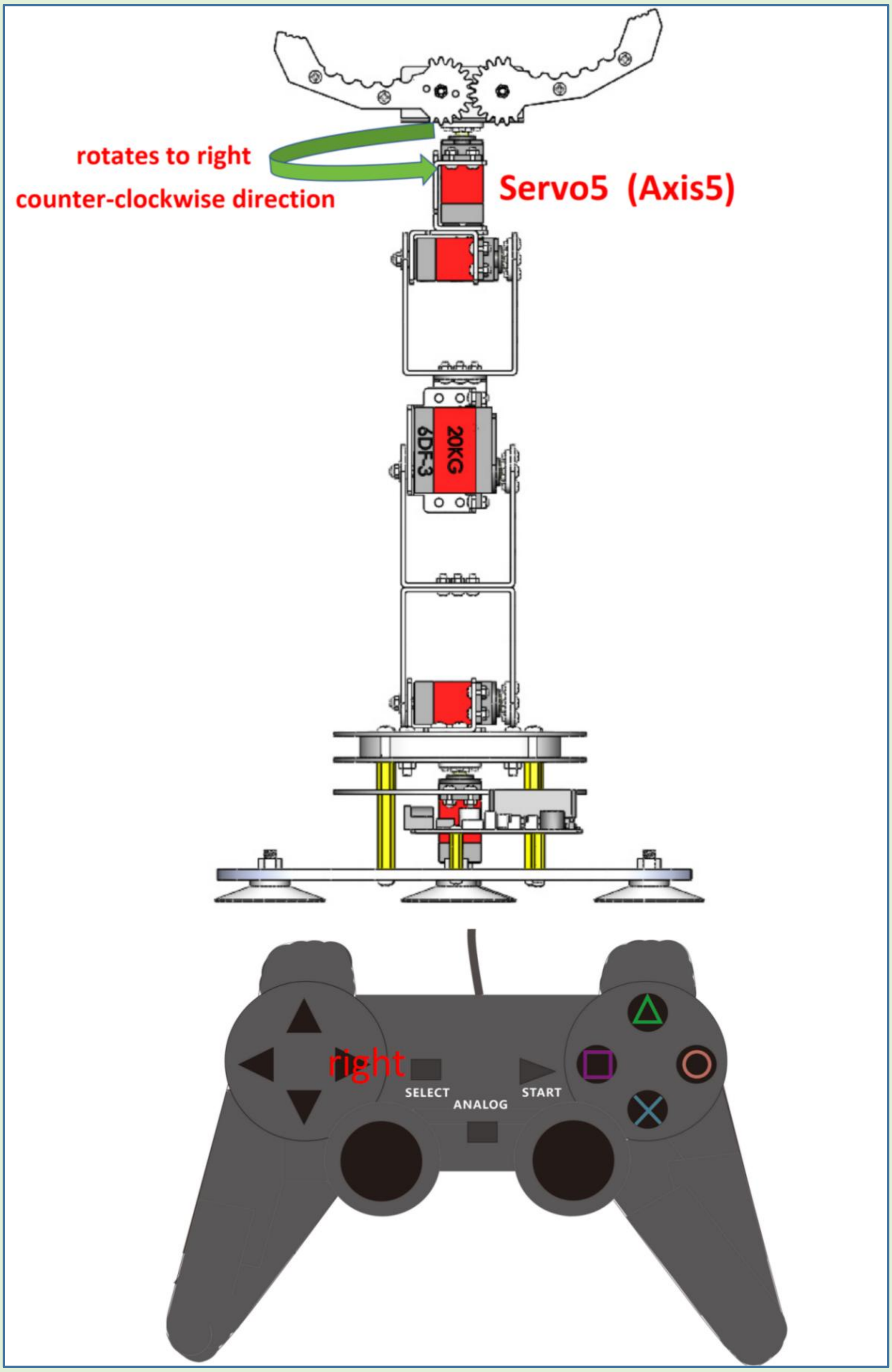
"left" button:Press and hold the left button to control servo5, and rotate AxiS5 to the left (clockwise direction). After releasing the button, servo5 stops moving.



"right" button:Press and hold the right button to control servo5, and rotate AxiS5 to the right (counterclockwise). After releasing the button, servo5 stops moving.



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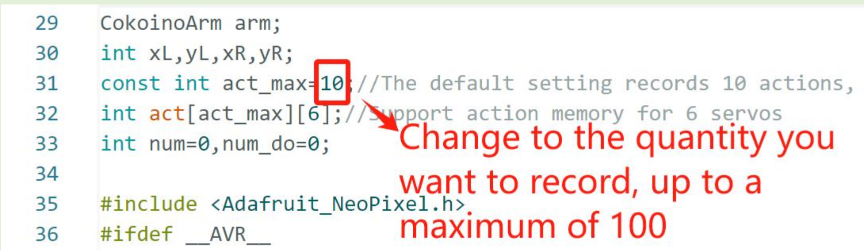
“triangle” button:Record an action.

After pushing the joystick or pressing the button to make the robotic arm perform an action, press the "triangle" button once, and this action will be memorized. After pushing the joystick or pressing the button again to make the robotic arm perform another action, press the "triangle" button once, and the second action will be memorized. In the code we provide, the default setting is to record 10 actions. After recording 10 actions, the buzzer will ring once to indicate that the action memory is complete.

If you want to remember more actions, you need to change the setting of the number of actions in the code. In line 31 of the code, you can modify the number, and the maximum should not exceed 100.



```
29  CokoinoArm arm;
30  int xL,yL,xR,yR;
31  const int act_max=10;//The default setting records 10 actions,
32  int act[act_max][6];//Support action memory for 6 servos
33  int num=0,num_do=0;
34
35  #include <Adafruit_NeoPixel.h>
36  #ifdef __AVR__
```


“cross” button:Execute recorded actions

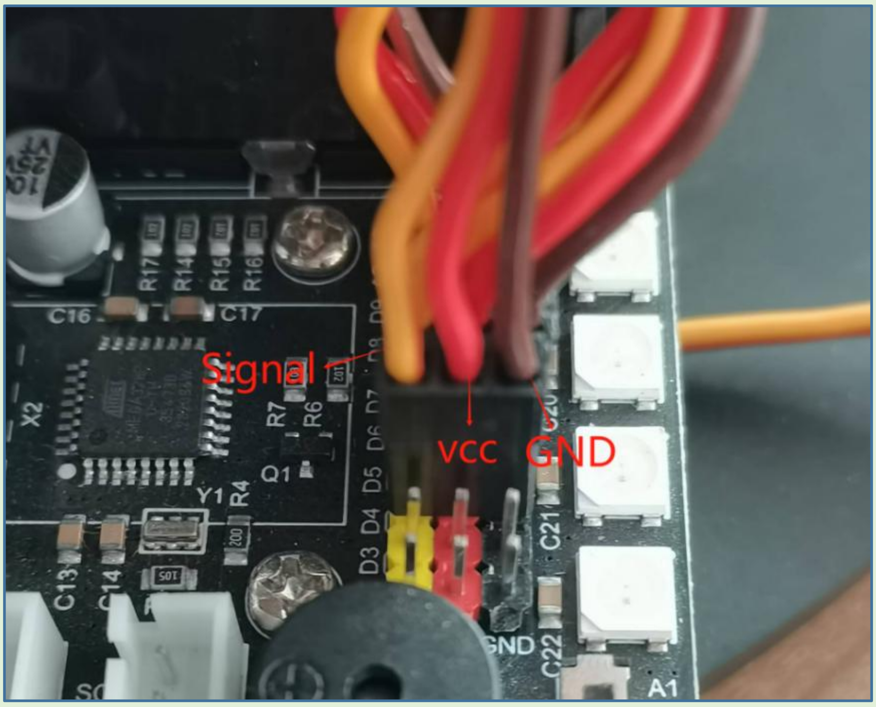
After completing the memory action, press the "cross" button, the buzzer rings twice, and the robotic arm executes the memory action. After all actions are completed, the buzzer will sound for 3 seconds and stop.

6. Trouble Shooting

6.1 The robotic arm is not working

---Check if the power light on the Robot Arm Drive Hat is on. If it is not on, it means that there is no power on. Check if the switch is turned to the "ON" state, and if the power adapter is plugged into the Robot Arm Drive Hat and powered on.

---Check if the female terminal of the servo motor is plugged into the correct position on the Robot Arm Drive Hat. Signal corresponds to the yellow pin, VCC corresponds to the red pin, and GND corresponds to the black pin.



6.2 The working methods do not match the description

---Confirm that all 6 servos have been tested and adjusted to 90 degrees before assembly.

---The servos 1, 2, 3, 4, 5, and 6 correspond one-to-one to D2, D3,D4,D5,D6,D7 on the Robot Arm Drive Hat, Confirm that the servo sequence is not connected incorrectly.

---Confirm that the servo cable is long enough and not wrapped around the robotic arm.

6.3 Robotic arm shaking

---The robotic arm shakes without operating the Handle controller. This is because there is a gap in the servo gear, which is around 3 °. When the robotic arm is in a standing position (when the center of gravity is not vertically downward), all the weight of the upper part of the Axis2 is loaded onto the Servo2, and under the action of gravity, it drives the servo panel on the Servo2 to rotate downwards towards the clearance angle. When the servo panel rotates to the limit position of the gear clearance, due to the inertia of gravity, it drives the Servo2 gear to rotate downwards by some angle. However, the program in the Robot Arm Drive Hat needs to maintain the angle before Servo2, and then drive Servo2 to rotate upwards back, and then Servo2 will rotate towards the gear clearance under the action of gravity. This cycle creates shaking.

Solution: Use your hands to straighten the body of the robotic arm so that it stands completely vertically with its center of gravity on Servo2 and vertically downward. At this point, the robotic arm will stop shaking.

6.4 The claw automatically release after grabbing the object

---The servo of the claw is Servo6, after using the handle to control the claw to grab objects, we added a 1A current self recovery fuse F3 in front of the Servo6 power supply on the Robot Arm Driver Hat to prevent the claws from closing excessively and damaging the servo. When the locked rotor current of Servo6 exceeds 1A, F3 will disconnect and Servo6 will stop working, causing the claw to release.

7. Any questions and suggestions are welcome

Thank you for reading this document!
If you find any errors and omissions in the tutorial, or if you have any suggestions and questions, please feel free to contact us:

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We will do our best to make changes and publish revisions as soon as possible.

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