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myCobot 280 M5 (2023)

The world's smallest collaborative robot

Core Document

This document contains comprehensive information from product introduction, detailed technical parameters to user instructions and product development guidance. The document will introduce the basic functions of the myCobot 280 M5 robot arm in depth, provide software development guidelines, and show successful application cases to help you understand how to effectively integrate myCobot 280 M5 into various applications. In addition, we also provide a wealth of support and service information to ensure that you can get the necessary help when you encounter any technical challenges.

Document Description

Depending on your needs and your level of expertise in myCobot 280 M5 application development, you can choose to follow this order from beginning to end or use it as a standalone reference. You can always use the sidebar navigation on the left to jump to any part of this document. The full text is divided into the following five sections:

Product Information

The product information section will provide you with a basic overview of the robot arm, including detailed technical specifications such as main functions, product parameters and electrical characteristics, to help you quickly understand the basic characteristics and usage environment of the product. In addition, this section will detail the application examples and supported extended development of the product, providing you with the necessary development guides and resources. At the end of the article, relevant purchase links and channels will be provided for your convenience.

Basic Settings

This section is an important section that every user of this product must read carefully. It covers key information about the use, transportation, storage and maintenance of the product, aiming to ensure the safety and efficiency of users when operating the product. In addition, this section also details the division of responsibilities for product failure or damage that may occur due to failure to follow these guidelines.

Functions and Applications

The Functions and Applications section details the basic functions of the robot arm and how to use the software, including system instructions and firmware functions. The Software Development Guide provides guidance based on different development environments, such as Python and ROS, to support technical developers in application expansion. By showing successful application cases and providing supporting resources, it provides you with practical references and necessary support materials for a deeper understanding and use of the product.

Support and Services

The Support and Services section will provide you with comprehensive troubleshooting guides and post-purchase service information, such as warranty and service terms, to help you quickly resolve problems when you encounter them, and ensure that you understand your rights and obligations after purchase. In addition, the 'About Us' section

reinforces the user's understanding of the myCobot series product design and manufacturer, aiming to build trust and brand loyalty.

Acknowledgements

We appreciate your taking the time to read the myCobot 280 M5 User Manual. We hope that this document will help you better understand and effectively use this robot, thereby inspiring your creativity. If you have any questions or need further assistance, please feel free to contact our customer support team. We look forward to seeing the innovative projects you complete with myCobot 280 M5 and welcome you to join our fast-growing developer community.

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    - Phone holder
    - Dexterous hand
    - USB camera
    - Bamboo flange
- Acknowledgments

Chapter 1 Product Introduction

1.product description

myCobot 280 M5

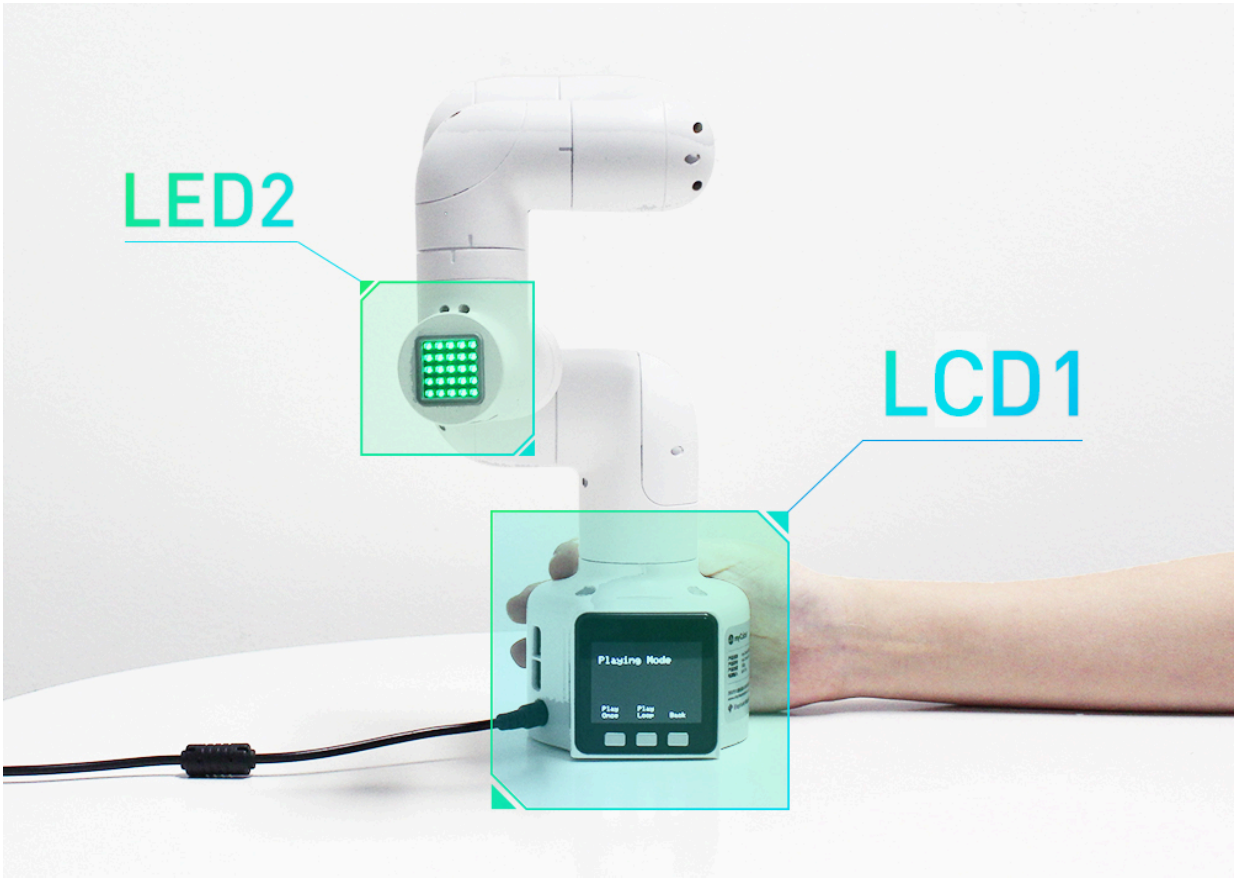
Desktop six-axis collaborative robot

Product Introduction

myCobot is jointly produced by **Elephant Robot** and **M5stack**. It is the **world's smallest and lightest six-axis collaborative robot**. It can be redeveloped according to user needs to achieve user customization. It is a productivity tool and a tool to expand the boundaries of imagination.

myCobot weighs 850g, has a payload of 250g, and an effective working radius of 280mm. It is small in size but powerful in function. It can be matched with a variety of end effectors to adapt to a variety of application scenarios, and can also support the secondary development of multi-platform software to meet the needs of various scenarios such as **scientific research and education, smart home, and commercial exploration**.

design concept

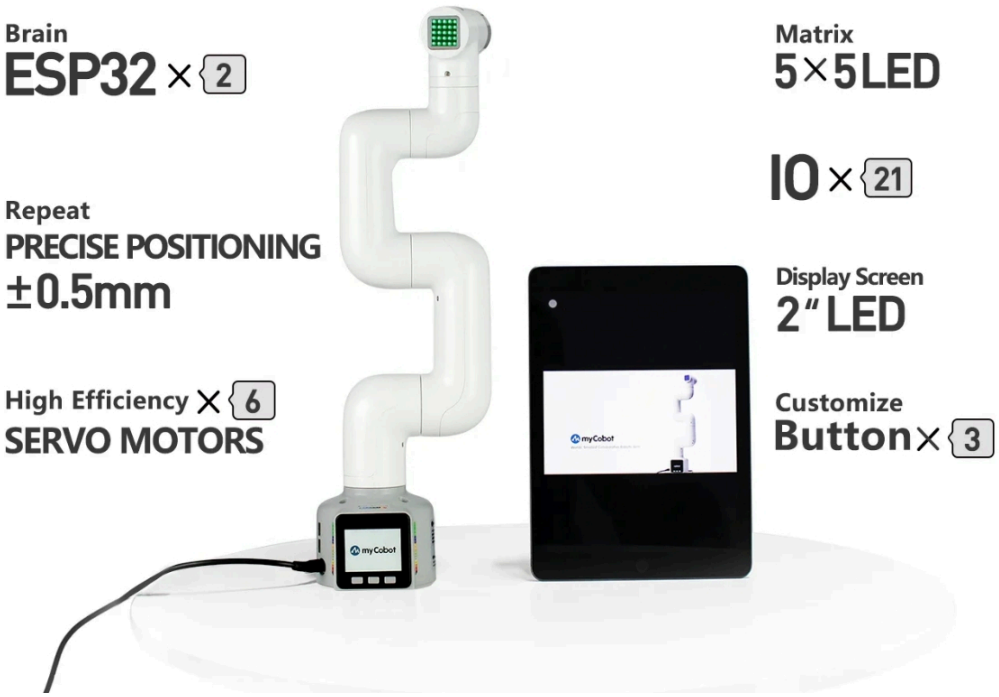


The myCobot 280 series robot arm is a six-degree-of-freedom collaborative robot developed by Elephant Robotics for scenarios such as scientific research and education, maker applications, and commercial displays. The robot arm has a compact and exquisite appearance and structure, and a one-piece fully enclosed body design without any leaking cables. It is equipped with the robot motion control algorithm independently developed by Elephant Robotics, and supports multiple control modes such as angle, coordinate, potential value, and radian value, making it easier for users to understand the complex working principles of robots and the application principles of robots. It supports the development of application cooperation and can be expanded to a variety of main controls such as PCs, industrial computers, and embedded devices, suitable for a variety of application scenarios.

Design goals

Design goals	description	Application scenarios and features
Universal multi-functional platform	myCobot 280 M5 is suitable for a variety of application scenarios such as education, research and commercial display, maker development, etc.	Its six degrees of freedom and 280mm arm span support complex motion control in various working environments. It can be equipped with a variety of end accessories such as grippers and suction pumps to meet various application scenarios.
Educational Support	myCobot 280 M5 supports drag-and-drop programming language and interactive drag-and-drop teaching, which facilitates the intuitive display of how the robot arm works.	The product supports the myblocky graphical programming tool, which allows beginners to intuitively experience robot applications by dragging and combining different modules for programming.
Programmability and scalability	The myCobot 280 M5 is highly programmable, allowing users to customize and program it to meet the needs of future technologies based on emerging technologies.	Through user-defined programming, the equipment can achieve optimized operation and experimental results to meet the ever-changing needs of research and development.
Technological innovation and knowledge dissemination	myCobot 280 M5 can be used as a platform to showcase the latest scientific and technological achievements in commercial exhibitions, aiming to enhance the public's understanding and interest in science and technology and promote the transformation of scientific and technological innovation into commercialization.	By displaying and demonstrating the latest scientific and technological achievements, we can increase public participation, promote the popularization of scientific and technological knowledge and the market acceptance of scientific and technological products.

Features



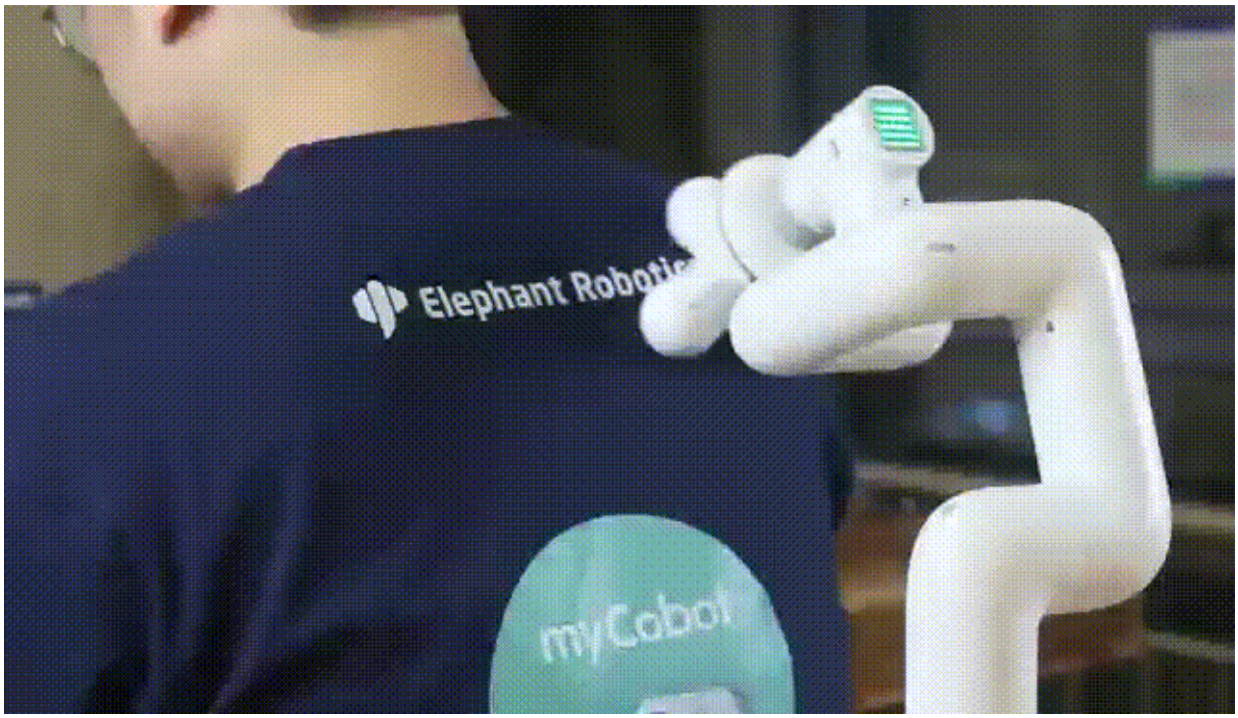
Unique industrial design, extremely compact	Integrated design, compact overall structure, net weight of only 850g, very easy to carry. Modular design, few spare parts, low maintenance cost, can be quickly disassembled and replaced, and realize plug and play
High configuration, equipped with two displays	It contains 6 high-performance servo motors with fast response, small inertia and smooth rotation. It has two display screens and supports fastLED library, which is convenient for expanding application interactive output.
LEGO connector, M5 has thousands of applications	The base uses M5Stack-basic as the main control, and thousands of application cases can be used directly. The base and the end are equipped with Lego technology parts interface, which is suitable for the development of various micro embedded devices.
Graphical programming, supporting industrial robot software	Using myBlockly visual programming software, programming is easy on the palm of your hand, and the operation is simple and easy to use. Supports Arduino + ROS open source system.
Track entry, point saving	myCobot 280 M5 supports drag-to-teach and can record the saved paths. It breaks away from the traditional path point storage mode and can save up to 60 minutes of different paths.

2.Product Application

Client

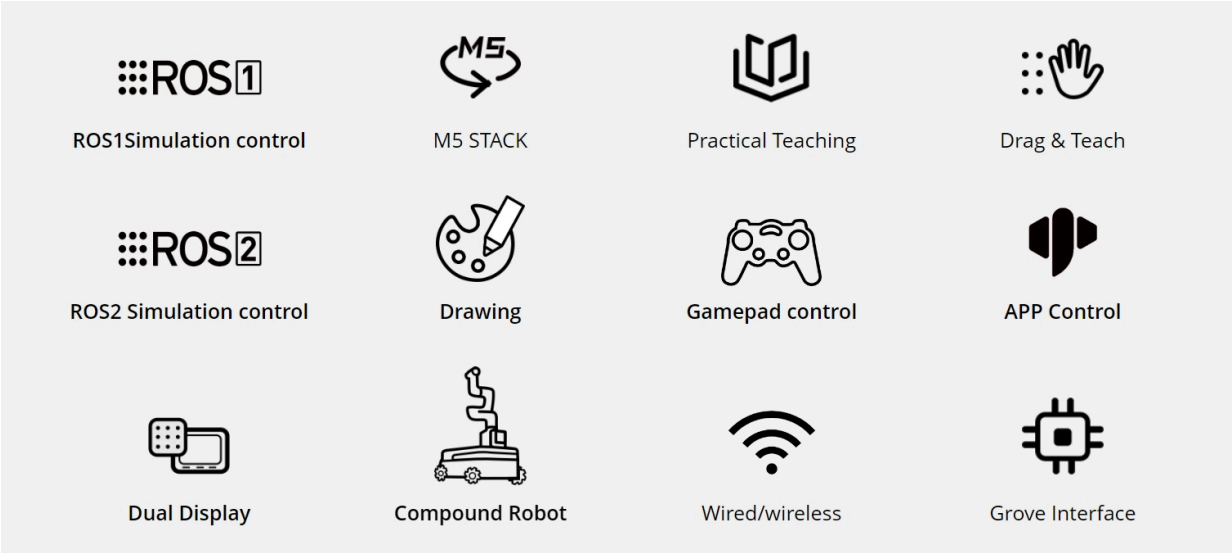
Educational institutions	myCobot 280 can be used as a teaching and scientific research tool designed for robotic experiments and technology demonstrations. It can effectively support complex data analysis, algorithm development and verification activities, significantly improving research quality and educational effectiveness.
Technical developers and engineers	Supporting multiple programming languages such as Python, C++, C#, myCobot 280 M5 is suitable for professionals who need personalized programming and system integration. Its modular design and high programmability make it an ideal platform for developing and testing new control algorithms or robot applications.
Trade show and public exhibition organisers	myCobot 280 has become the preferred equipment for technology display and product demonstration with its precision operation display advantage. Dynamic demonstration not only attracts the audience, but also enhances their sense of participation, effectively promoting technological innovation and products.
Geek development enthusiast	myCobot 280 uses myBlockly visual programming software, which allows users to easily program on the palm of their hands and is easy to operate. It supports Arduino + ROS open source systems to meet the various creative needs of enthusiasts.

Application Scenario



User Group	Application Scenarios	Advantage Target
Teachers and students in the field of education	- STEM education	- Improve students' interest in science and technology
	- Robotics projects	- Enhance hands-on skills and problem-solving skills
	- Interdisciplinary research projects	- Promote innovative thinking and teamwork
	- Education and research	- Provide a practical platform for data collection and robotics
Makers and technical developers	- Prototype development	- Accelerate research progress
	- Experimental research	- Connect theory and practice
	- Algorithm testing and verification	- Promote technological innovation
	- Robot trial teaching	- Support multiple programming languages and development environments
Business presentations and marketing professionals	- Exhibition displays	- Attract potential customers and investors
	- Technology demonstrations	- Showcase the company's technological strength and innovative products
	- Brand promotion	- Enhance brand influence

3.Supported extension development



The mycobot series of robotic arms are extremely valuable in the fields of education and scientific research, especially in Python and ROS (Robot Operating System), two widely used development environments. These environments provide strong support, allowing the mycobot series of products to be widely used in machine learning, artificial intelligence research, complex motion control, and visual processing tasks. At the same time, with dozens of accessories such as adaptive grippers, camera flanges, suction pumps, etc., you can give full play to myCobot's creative ideas.

Python	The robot supports Python and has a complete Python API library. The robot's joint angles, coordinates, grippers, etc. can be controlled through Python.
ROS	Supports both ROS1 and ROS2 versions, and provides RVIZ simulation environment support. Allows users to display the robot arm and collect the robot arm's status information in real time, making mycobot 280 M5 suitable for ROS beginners and educational purposes.
Hardware interface	Including IO, USB, etc., to facilitate the connection of various sensors and actuators.
Software library	Provides a wealth of open source libraries and APIs to simplify the development process.
System compatibility	Compatible with Windows, Linux, MacOS, and adaptable to a variety of development environments.
C++	Using the C++ language, you can freely develop (coordinate control, angle control, IO control, gripper control, etc.) through the C++ dynamic library developed by our company, and control some robots that our company has developed.
C#	Using the C# language, you can freely develop (coordinate control, angle control, io control, gripper control, etc.) through the C# dynamic library provided by our company, and control some robots that our company has developed.
Arduino	Provides the open source program MyCobotBasic sample program. At the same time, users can also modify the open source program according to their own needs.
JavaScript	The robot can be controlled through the company's JavaScript language ecosystem library.
myBlockly	It is both a graphical programming software and a visualization tool. Users can drag and drop modules to create programs. This process is very similar to building blocks, which is convenient, fast and easy to use.

4.purchase address

If you are interested in purchasing this device, please click on the link below

Taobao：https://shop504055678.taobao.com

Shopify：https://shop.elephantrobotics.com/

AliExpress：https://elephantrobotics.aliexpress.com/store/1101941423

Next Chapter →

Robot Parameters

> In the first chapter, we discussed the selling points of the product and its design concept, providing you with a panoramic perspective of the high-level understanding of the product. Now, let's move on to the second chapter - Robot Parameters. This chapter will be the key to your understanding of the product's technical details. A detailed understanding of these technical parameters will not only help you fully realize the advancement and practicality of our products, but also ensure that you can use these technologies more effectively to meet your specific needs.

1.Robot Specifications

Index	Parameters
Name	Little Elephant Collaborative Robot Arm
Model	myCobot 280 for M5
Degrees of Freedom	6
Payload	250g
Working Radius	280mm
Repeatability	±0.5mm
Weight	800g
Power Input	12V, 5A
Operating Temperature	-5-45℃
Communication	Type-C

2.Control Core Parameters

2.1Main Controller Specifications

Indicators	Parameters
Main Controller	M5Stack-basic
Main Controller Model	ESP32
CPU	240MHz Dual Core. 600 DMIPS, 520KB SRAM. Wi-Fi, dual-mode Bluetooth
Bluetooth	2.4G/5G
Wireless	2.4G 3D Antenna
Input	1, 2, 3, 5, 18, 19, 21, 22, 23, 25, 26, 35, 36
Output	Shared with input
LCD display	2.0" @ 320*240 ILI9342C IPS panel, maximum brightness 853nit
Physical buttons	

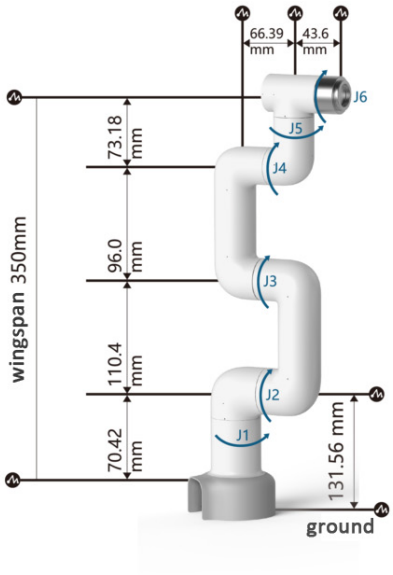
2.2Auxiliary controller specification table

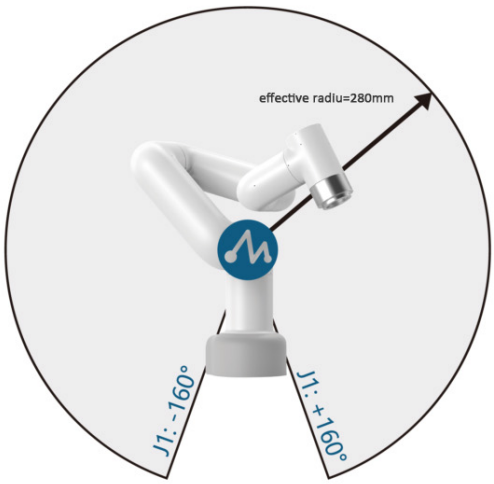
Indicators	Parameters
Auxiliary control	Atom
Auxiliary control model	ESP32
Auxiliary controller core parameters	240MHz dual-core. 600 DMIPS, 520KB SRAM. Wi-Fi, dual-mode Bluetooth
Auxiliary controller flash	4MB
LED matrix	5*5 LED light matrix
LCD display	2.0"@320*240 ILI9342C IPS panel, maximum brightness 853nit
C type	*1
Auxiliary control expansion IO	G19, G21, G22, G23, G25, G33

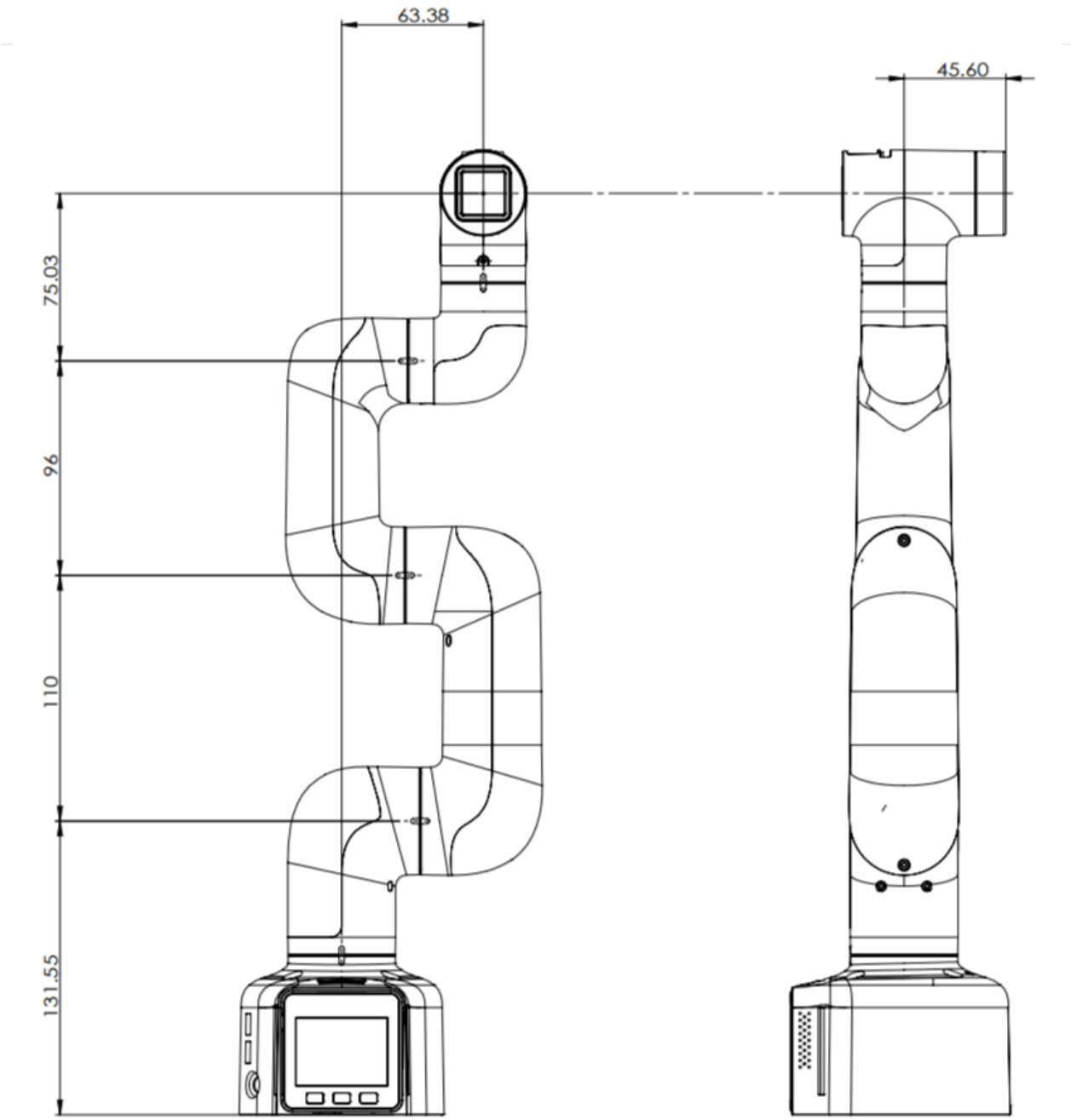
3.Structural dimension parameters

> ! This chapter uses millimeters as distance units and degrees as angle units.

3.1Product dimensions and working space







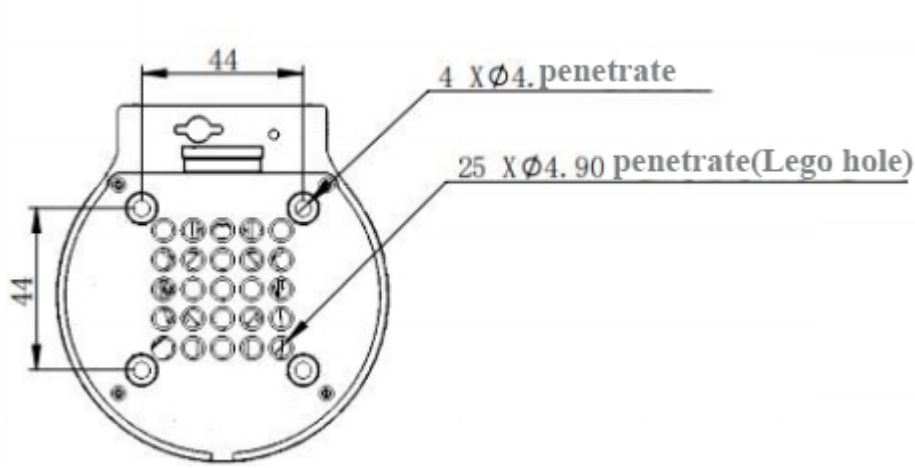
3.2Joint range of motion

> **Note:** ⚠ This joint limit information function is only available on Atom firmware ≥ 7.3 and pymycobot library ≥ 4.0.2.

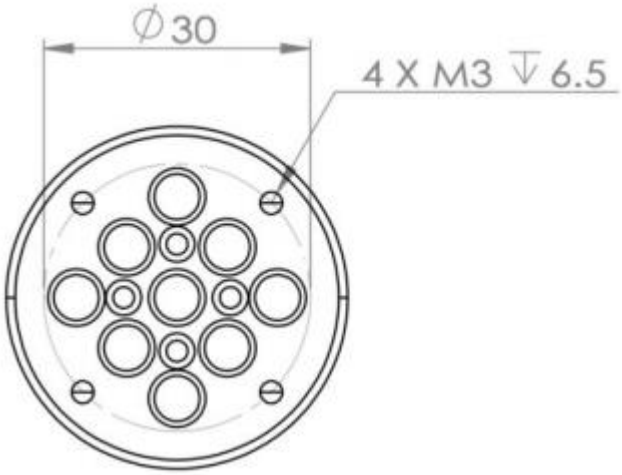
Joint	Range
J1	-168 ~ +168
J2	-140 ~ +140
J3	-150 ~ +150
J4	-150 ~ +150
J5	-155 ~ +160
J6	-180 ~ +180

3.3Hole installation

- The robot base is mounted with flanges. The base is compatible with both LEGO technology and M4 screw installation.



- The robot end is equipped with a flange, and the end of the robotic arm is compatible with both LEGO technology holes and screw thread holes.



4.Electrical characteristic parameters

4.1Electrical interface of the robot base

Introduction to the base

- A. The front of the base is shown in the figure below:

- ① Function interface group 1
- ② Basic display screen
- ③ Button 1, Button 2, Button 3

- B. The left side of the base is shown in the figure below:

- ① Grove 1, Grove 2
- ② Power DC interface
- ③ Function interface group 2
- ④ Reset button
- ⑤ Type C interface
- ⑥ Grove 3

- C. The right side of the base is shown in the figure below:

① Functional interface group three

- D. The bottom interface surface of the base is shown in the figure below:

① Functional interface group four

4.2Base interface description

> **Note:** The functional interface groups are all 2.54mm DuPont interfaces, and 2.54mm DuPont cables can be used externally.

- A. The definitions of each interface in function interface group 1 and function interface group 4 are consistent. The definition of each interface is shown in the following table:

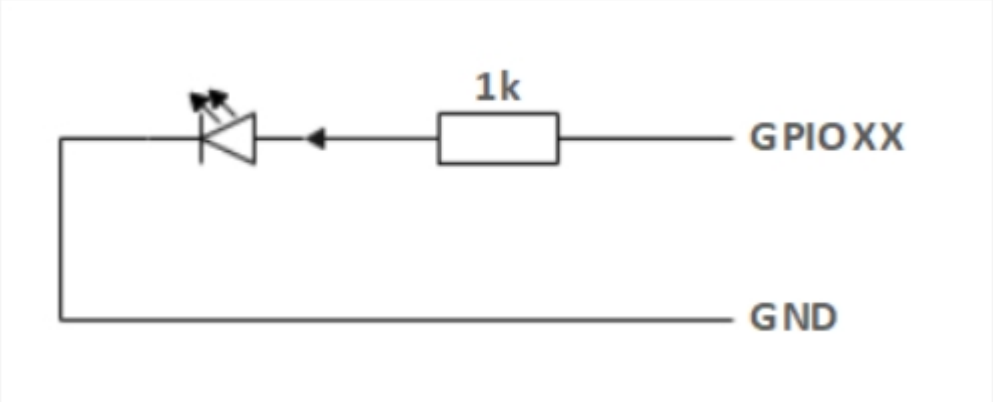
Label	Signal name	Type	Function	Remarks
18	G18	I/O	GPIO18	Not available when using TF card
19	G19	I/O	GPIO19	Not available when using TF card
23	G23	I/O	GPIO23	Not available when using TF card
22	G22	I/O	GPIO22	
21	G21	I/O	GPIO21	
G	GND	P	GND	
3V3	3V3	P	DC 3.3V	
5V	5V	P	DC 5V	

- B. The definitions of each interface in function interface group 2 and function interface group 3 are consistent. The definition of each interface is shown in the following table:

Label	Signal name	Type	Function	Remarks
3	G3	I/O	GPIO3	Not available when using TypeC or Grove 2
1	G1	I/O	GPIO1	Not available when using TypeC or Grove 2
16	G16	I/O	GPIO16	Not supported yet
17	G17	I/O	GPIO17	Not supported yet
2	G2	I/O	GPIO2	
5	G5	I/O	GPIO5	
25	G25	I/O	GPIO25	Not supported
26	G26	I/O	GPIO26	Not available when using Grove 1
35	G35	I/O	GPIO35	Not supported
36	G36	I/O	GPIO36	Not available when using Grove 1
RST	RST	-	Controller reset	Not supported
BAT	BAT	-	BTTERY	Not supported
3V3	3V3	P	DC 3.3V	
5V	5V	P	DC 5V	
G	GND	P	GND	

Note:

1. I: Input only.
2. I/O: This function signal includes input and output combination.
3. When the tube angle is set as the output end, it will output a voltage of 3.3V.
4. i. The pull current of a single tube angle decreases as the number of pins increases, from about 40mA to 29mA.
5. If a GPIO is set to output mode, it outputs a high-level signal, and the circuit connection is shown in Figure 2.1.1.2-5, and the LED light will light up.



1. The other function tables of the function interface are shown in the figure below. When other functions are used, the IO function is not available.

GPIO TYPE	Analog Function	M-BUS LINE 0		LINE 1		Analog Function	GPIO TYPE
		GND		ADC	G35	ADC1_CH7	I
		GND		ADC	G36	ADC1_CH0	I
		GND		RST	EN		
I/O/T		G23	MOSI	DAC/SPK	G25	ADC2_CH8	I/O/T
I/O/T		G19	MISO	DAC	G26	ADC2_CH9	I/O/T
I/O/T		G18	SCK	3.3V			
I/O/T		G3	RXD1	TXD1	G1		I/O/T
I/O/T		G16	RXD2	TXD2	G17		I/O/T
I/O/T		G21	SDA	SCL	G22		I/O/T
I/O/T	ADC2_CH2/T2	G2	GPIO	GPIO	G5		I/O/T
I/O/T	ADC2_CH5	G12	IIS_SK	IIS_WS	G13	ADC2_CH4/T4	I/O/T
I/O/T	ADC2_CH3/T3	G15	IIS_OUT	IIS_MK	G0	ADC2_CH1/T1	I/O/T
		HPWR		IIS_IN	G34	ADC1_CH6	I
		HPWR		5V			
		HPWR		BATTERY			

- C. Power DC interface: Use a DC power socket with an outer diameter of 6.5mm and an inner diameter of 2.0mm; the 8.4V 5A DC power adapter provided by the manufacturer can be used to power myCobot 280.
- D. Grove interface: Grove interface definition as shown in Figure A, Figure B, and Figure C

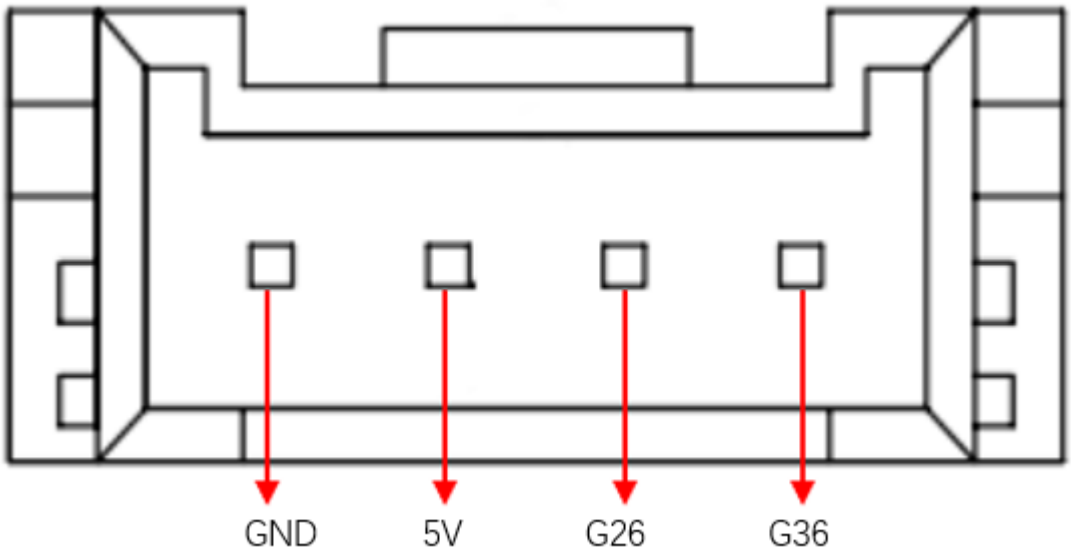


Figure A Grove 1

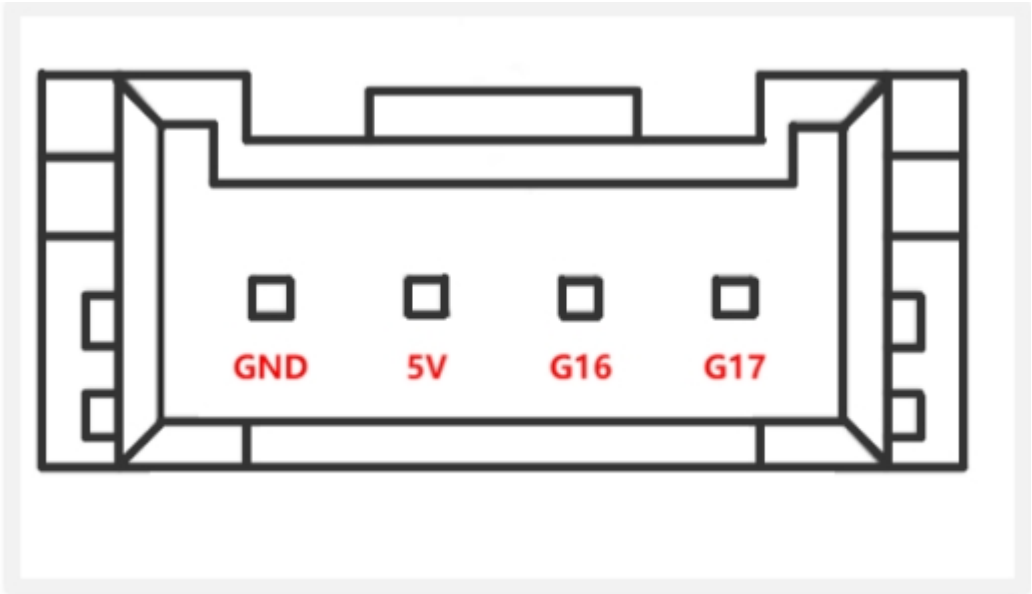


Figure B Grove 2

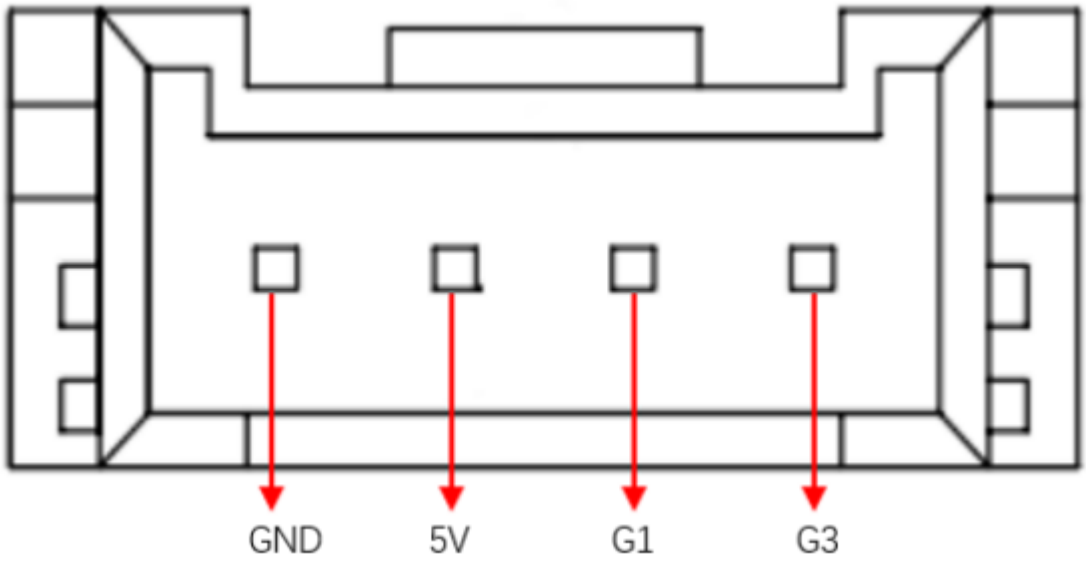


Figure C Grove 3

- E. Type C interface: can be used to connect and communicate with the PC. When this interface is used, the G1 and G3 interfaces are occupied.
- F. Reset button: used to reset the main control system.
- G. Button A, Button B, and Button C: used with the display screen for functional operations.
- H. Display screen: Use a 2-inch IPS screen, which can be used to display myCobot communication status/correct the robot origin with buttons, etc.

4.3 Electrical interface of the end of the robot

Introduction to the end of the robot

- A. The end of the robot is shown in Figure D and Figure E:

Figure D End of the robot

- ① Servo interface
- ② Atom

Figure E End of the robot

- ① Function interface group 5
- ② Grove 4
- ③ Type C

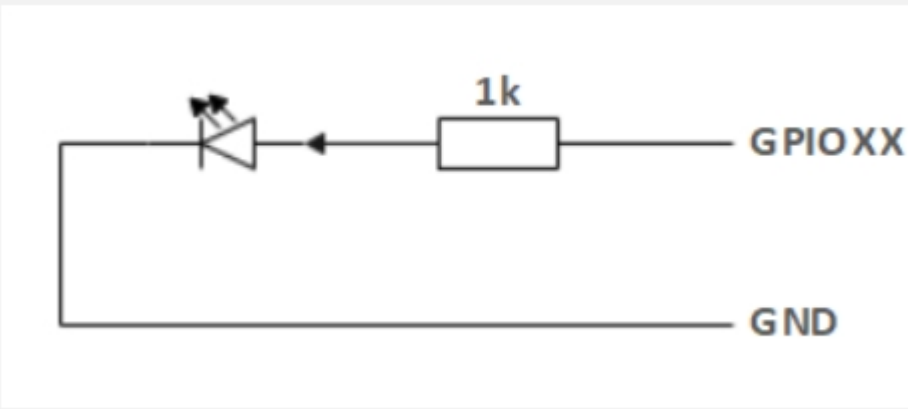
End interface description

- A. The definitions of each interface of the function interface group 5 are shown in the following table:

Label	Signal name	Type	Function	Remarks
5V	5V	P	DC 5V	
GND	GND	P	GND	
3V3	3V3	P	DC 3.3V	
G22	G22	I/O	GPIO22	
G19	G19	I/O	GPIO19	
G23	G23	I/O	GPIO23	
G33	G33	I/O	GPIO33	

Note:

1. I: Input only.
2. I/O: This function signal contains input and output combination.
3. When the tube angle is set as output terminal, it will output voltage 3.3V.
4. i. The pull current of a single tube angle decreases as the number of pins increases, from about 40mA to 29mA.
5. If a GPIO is set to output mode, it outputs a high-level signal, and the circuit connection is as shown in the figure below, and the LED light will light up.



- B. Type C interface: can be used to connect and communicate with the PC and update the firmware.

- C. Grove 4: definition as shown in Figure F

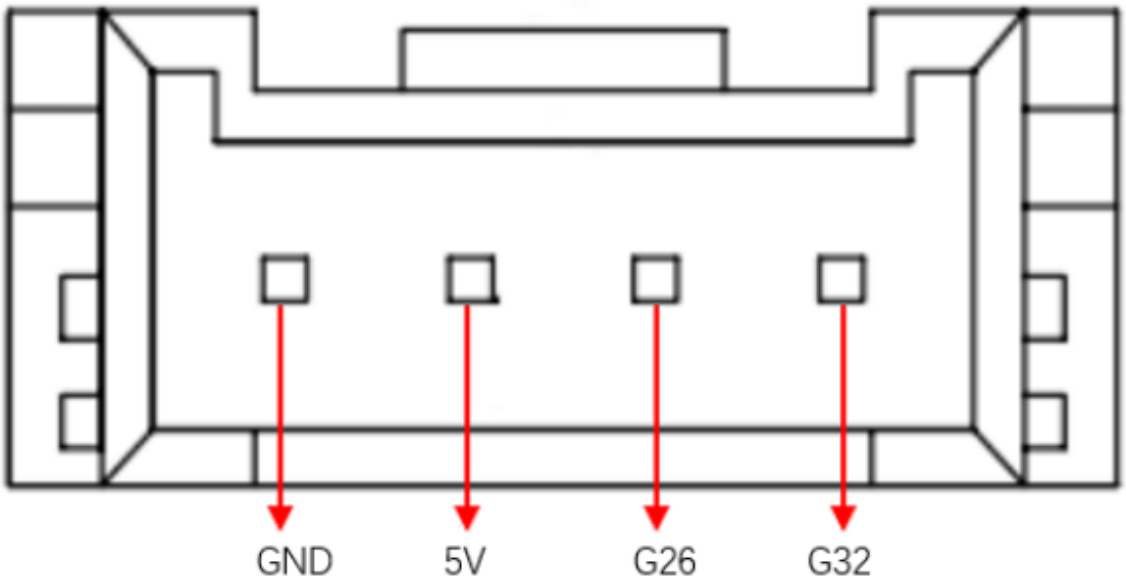
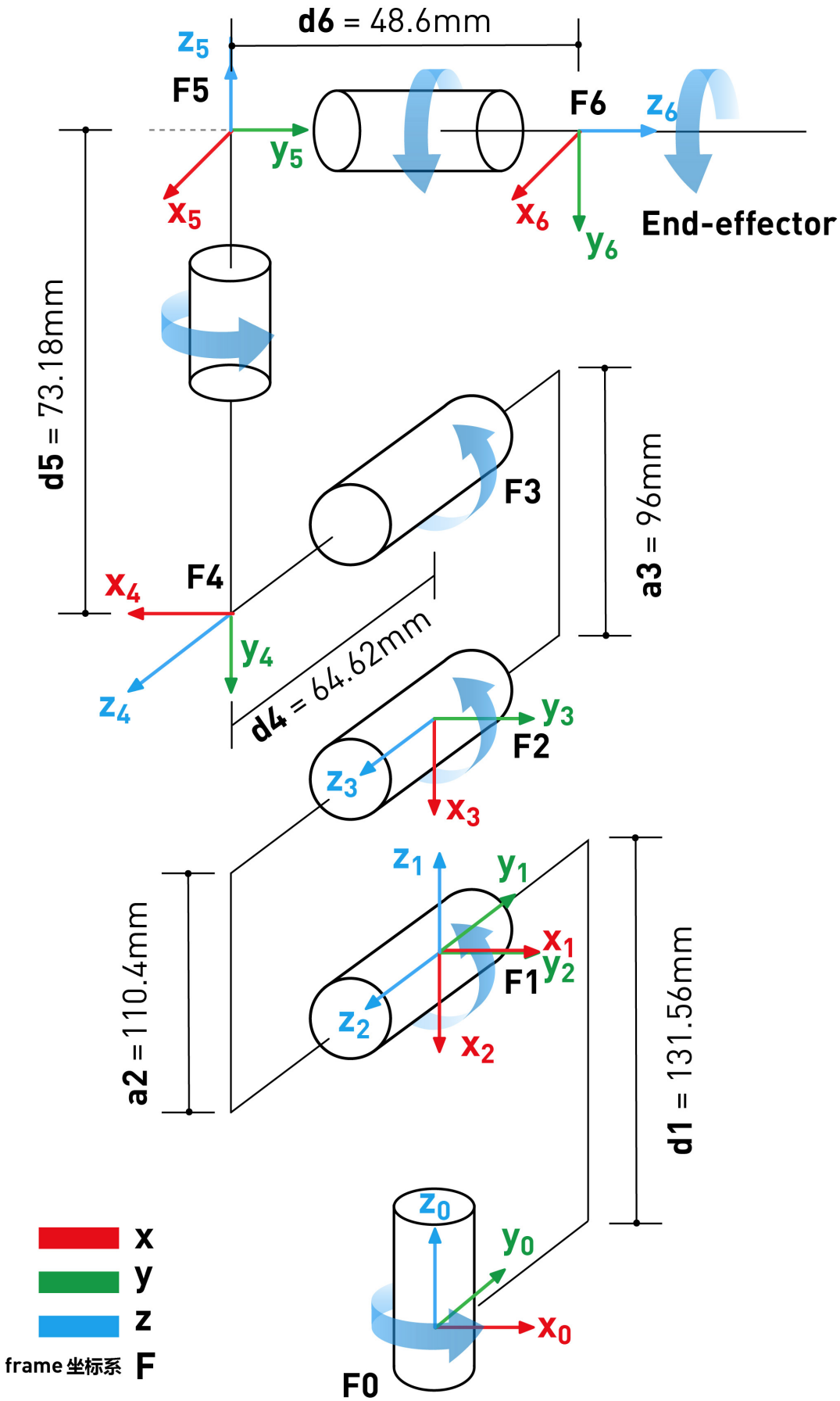


Figure F Grove 4

- D. Servo interface: used for the end extension gripper, currently supports the use of matching adaptive grippers.
- E. Atom: for 5X5 RGB LED (G27) display and key function (G39)

5.Cartesian coordinate parameters


d6 = 48.6mm
z5
F5
y5
x5
F6
z6
x6
y6
End-effector
d5 = 73.18mm
F3
a3 = 96mm
x4
F4
y4
z4
d4 = 64.62mm
y3
F2
z3
x3
z1
y1
x1
y2
F1
z2
x2
a2 = 110.4mm
d1 = 131.56mm
z0
y0
x0
F0
x
y
z
frame 坐标系 F

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Chapter 3 User Notice

> Chapter 3 User Notice is a must-read for every user to ensure that the user can achieve the established safety standards and efficiency when using the product. This chapter not only provides basic information on product use, transportation, storage and maintenance to ensure safe operation and maximized efficiency of the product, but also details the liability issues for product failure or damage that may result from failure to comply with these guidelines.

1.Safety Instructions

Introduction

This chapter details general safety information for personnel who perform installation, maintenance and repair work on the Elephant Robot. Please fully read and understand the contents and precautions of this chapter before handling, installing and using it.

Hazard Identification

The safety of collaborative robots is based on the premise of correctly configuring and using the robots. Moreover, even if all safety instructions are followed, injuries or damage to the operator may still occur. Therefore, it is very important to understand the safety hazards of robot use, which is conducive to preventing them before they happen.

Tables 1-1 to 3 below are common safety hazards that may exist when using robots:

Table 1-1 Dangerous safety hazards


1 Personal injury or robot damage caused by incorrect operation during robot handling.
2 Failure to fix the robot as required, such as lack of screws or screws not tightened, insufficient base locking capacity to stably support the robot for high-speed movement, etc., causing the robot to fall over, resulting in personal injury or robot damage.
3 Failure to correctly configure the robot's safety functions, or insufficient installation of safety protection tools, etc., causing the robot's safety functions to fail to function, thus causing danger.

Table 1-2 Warning-level safety hazards


1 Do not stay in the robot's motion range when debugging the program. Improper safety configuration may not be able to avoid collisions that may cause personal injury.
2 The connection between the robot and other equipment may cause new hazards, and a comprehensive risk assessment needs to be re-performed.
3 Scratches and punctures caused by sharp surfaces such as other equipment or the robot's end effector in the working environment.
4 The robot is a precision machine and trampling may cause damage to the robot.
5 Failure to clamp in place or not removing the clamped object before turning off the robot's power or air source (not confirming whether the end effector is secure and the clamped object falls due to power loss) may cause dangers, such as damage to the end effector and injuries to people.
6 The robot may move unexpectedly. Do not stand under any axis of the robot under any circumstances!
7 The robot is a precision machine. If it is not placed stably during transportation, it may cause vibration, which may cause damage to the robot's internal components.
8 Compared with ordinary mechanical equipment, the robot has more degrees of freedom and a larger range of motion. Failure to meet the range of motion may cause unexpected collisions.

Table 1-3 Safety hazards that may cause electric shock


1 Using non-original cables may cause unknown dangers.
2 Electrical equipment in contact with liquid may cause leakage.
3 There may be a risk of electric shock when the electrical connection is incorrect.
4 Always turn off the power of the controller and related devices and unplug the power plug before replacing. If the work is carried out in the power-on state, it may cause electric shock or malfunction.

Safety Precautions

The following safety rules should be followed when using the robot arm:

- The robot arm is a live device. Non-professionals are not allowed to change the circuit at will, otherwise it is easy to cause damage to the equipment or personal injury.

- When operating the robot arm, local laws and regulations should be strictly observed. The safety precautions and "Danger", "Warning" and "Caution" items described in the manual are only used as supplements to local safety regulations.
- Please use the robot arm within the specified environmental range. Exceeding the robot arm specifications and load conditions will shorten the product life or even damage the equipment.
- Personnel responsible for installing, operating and maintaining the myCobot robot arm must first undergo rigorous training, understand various safety precautions, and master the correct operation and maintenance methods before operating and maintaining the robot.
- Do not use this product in a humid environment for a long time. This product is a precision electronic component. Long-term operation in a humid environment will damage the device.
- Do not use this device in a high temperature environment. The outer surface of this device is made of photosensitive resin as raw material. Higher temperatures will damage the outer shell of the device and cause equipment failure.
- Highly corrosive cleaning is not suitable for cleaning the robot arm, and anodized parts are not suitable for immersion cleaning.
- Do not use this product without a base installed to avoid damage to the device or accidents. This product should be used in a fixed environment with no obstacles around.
- Do not use other power adapters for power supply. If the device is damaged due to the use of an adapter that does not meet the standards, it will not be covered by after-sales service.
- Do not disassemble, disassemble, or unscrew the screws or casing of the robot arm. If disassembled, warranty service cannot be provided.
- Personnel who have not received professional training are not allowed to repair faulty products or disassemble the robot arm without authorization. If the product fails, please contact myCobot technical support engineers in time.
- If the product is scrapped, please comply with relevant laws to properly dispose of industrial waste and protect the environment.
- Children must be monitored by someone during use, and the device must be turned off in time when the operation is completed.
- When the robot is in motion, do not put your hand into the range of motion of the robot arm to avoid injury.
- It is strictly forbidden to change or remove and modify the nameplate, instructions, icons and markings of the robot arm and related equipment.
- Please be careful during transportation and installation. Please place the robot gently and correctly in the direction of the arrow according to the instructions on the packaging box, otherwise it is easy to damage the machine.
- **Do not burn other product drivers without authorization, or use unofficial recommended methods to burn firmware.** If the device is damaged due to the user's personal burning of other firmware, it will not be covered by after-sales service.

If you have any questions or suggestions about the contents of this manual, please log in to the official website of Elephant Robotics to submit relevant information:

https://www.elephantrobotics.com

Do not use the robot arm for the following purposes:

- Medical and life-critical applications.
- In an environment that may cause an explosion.
- Direct use without risk assessment.
- Use with insufficient safety function level.
- Use that does not meet the robot performance parameters.

2.Transportation and storage

Packing and packaging

When packing and packaging the robot product, please make sure to use packaging materials and boxes designed for it. These materials can provide sufficient cushioning and support to prevent impact and vibration during transportation. Be sure to check that all parts are properly fixed to avoid looseness and damage. For fragile or sensitive parts, additional anti-vibration protection materials should be used for reinforcement. Finally, make sure that the outside of the packaging box is marked with clear handling and warning labels to indicate the correct handling method and storage direction.

Logistics and Transportation

During transportation, the robot product should be transported in the original packaging. During transportation, it should be ensured that the robot product is stable as a whole in the packaging box and protected by appropriate measures. During transportation and long-term storage, the ambient temperature should be maintained in the range of -20 to +55°C, and the humidity should be ≤95% without condensation.

Because the robot is a precision machine, the robot product should be handled with care when it is removed from the packaging. During transportation, if it is not placed stably, it may cause vibration and damage the internal parts of the robot.

Equipment Storage

After transportation, the original packaging should be properly stored in a dry place, the ambient temperature should be kept within the range of -20 to +55°C, the humidity should be ≤95% and there should be no condensation, in preparation for future repackaging and transportation needs. Do not stack other items on the original packaging box of the robot arm to prevent deformation of the packaging box and damage to the robot arm.

3.Maintenance and Care

As a robot manufacturer, we value ensuring that our customers can properly and safely maintain and upgrade their robot equipment. To this end, we provide the following detailed maintenance and care guide, including common maintenance items and parts for repairing or upgrading hardware. Please read carefully:

Common maintenance items and recommended cycles

Maintenance items	Description	Recommended cycle
Visual inspection	Inspect the robot for obvious damage, foreign material accumulation or wear.	Daily
Structural cleaning	Clean the robot structural parts with a clean, dry cloth. Avoid moisture and aggressive cleaning agents.	Daily
Fastener inspection	Inspect and tighten all bolts and connectors.	Daily
Lubrication	Lubricate joints and moving parts with the lubricant recommended by the manufacturer.	Every 3 months
Cable and wiring inspection	Inspect the cables and wiring to ensure that there is no damage or wear.	Monthly
Electrical connection check	Ensure that all electrical connections are secure and free of corrosion or damage.	Monthly
Software update	Check and update the control software and application.	Every update
Software data backup	Regularly back up key software configuration and data.	Quarterly
Firmware update	Regularly check and update the firmware to obtain the latest features and security patches.	Every update
Sensor and device check	Check sensors and other key devices to ensure normal operation.	Monthly
Emergency stop function test	Regularly test the emergency stop function to ensure its reliability.	Monthly
Environmental condition monitoring	Monitor the temperature, humidity, dust, etc. of the working environment to ensure that it meets the operating specifications of the robot.	Continuous monitoring
Safety configuration review	Regularly check and confirm the safety configuration of the robot, such as speed limit and working range settings.	Monthly
Preventive maintenance plan execution	Perform regular inspections and maintenance according to the manufacturer's maintenance plan.	By Manufacturer's Guide

4.Guide to Independently Changing Robot Hardware

We understand that customers may have the need to upgrade or repair robot hardware by themselves. Before performing any upgrade operations, please be sure to read the relevant parameters of the product in detail and confirm with our official personnel whether such operations are allowed. Operations without official permission may cause product failure and are not covered by the warranty.

Material Requirements

Officially manufactured or recommended materials: All accessories and components required for repairs and upgrades must be officially manufactured or explicitly recommended by us. This includes but is not limited to electronic components, sensors, motors, connectors, and any other replaceable parts.

Material Acquisition: Customers can purchase the required repair and upgrade materials through our official channels. This ensures the quality and compatibility of the accessories.

Repair or Upgrade Process

Customer Self-Repair: Customers are responsible for completing the repair work. We will provide detailed repair instructions and manuals to guide customers through the repair steps.

Follow official instructions: Repair operations should strictly follow the official instructions provided by us. Any deviation from the official instructions may cause damage to the equipment.

Liability and Warranty Policy

- Division of Responsibilities: Manufacturer: Provide official instructions for repairs and upgrades, officially manufactured or recommended materials, and handle problems caused by manufacturing defects. Customer: Responsible for completing repairs in accordance with official instructions and using official accessories.
- Warranty Policy: Warranty Valid: Warranty is valid only if the repair operation fully follows our instructions and uses official accessories. Warranty Void: If the customer does not follow the official instructions or uses unofficial accessories for repairs or upgrades, any damage caused will not be covered by the warranty.

Notes

- Safety First: Before performing any repair or upgrade operations, please make sure to follow all safety guidelines, including powering off and using appropriate protective equipment.
- Technical Support: If you encounter problems during the repair process, it is recommended to stop the operation and contact our technical support team for assistance.

We strongly recommend that customers strictly follow these guidelines to ensure the safe and effective operation of the robot equipment. Improper repair operations may cause damage to the equipment and affect the warranty status. For further guidance or support, please contact our professional technical team in a timely manner.

If you have read all of this chapter, please continue to the next chapter.

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Chapter 4 First Installation

1.Product Standard List

Product List Image

> Thank you for choosing the Elephant Robot myCobot 280 M5 robot arm. This chapter is designed to help you easily get started with Elephant Robot products and enjoy every wonderful moment brought by the product.

Product Standard List Comparison Table

Serial Number	Product
1	myCobot Robotic Arm (Model myCobot-280 M5)
2	myCobot Robotic Arm-Product Brochure
3	myCobot Robotic Arm-Supporting Power Supply
4	USB-Type C
5	Jumper
6	M4*35, Cup Head Hexagon, Full Thread, Stainless Steel Screws
7	Hexagon Wrench

Note: After the packing box arrives, please confirm that the robot packaging is intact. If there is any damage, please contact the logistics company and the supplier in your area in time. After unpacking, please check the actual items in the box according to the item list.

2.Product Unpacking Guide

Product Unpacking Graphic Guide

Why do you need to follow the steps to disassemble the product

In this section, we strongly recommend that you follow the specified steps to disassemble the product. This will not only help ensure that the product is not damaged during transportation, but also minimize the risk of unexpected failures. Please read the following graphic guide carefully to ensure the safety of your product during the unpacking process.

- **1** Check the packaging box for damage. If there is damage or missing accessories, please contact the logistics company and the supplier in your area in time.
- **2** Open the box and take out the product brochure, sponge packaging cover, myCobot robot arm, matching power supply, flat base and accessory bag.
- **3** Make sure each step is completed before proceeding to the next step to prevent unnecessary damage or omissions.

Note: After taking out the product, please carefully check the appearance of each item. Please check the actual items in the box against the item list.

3.Product unboxing video guide

If the video above does not play, you can click the link below to view the unboxing video unboxing video guide

4.Power-on inspection guide

Structural installation and fixation

During the movement of the **robot arm**, if the **bottom surface of myCobot is not connected to the desktop or other bottom surface**, myCobot will still **shake or overturn**.

There are three common ways to fix the robot arm:

1) Use the Lego key to fix it on a base with a Lego interface We sell two types of bases: flat suction cup base and G-clip base

Flat base Applicable model: myCobot 280

- Install suction cups at the four corners of the base and tighten them.
- Use the included Lego technology parts to connect the flat base and the bottom of the robot arm.
- Fix the four suction cups on a flat and smooth surface before starting to use.

- Tips: You can add a small amount of non-conductive liquid under the suction cup to fill the gap between the suction cup and the desktop to obtain the best adsorption effect.

G-type base Applicable models: myCobot 280, myPalletizer 260

- Use the G-clip to fix the base to the edge of the table

- Use the included Lego tech parts to connect the base and the bottom of the robot arm
- Make sure it is stable before starting to use

2 myCobot base screw hole connection

The robot needs to be fixed on a solid base for normal use. Base weight requirement: fixed base or mobile base.

Please make sure there are corresponding threaded holes on the fixed base before installation.

Before formal installation, please confirm:

- The installation environment meets the requirements of the above "Working Environment and Conditions" table.
- The installation location is not less than the robot's working range, and there is enough space for installation, use, maintenance, and repair.
- Place the base in a suitable position.
- The installation related tools are ready, such as screws, wrenches, etc. **After confirming the above content**, please move the robot to the base installation table, adjust the robot position, and align the robot base fixing holes with the holes on the base installation table. After aligning the holes, align the screws with the holes and tighten them.
- Note: When adjusting the robot position on the base installation table, please try to avoid pushing and pulling the robot directly on the base installation table to avoid scratches. When manually moving the robot, please try to avoid applying external force to the fragile parts of the robot body to avoid unnecessary damage to the robot.

5. Common Problem Solving

This section aims to help users solve common problems encountered during use, covering hardware, software, accessories, and how to self-check for the first time. If you encounter problems while using the robot arm, please read the contents of this section first to find solutions. If the listed problems cannot help you solve and you have more after-sales questions to consult, please add the after-sales butler WeChat.

First-time self-check

Common software problems and solutions

Common hardware problems and solutions

Common accessories problems and solutions

Other problems and solutions

If you have read all the contents of this chapter, please continue to the next chapter.

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First-time self-check- Machine Joint Function Verification

> **Note:** When starting the robot arm, please be careful not to let the robot arm be in a curled-up or touching position between joints. It is recommended that the robot arm posture should be as shown in Figure 1 below when starting. Figures 2 and 3 are both incorrect starting postures:

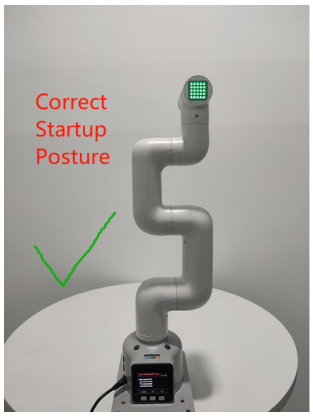
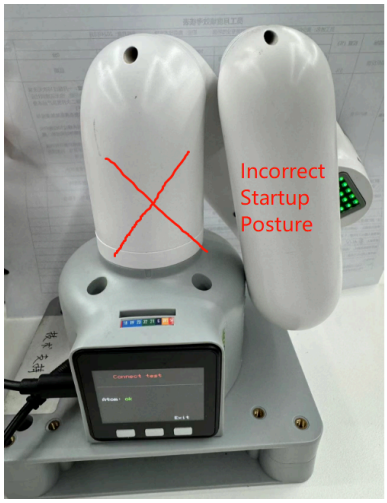
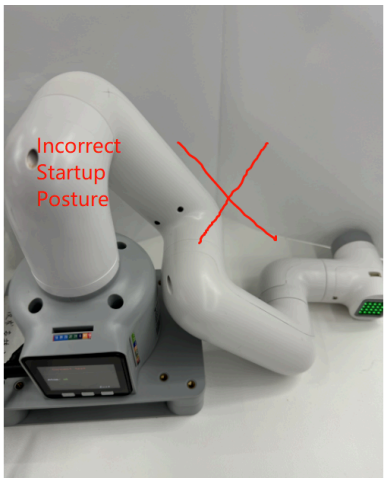
		

Figure 1 (Correct Posture)	Figure 2 (Incorrect Posture)	Figure 2 (Incorrect Posture)

Joint control method steps

1. Make hardware connections

- Hardware connections for M5 series machines:

Make sure the M5 series robot is connected to the power adapter and USB data cable.

2. Install and configure the software environment

You need to prepare a computer to use the M5 version of the machine. Install python, pymycobot library and USB serial port driver on the computer. For details, please refer to the environment configuration section of gitbook.

3. Choose the correct communication method

Before using each communication method, you need to make sure that the LCD screen of M5 is adjusted to the corresponding mode and maintain this communication state to control the robot arm normally. When using myblockly, python, ros and other development methods for the M5 robotic arm, you need to ensure that the M5 LCD screen stays on the Atom: ok interface, as shown below:

Note: When the screen displays Atom: no, you need to power on the machine again and check according to the self-check steps of the hardware-related "How to solve the problem of the robotic arm not being able to lock when powered on" in this article

4.USB communication example

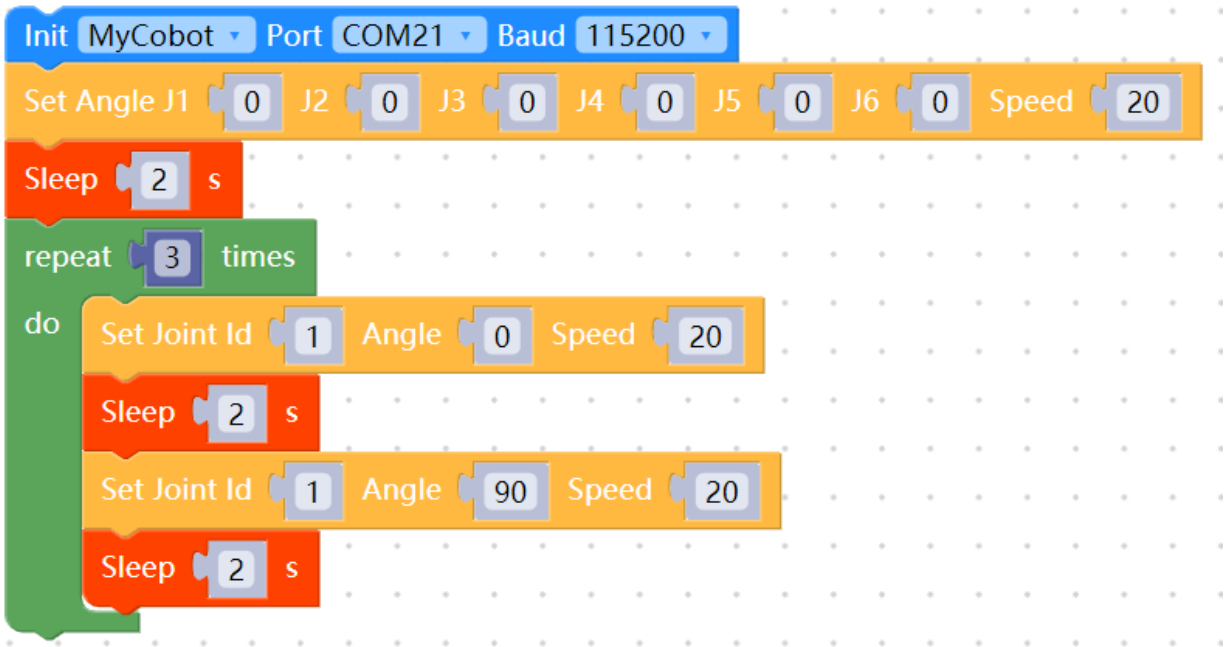
Please use myblockly or python source code examples to verify the joint motion of the robotic arm.

Pay special attention to the need to select the corresponding serial port and baud rate when using the USB serial port opening method so that the robot arm can communicate with the computer normally and thus control the robot arm normally:

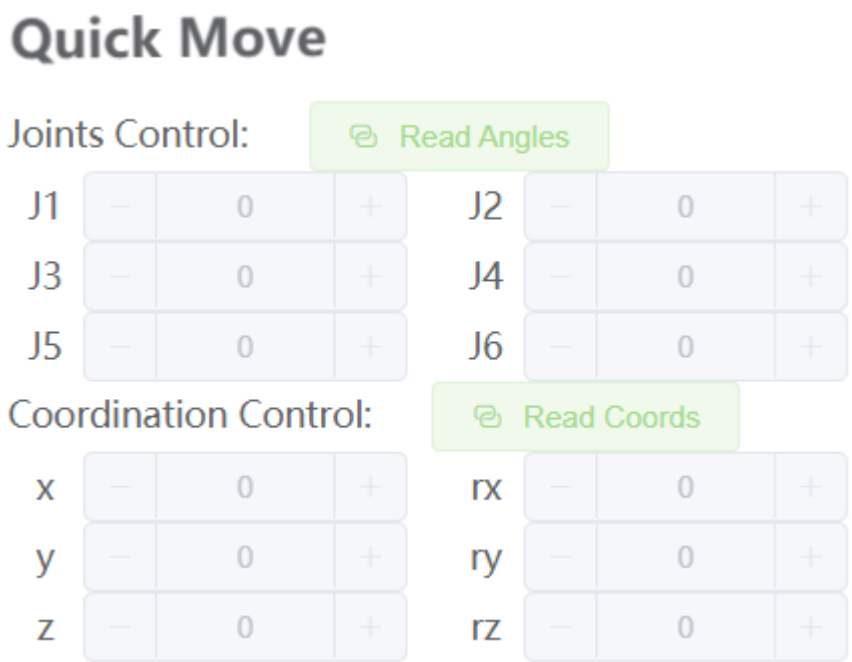
Machine model	Serial port number	Baud rate
260 M5	Win: COM; Linux: /dev/ttyUSB	115200
270 M5	Win: COM; Linux: /dev/ttyUSB	115200
280 M5	Win: COM; Linux: /dev/ttyUSB	115200

Note: Regarding the selection of the COM port of the M5 series machine, it is necessary to make a real-time selection based on the port number recognized by the current personal computer, because the COM port number recognized by each person's computer may be different and not fixed. The specific selection scheme can be viewed in this document. "Q: Why is the connection rejected when selecting a certain COM port? Or how to find the corresponding COM port?" Answer

4.1 Robotic arm joint movement myblockly source code



When you see the robot arm joint 1 cycle 3 times from 0 to 90 degrees, it means that the robot arm joint 1 responds normally. You can try to change the joint ID to test other joints and learn other cases in gitbook step by step or use the robot arm to do various interesting things! It is worth mentioning that if you are not familiar with the code block development method of myblockly, there is also a relatively quick way to verify the joints: use the myblockly fast movement tool to perform simple joint motion control. For specific usage, please refer to: Myblockly fast movement tool usage



4.2 Robotic arm joint motion joint python source code

```
#The motion effect is that the robot arm moves around the zero position, and the 1-6 joints move one by one ±20 degrees
import time
from pymycobot.mycobot import MyCobot

if __name__ == "__main__":
    cobot = MyCobot('com22',115200)#Select the corresponding port number and baud rate according to the model
    cobot.set_fresh_mode(1)
    cobot.send_angles([0, 0, 0, 0, 0, 0], 20)
    time.sleep(2)
    print("start")
    for i in range(1,7):
        cobot.send_angle(i, (-30), 20)
        time.sleep(2)
        cobot.send_angle(i, (30), 20)
        time.sleep(2)
        cobot.send_angle(i, (0), 20)
        time.sleep(2)
```

When you see the robot arm around the zero-position posture, 1-6 joints move one by one ±20 degrees, indicating that joints 1-6 respond normally, you can gradually learn to use other cases in gitbook or use the robot arm to do various interesting things!

If you do not see the corresponding effect when executing the case, please refer to the common problem solutions below. In addition, please make sure that you have checked the following 5 points before contacting technical support personnel:

1. Can the robot arm lock normally after power-on? If it cannot be locked, please refer to FQA hardware-related questions: "Q: How to solve the problem that the robot arm cannot be locked after power-on?" for troubleshooting
2. If you have an M5 series robot arm, is your computer connected to the USB port on the side of the M5stack via type-c?
3. If you have an M5 series robot arm, is your screen LCD now stuck in the Atom: ok interface?
4. If you have an M5 series robot arm, the LCD interface shows Atom: no, please refer to "Q: How to solve the problem that the robot arm cannot be locked after power-on?" for troubleshooting
5. Is there any error message when running the code?

Please describe the usage details as detailed as possible. If convenient, please provide an operation video, which will help to quickly analyze and locate the problem. Thank you in advance!

Software Issues

1 myStudio related

Q: What is myStudio?

- A: It is our company's self-developed software. It is a tool for burning or modifying the firmware of the existing robot arm launched by our company.

Q: What is the method to troubleshoot the abnormal download of minirobot, Atom, and PICO firmware?

1. Check whether the network connection is normal. During the firmware download process, you need to connect to the network to download the firmware first.
2. Check whether the line has been connected. The details are as follows: In the M5/Arduino series machine, when burning the Atom firmware, you need to use a USB cable to connect the Atom interface at the end to the USB port of the computer; when the M5 series machine burns the nimirobot firmware, use a USB cable to connect the side interface of the M5stack to the USB port of the computer.
3. Select the firmware of the corresponding model, and don't choose the wrong model.
4. Download and install the driver. If it still cannot be recognized after downloading the driver, try to replace the latest ch340 driver. If the port number still cannot be displayed after installing the driver and the system is a win11 model, try How to install the CH340 driver in Win11 system.
5. Try to change a USB cable, USB port or computer to download it to avoid abnormal firmware download caused by the cable not having data transmission function.
6. Uninstall mystudio and reinstall mystudio in a non-C drive location, such as installing mystudio in the D drive. When mystudio is installed in the C drive, the file permissions are relatively strict, and the firmware may not be burned.

Q: Why does the device not work properly after I burn the firmware to the ATOM terminal?

- A: The firmware of the ATOM terminal needs to use our factory firmware. Other unofficial firmware cannot be changed during use. If the device accidentally burns other firmware, you can use "myCobot firmware burner" to select ATOM terminal-select serial port-select ATOMMAIN firmware to burn the ATOM terminal.

Q: Can the drag teaching in the firmware record the gripper action?

- A: It is temporarily impossible to use drag teaching to record the gripper action, because the gripper belongs to joint number 7, and our drag teaching can only record and play the movement of joints numbered 1-6.

Q: Why can't drag teaching be performed after burning the minirobot firmware?

- A: First check whether the M5Stack-basic firmware and atom firmware are burned, whether the burned firmware corresponds to the requirements to be implemented, and whether the burned firmware is the latest version of the firmware.
- It is recommended to burn the minirobot firmware to version v2.1 and the top atommain firmware to version v4.1 and above (need to support mystudio version v4.3.1 and above).

Q: What should I do if mycobot's serial port cannot be recognized on mystudio?

- A: If your computer device does not prompt for the connected robot arm, please install the serial port driver first.
- In addition, it should be noted that the Raspberry Pi, Arduino and Jetson nano series robot arms are **cannot be connected to a laptop using a data cable**, and you need to use mystudio in the built-in system to burn the firmware.

Q: Can the trajectory recorded by dragging teaching be saved to the card?

- A: It cannot be saved to the memory card at present. And dragging teaching can only save one path at a time, and the next recording will overwrite the previous action.

2 Roboflow Related

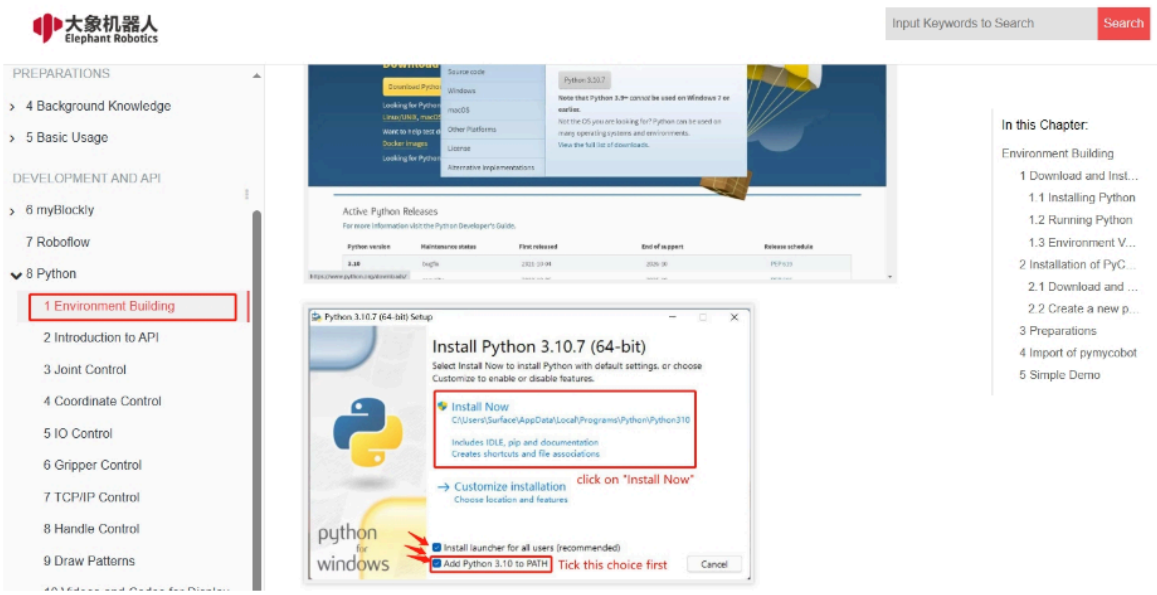
Q: What should I do if I cannot download the Roboflow software or if Roboflow fails to properly control the robot?

- A: Currently, the Roboflow software only supports the 600 Pro and 630 Pro (two professional collaborative robot models). It no longer supports the Mycobot collaborative series or other robot models. For Mycobot-series robots, it is recommended to use MyBlockly, Python, or ROS for control. Notably, MyBlockly is a software with a graphical interface similar to Roboflow. If you prefer visual, block-based programming, MyBlockly is the preferred choice.

3 Python related

Q: The running prompt is missing library filesQ: The error message: ModuleNotFoundError: No module named "pymycobot", how to deal with it?

- A1: Pymycobot is not installed. The corresponding solution is to reinstall pymycobot. The command is `pip3 install pymycobot --upgrade --user`
- A2: During the installation of Python, the "Add Pythonxx to PATH" in the figure below was not checked. You need to uninstall Python and reinstall Python, and check this option.



- A3: If it is an M5 or AR series machine, please confirm whether there are multiple Python versions in the PC. It is recommended to uninstall all Python versions in the PC and reinstall a version higher than Python 3.8. Note that there is only one Python version higher than Python 3.8 in the PC. If multiple python versions are required for actual use, please specify the python version used by pymycobot and specify the python version when calling the pymycobot library.
- A4: It is recommended to use version 3.9 of pyhton, as pyhton12 will be incompatible.

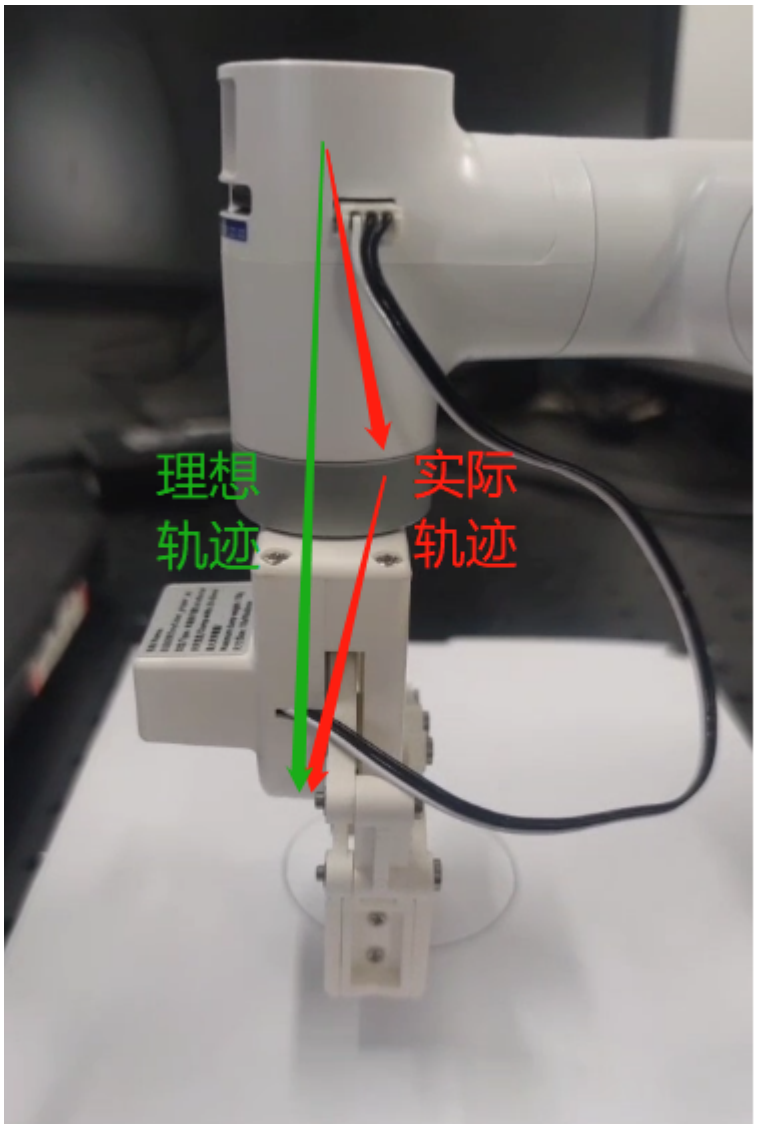
Q: Is there a more popular explanation for the mode in send_coords(coords, speed, mode)?

- A: Linear 1 means that the end of the robot reaches the target position in a straight line. If it cannot go in a straight line due to limitations, structure, etc., the command will not be fully executed; Linear 0 means that the end reaches the target position in an arbitrary posture. Since there is no straight line restriction, it is not easy for the command to not be executed.

Q: What is the difference between the interpolation and refresh modes of set_fresh_mode(mode)?

- A: Interpolation 0 means that many dense points are planned between the starting point and the end point, so as to achieve the effect of controlling the trajectory of the middle segment. How to achieve the effect of program parallelism: Non-interpolation 1 means that there is no planning of the middle segment, and the trajectory cannot be controlled, but the movement will be relatively smooth.

Q：Is it normal for the trajectory not to be straight up and down when only the Z-axis is changed, but the final landing point is adjusted only in the Z-axis? How can the middle trajectory be ensured to be straight?



- Turn on interpolation and walk in a straight line to ensure the trajectory

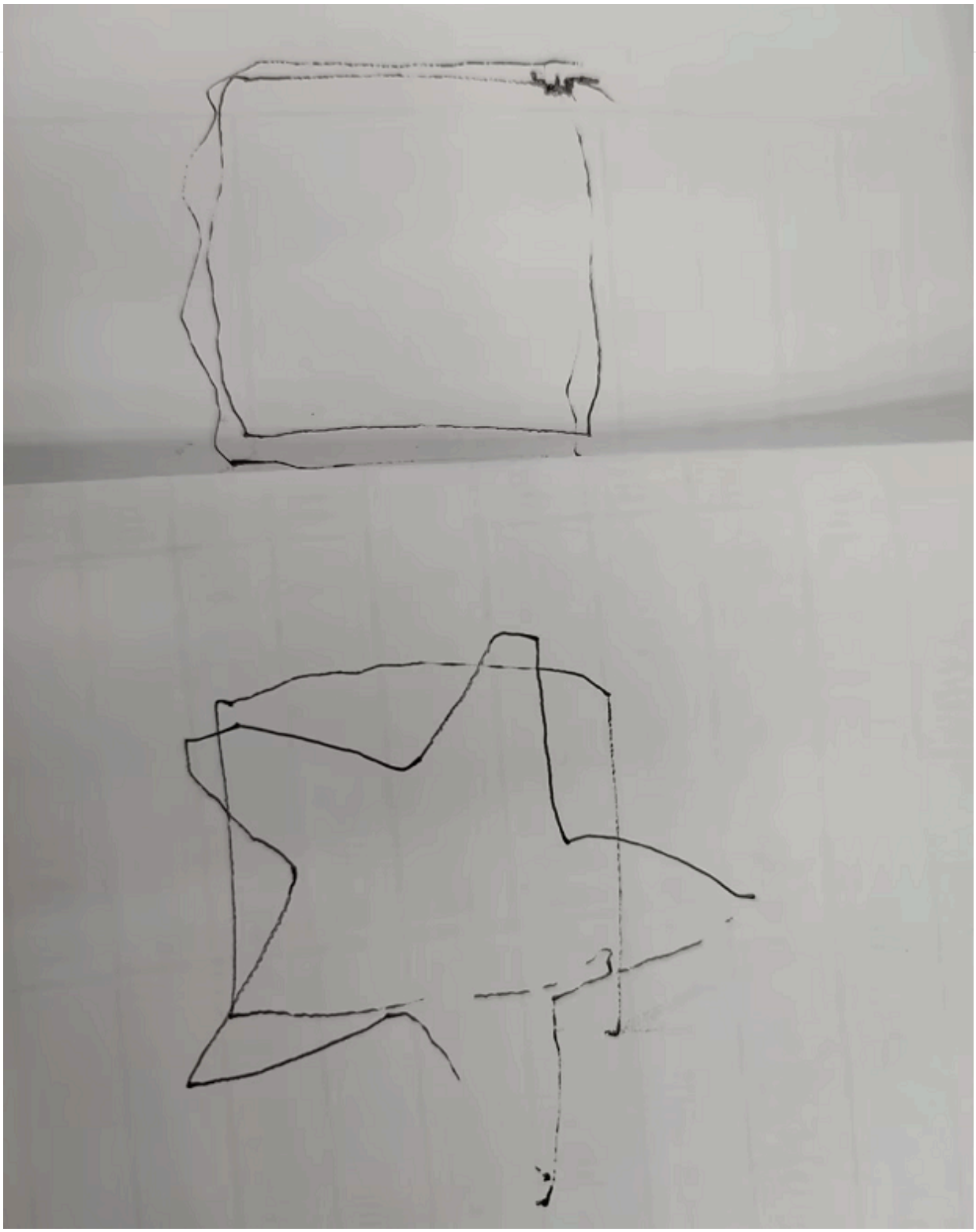
```
set_fresh_mode(0) # Turn on interpolation
send_coords(coords, speed, mode=1) # Walk in a straight line
```

Note that the intelligent planning route set in send_coords will only be useful after turning on interpolation. Interpolation means that many dense points are planned between the starting point and the end point, so as to achieve the effect of controlling the trajectory of the middle section. Non-interpolation means that there is no planning of the middle section, and the trajectory cannot be controlled.

Q: What does the return value of get_error_information() being -1 mean?

- A: The return value of `get_error_information()` is -1, indicating that communication is not possible. You need to check whether the power adapter and USB cable are connected, and whether the LCD screen stays on the Atom: ok interface. If the line is not connected successfully and does not display ok, communication abnormalities will occur. You need to reconnect and test again.

Q: In the case of drawing with a 280 machine, it is found that the shape trajectory is not very straight. Can it be optimized?



- A1: It is normal to get a deviation in the trajectory when using a signature pen or hard stationery to draw this case. There are two main reasons for this deviation. First, mycobot uses a servo motor, which has a certain accuracy deviation (if it is a machine that has been used for a long time, the deviation of its joints will be greater due to aging of the joints). Second, when using a hard pen to draw, the contact distance with the desktop is relatively demanding. If the distance is too high, the trajectory is prone to interruption. If the distance is too low, the pen tip resistance will be too large and the drawing effect is not ideal. It is currently recommended to use soft stationery for drawing, such as brushes and other tools, which will help improve the drawing effect.

- A2: In addition, you can change the motion mode of the robot arm to interpolation mode, so that the motion trajectory will be relatively straight.

```
set_fresh_mode(0) # Enable interpolation
send_coords(coords, speed, mode=1) # Go straight
```

Note that the intelligent planning route set in send_coords will only be useful after interpolation is turned on. Interpolation means that many dense points are planned between the starting point and the end point to achieve the effect of controlling the trajectory of the middle section.

Q: The target position is identified, but the end cannot reach it. How to determine whether this coordinate can be reached and then process it?

- A: Use solve inv kinematics(target coords, current_angles) to see if there is a solution. solve_inv_kinematics(target_coords, current_angles)
- Function: Convert coordinates to angles.
- Parameters:
- target_coords: list A floating point list of all coordinates.
- current_angles: list A floating point list of all angles, the current angle of the robot
- Return value: list A floating point list of all angles.

4 ROS related

Q: Is there a virtual machine image with a configured environment?

- A: We have provided a virtual machine environment with configured ROS1 and ROS2 environments and built-in ROS source code. Users can download it through the following link and import the virtual machine file into VirtualBox, saving the trouble of configuring the environment by themselves. When testing ROS cases, it is recommended to use the virtual machine environment we have configured for verification to avoid some case operation errors due to environmental configuration reasons Please refer to the operation steps video of importing virtual machine files into virtual machine software: https://drive.google.com/file/d/1KeYk_CUgDE46rVn7zbd0EhraIbgt3qZt/view?usp=sharing

ROS1 virtual machine file download

Download ROS2 virtual machine file

Download virtual machine software VirtualBox

Q: How to deal with errors when importing ROS2 virtual machine files?

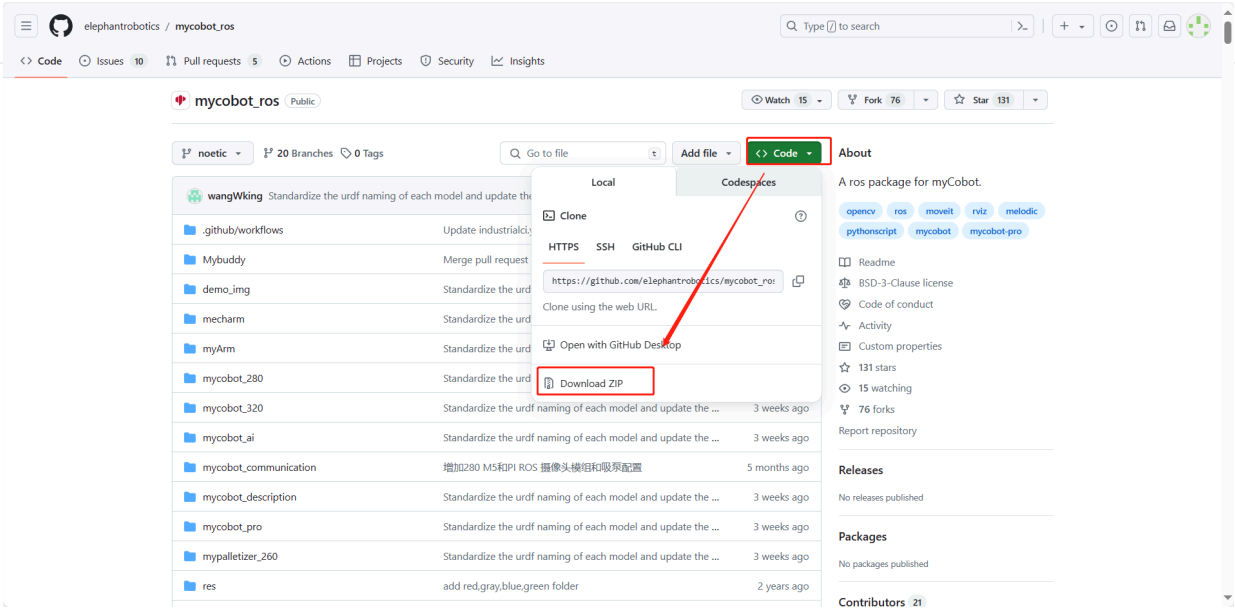
- A: This is because the version of the virtual machine software Oracle VM VirtualBox is too low, and the virtual machine software version needs to be updated.

Q: How to re-download the ROS source code package?

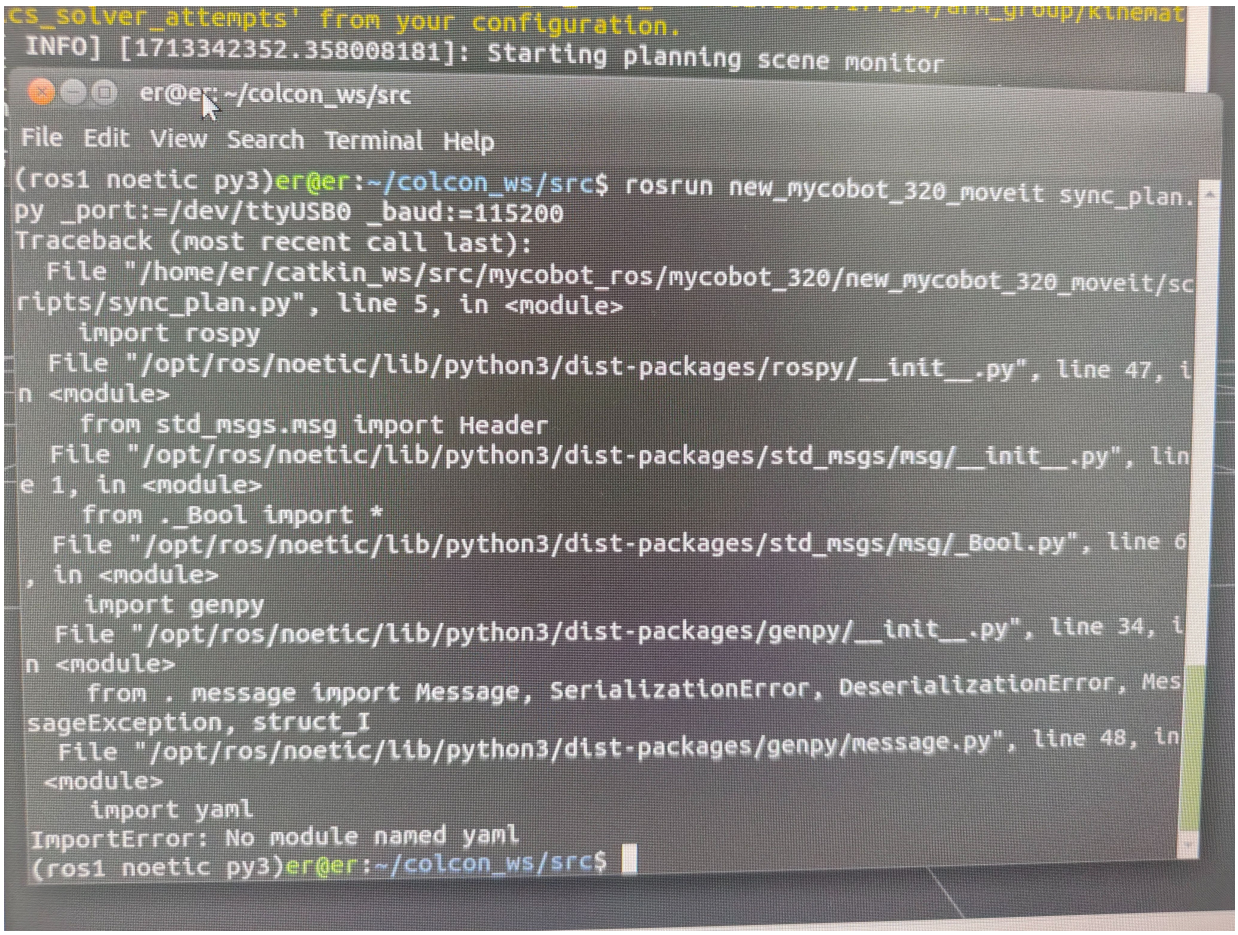
- A: Use the command to pull:

```
git clone https://github.com/elephantrobotics/mycobot_ros.git
```

Or download manually. The download method is to enter the ROS source code package address and follow the steps below. The source code package address is: https://github.com/elephantrobotics/mycobot_ros



Q: What should I do if I run the ROS moveit case and get an error ImprotError: No module named yaml?

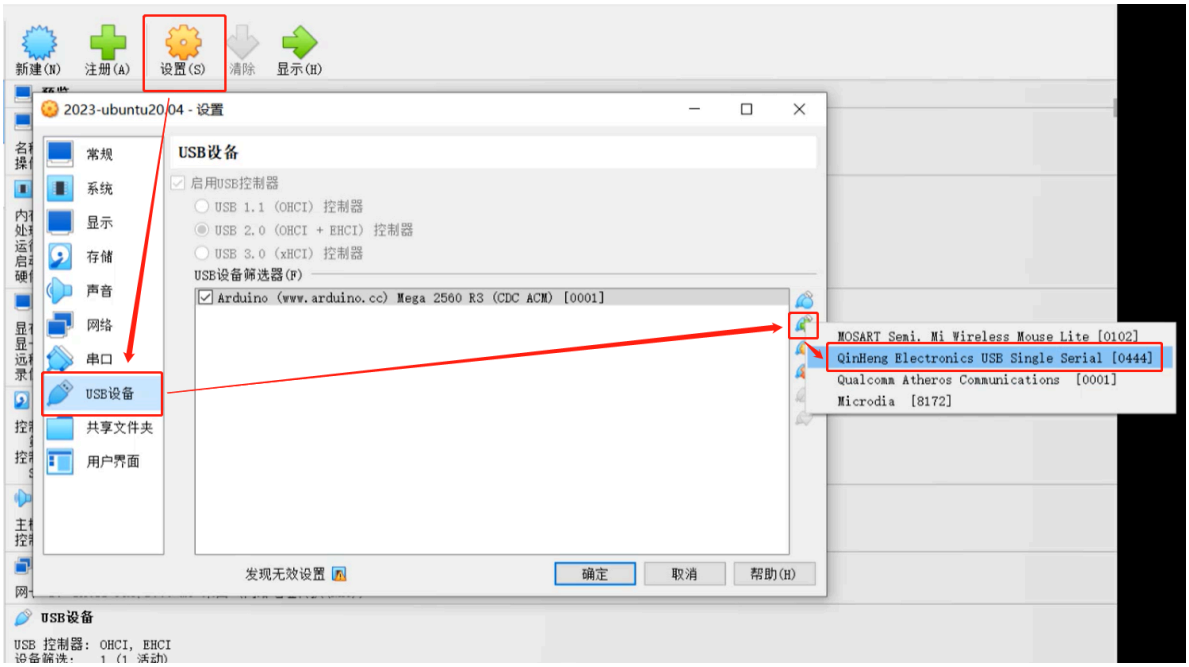


- A: In the first line of this script, change the Python interpreter to python3

Q: What should I do if the serial port cannot be found when running the virtual machine?

- A: Use a USB cable to connect the M5 robot to the PC, open the virtual machine settings → USB device → Add USB device → Select the serial port number QinHeng xxxxx, which is the serial port device of the machine. If there is no such device number, you can get the corresponding USB device number by re-plugging the device.

The serial port number corresponding to the machine serial port device number is the one that changes when plugging and unplugging.



Q: Using a mujoco-based environment for simulation training, the robot's xml file is required

- A: Currently, there is only the 280JN xml file on GitHub: 280JN
- Provide customers with methods on how to convert dae and urdf files into xml files, and let customers use meshlab to convert by themselves.

Q: When the terminal switches to ~/catkin_ws/src and uses git to install and update mycobot_ros, the target path "mycobot_ros" already exists. What is the reason?

- A: This means that there is already a `mycobot_ros` package in `~/catkin_ws/src`. You need to delete it in advance and then re-execute the git operation.

Q: When rosrun is running, the terminal reports an error message `counld not open port /dev/ttyUSB0: Permission: '/dev/ttyUSB0'`, why?

- A: The serial port permissions are insufficient. Enter `sudo chmod 777 /dev/ttyUSB0` in the terminal to grant permissions.

Q: When rosrun is running, the terminal prompts `Unable to register with master node [http://localhost:11311]: master may not be running yet. Will keep trying`. Why?

- A: Before running the ros program, you need to open the ros node. Enter `roscore` in the terminal.

Q: When rosrun is running, the terminal reports an error message `counld not open port /dev/ttyUSB0: No such file or directory: '/dev/ttyUSB1'`, why?

- A: The serial port is incorrect. You need to confirm the actual serial port of the current robot. You can check it through `ls /dev/tty*`.

Q: In Ubuntu 18.04, `catkin_make` failed to build the code, and the terminal prompted `Project 'cv_bridge' specifies '/usr/include/opencv' as an include dir, which is not found.` and other error messages

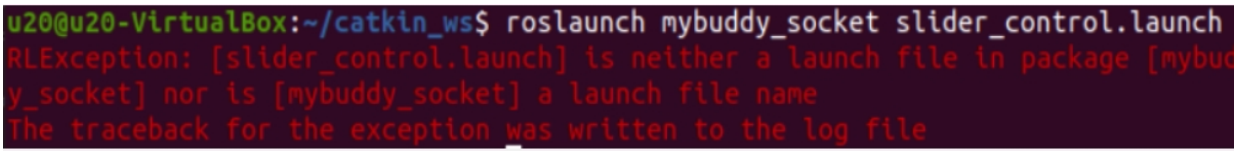
- A: The opencv path in the configuration file does not match the actual system path. You need to use sudo to modify the configuration file (the path is `/opt/ros/melodic/share/cv_bridge/cmake/cv_bridgeConfig.cmake`), and the actual system opencv path is under the `/usr/include/` path.

Q: I just cloned the mycobot_ros package, and then ran the rosrun program directly. The error `package 'mycobot_280' not found` or the file could not be found appeared?

- A: The mycobot_ros that I just cloned needs to build the code for ros environment compilation. Terminal input

```
cd ~/catkin_ws/
catkin_make
source devel/setup.bash
```

Q: After the compilation is completed, why does the following error appear when the launch command is run in a new terminal?



- A1: The system does not add ros environment variables, so you need to source each time you open a new terminal:

```
cd ~/catkin_ws/
source devel/setup.bash
```

- A2: The system adds ros environment variables, and you do not need to execute source each time you open a new terminal:

```
# noetic is Ubuntu20.04 system
echo "source /opt/ros/noetic/setup.bash" >> ~/.bashrc
source ~/.bashrc
```

- A3: The file name in the command may be inconsistent with the actual file name in the mycobot_ros package. Please check the command carefully for errors.

5 C++ related

Q: What should I do if I can't find various dll files?

- A1: If myCobotCpp.dll is missing, put myCobotCpp.dl in the lib directory to the directory where mycobotcppexample.exe is located.
- A2: If QT5Core.dll is missing, open qt command (search QT in the menu bar), select msvc2017 64-bit, and execute windeployqt--release to the directory where myCobotCppExample.exe is located (such as: windeployqt --release D:lvs2019myCobotCpploutlbuildlx64-Releaselbin). If the vs installation path cannot be found after executing the command here, please check the settings of the vs environment variables.

After executing the above steps, if the qt5serialport.dll file is missing, move this file in the gt installation directory (path such as: D:lgt5.12.1015.12.10msvc2017 64bin), copy it to the directory where myCobotCppExample.exe is located

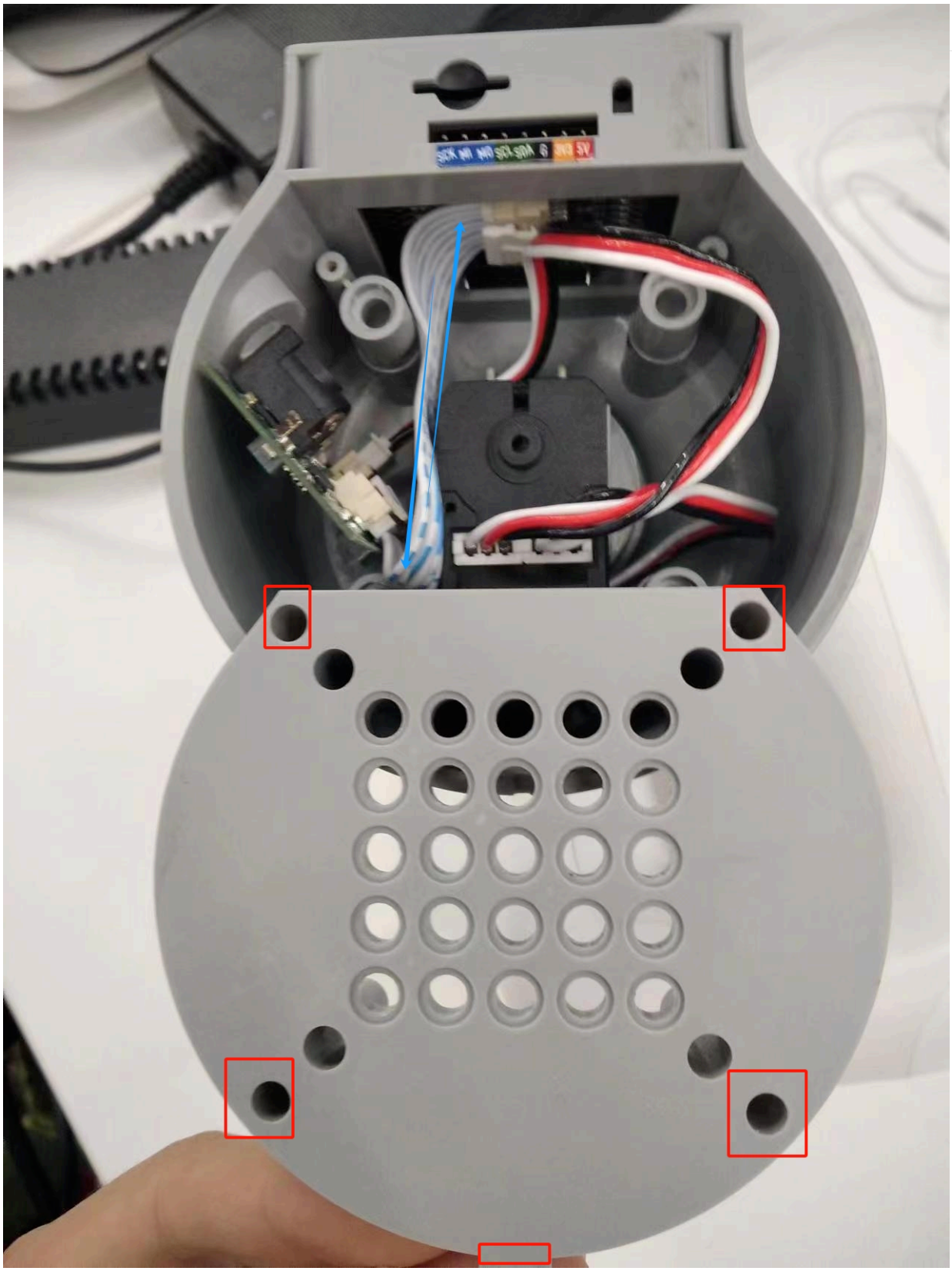
Q: Generate the myCobotCppExample.exe executable file, what could be the problem? Select the start

Hardware Issues

Q: How to resolve the issue if the M5 screen is not displaying anything?

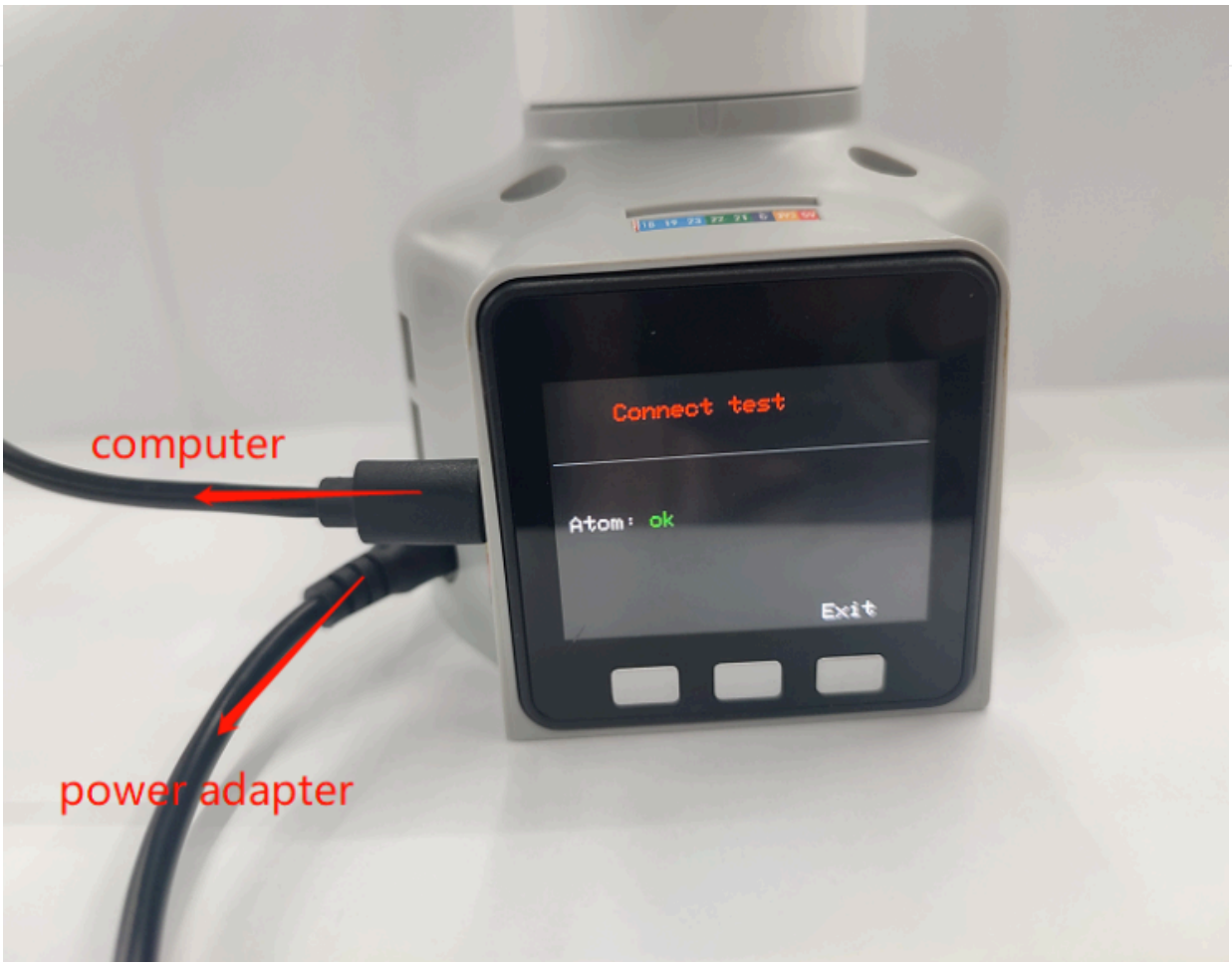
1. Check if the power adapter is properly connected to the machine. You can try unplugging and replugging the power adapter.
2. Gently press on the corners of the screen to ensure that the M5stack is making good contact with the internal expansion board.

1. Check the GitBook and download the corresponding MiniRobot firmware.
2. You can remove the base screws to inspect whether any internal cables are disconnected. If so, reconnect them before use.



Q: How to solve the problem that the robot arm cannot be locked when powered on?

1. Check whether the original power adapter is connected or whether the adapter is in good contact. You can try to re-plug the power adapter



1. Check whether the joint can rotate normally when the power is off, whether there is too much or too little resistance, and preliminarily determine whether the internal structure is physically broken. If there is no physical break, continue to check.
2. Check the Atom firmware as follows:

Under normal circumstances, the robot arm will self-lock after power is turned on, and the Atom will light up green, as shown in the figure below (note that mechArm has no light display)

After the robot arm is powered on, the Atom does not light up green or the joint cannot self-lock. You can check according to the following points: ① Gently press the Atom screen to make Atom contact well with the internal plate of the robotic arm.

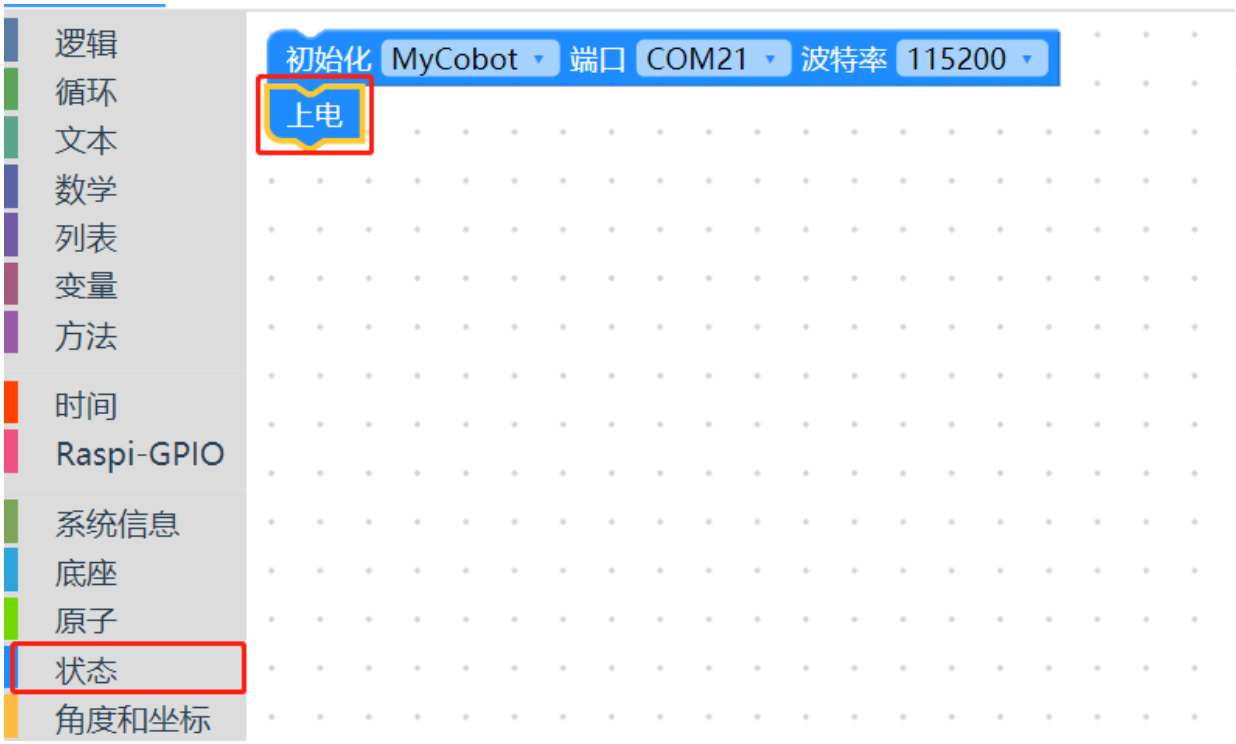
② Check gitbook to get the method of using mystudio. According to the model and version information, use mystudio to download the corresponding Atom firmware. If you encounter any problems during the burning process, please refer to the relevant "Firmware download exception" in this article mystuidio to obtain the troubleshooting steps.

③ When the Atom firmware is successfully burned and the robotic arm is not connected to the power supply, use type-c to connect Atom. If the green light of Atom is on, but the green light of Atom is off after unplugging type-c, it is judged that Atom is normal, but there is a problem of circuit detachment or damage inside the robotic arm, and it is necessary to contact the technician to deal with it.

④ When the Atom firmware is successfully burned and the robotic arm is not connected to the power supply, use type-c to connect Atom but the green light is not on, it is judged that the Atom hardware is damaged and it is necessary to contact the technician to replace it.

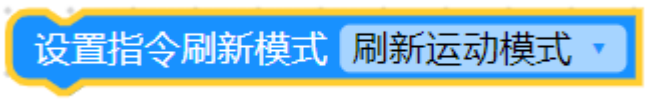
Q: After pressing the emergency stop, the emergency stop cannot be locked after release. How to lock the robotic arm again?

You need to power on the machine again, for example, power on the machine with myblockly



Q: How to optimize joint jitter, excessive joint angle deviation or joint weakness?

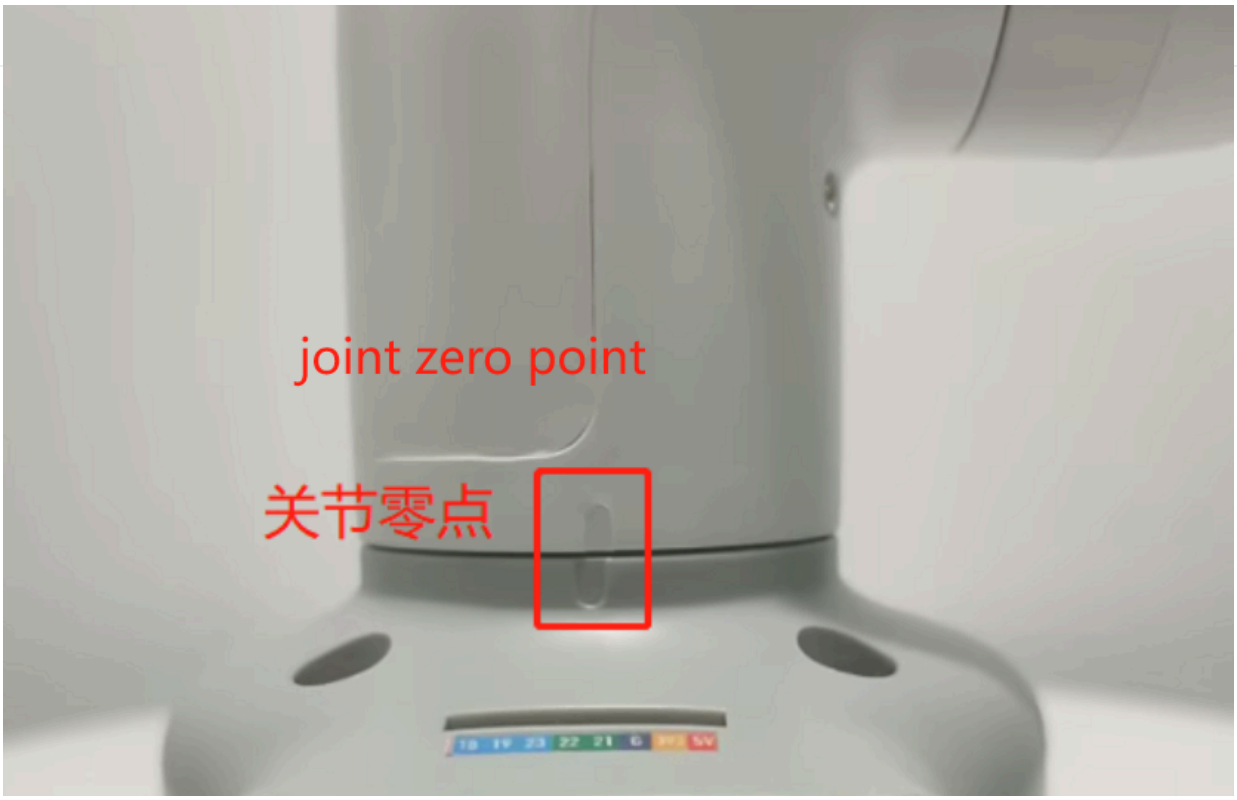
1. Refer to the robot parameter introduction section to check whether the actual load is within the effective load range of the robot arm. Excessive load will cause joint jitter. The load of the actual joint can be appropriately reduced.
2. Change the motion mode to refresh mode, so that the running trajectory of the robot arm will be relatively smooth. For specific APIs, please refer to set_fresh_mode(1)



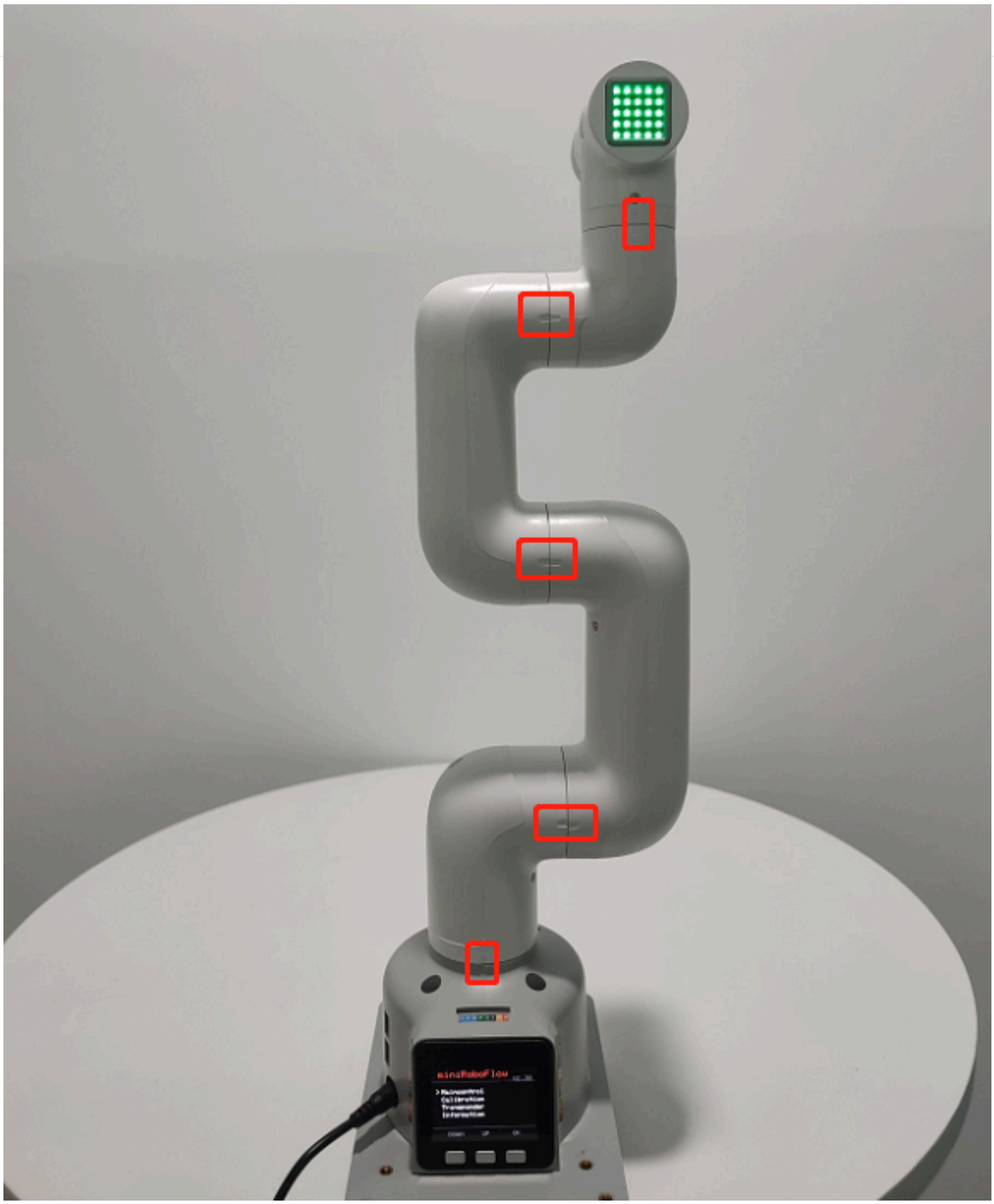
1. Check the following link to adjust pid: https://drive.google.com/file/d/1UWhaaSTuwLFImuEGY1J2tvgxTQDwWxK_/view?usp=sharing
2. Check the gitbook section and use mystudio to download the corresponding version of Atom firmware. It is recommended to download the latest
3. Check Chapter 5 of the gitbook to calibrate the robot arm at zero position. You can also refer to the calibration steps in the following link: https://drive.google.com/file/d/1XtKH-ykKWPH0q9Z_YHwzkgwNKRhstHhi/view?usp=sharing
4. For machines that have been used for a long time (more than 3 months), joints may age and produce joint gaps. You can follow the following video to manually bend the joints to check if there is any joint gap: https://drive.google.com/file/d/1tXDUALmfw1z0u6lM9uH5hOHivjbRoWxW/view?usp=sharing
5. If there is a joint gap problem due to joint aging, this kind of jitter is inevitable due to the natural aging of the machine.

Q: What is the joint zero position?

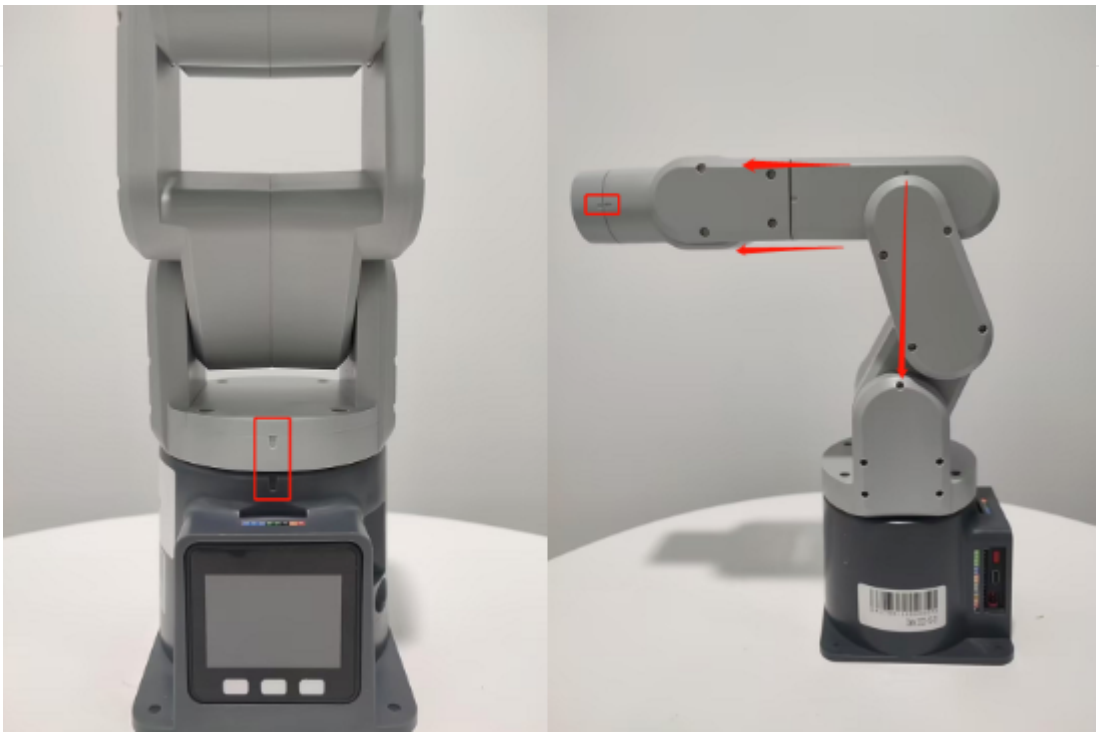
Take the following figure as an example, there is an arched groove designed between the joint and the edge of the joint shell, which is the joint zero point



Generally, the zero point posture after calibration is as follows:



Pay special attention to the zero position posture of the 270 joint as follows:



Q: Is there a method for zero point calibration?

Please refer to Chapter 5 of gitbook or the following link:

https://drive.google.com/file/d/1XtKH-ykKWPH0q9Z_YHwzkgwNKRhstHhi/view?usp=sharing

Q: Is the IO port of G36 unusable? Why is there no voltage return when measuring with a multimeter?

- A: 36 on basic can be used and is defined as an input pin. If the customer needs to test whether the IO can be used, the customer can modify the basic firmware code by himself. The firmware is open source. The customer writes a program by himself, single control IO

Q: What are the limits of myCobot's joints?

- A: One axis and five axes have limits. One axis is about 165° clockwise and about 165° counterclockwise. The five axes can rotate about 165° clockwise and counterclockwise

Note: When rotating the robot arm, it should be rotated at a small angle and gently. After reaching the limit, it cannot be rotated forcefully.

Q: What is the role of atom in the robot arm?

- A: Atom is mainly used in the robot arm to control the kinematic algorithm of the robot arm: including forward and inverse kinematics, solution selection, acceleration and deceleration, speed synchronization, multi-square interpolation, coordinate conversion, etc., and requires real-time control and multithreading. The relevant programs of atom are not open source yet.

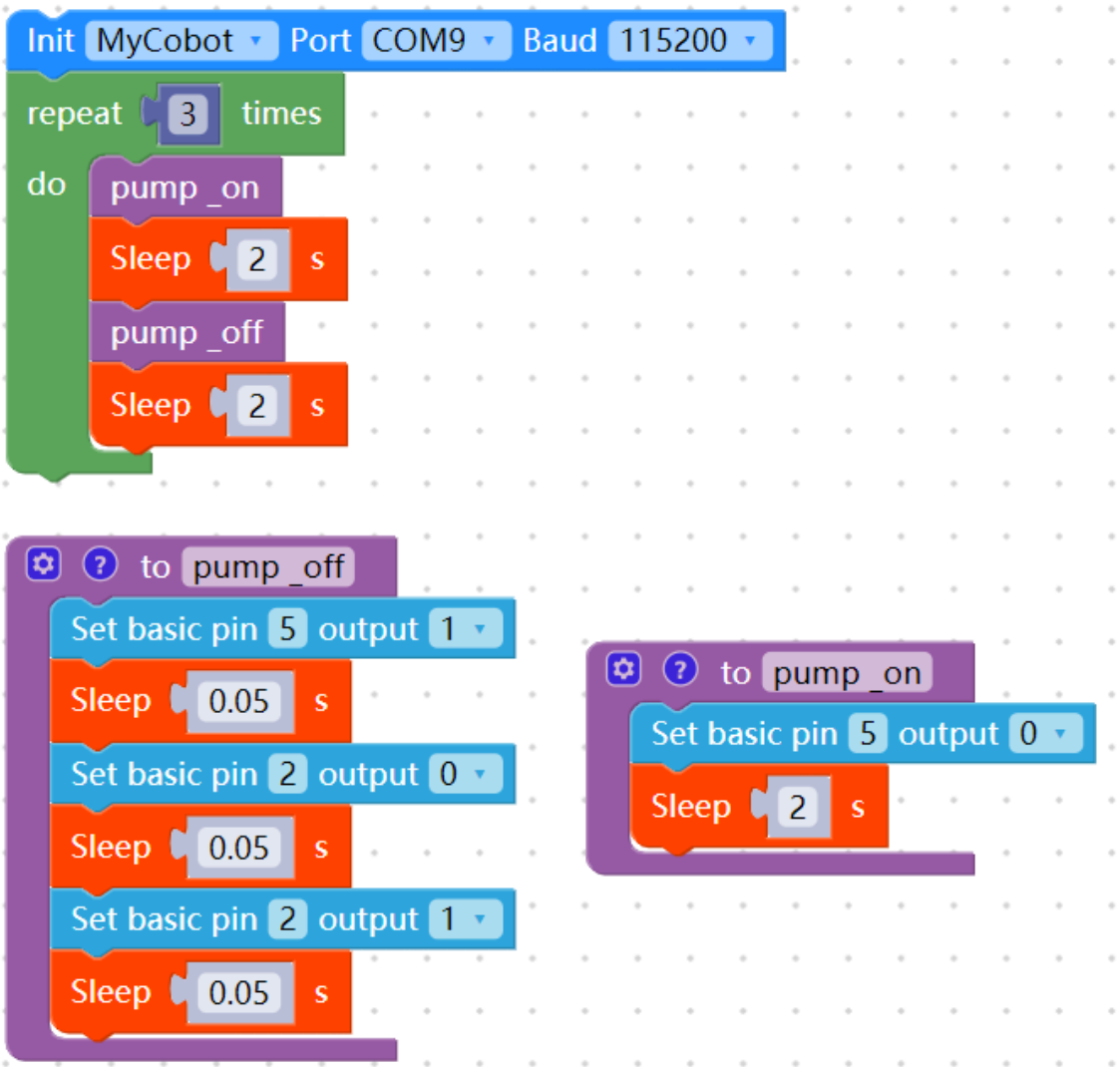
Q: What communication interfaces do different versions of the robot arm support?

- A: The robot arm based on the microprocessor supports socket communication TCP; the robot arm based on the microcontroller can communicate via USB to serial port.

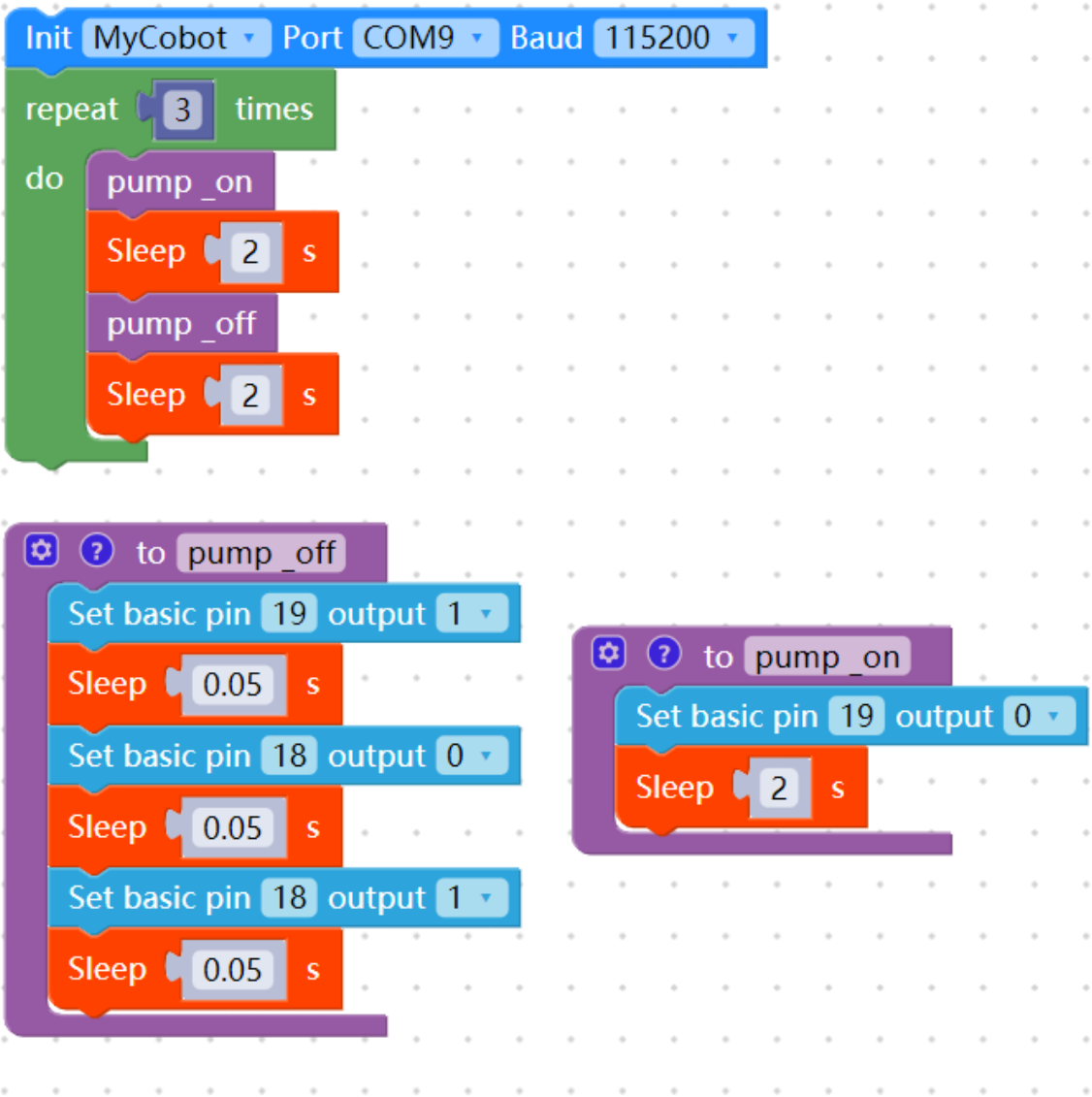
Accessory related questions

Q: 280M5 and suction pump 2.0 io connection diagram and quick use source code

- A: The new version v2.0 version of myblockly source code is as follows:



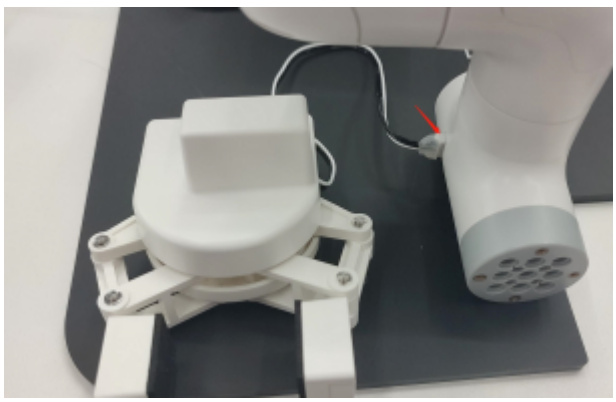
The G5 pin on the suction pump is the suction pump switch control pin, and the G2 label is the solenoid valve control pin. Both are low level valid. The function of the solenoid valve is to make the suction pump more rapid when released. If the solenoid valve is not used, the suction pump can also work normally, but the speed of releasing the object when the suction pump is closed is relatively slow. The source code here uses the G5 pin to control the opening and closing of the suction pump, and the G2 pin to control the opening and closing of the solenoid valve. The opening and closing of the solenoid valve mainly works in the stage of closing the suction pump. Note that the pins designated for connecting the suction pump and the machine end are not fixed. On the machine end, the G2 and G5 pins are not the only options. They can be replaced with any other two common GPIOs on the machine for control. However, when changing the control pins, you need to pay attention to the G2 and G5 pin function descriptions on the suction pump end - the pin corresponding to the G5 label on the suction pump end is the suction pump switch control pin, and the G2 label is the solenoid valve control pin, both of which are low-level valid. As shown in the following source code, GPIO18 and 19 are used to control the suction pump. G19 is selected to connect the suction pump's G5 to control the suction pump opening and closing, and the other G18 is connected to the suction pump's G2 pin to control the solenoid valve.



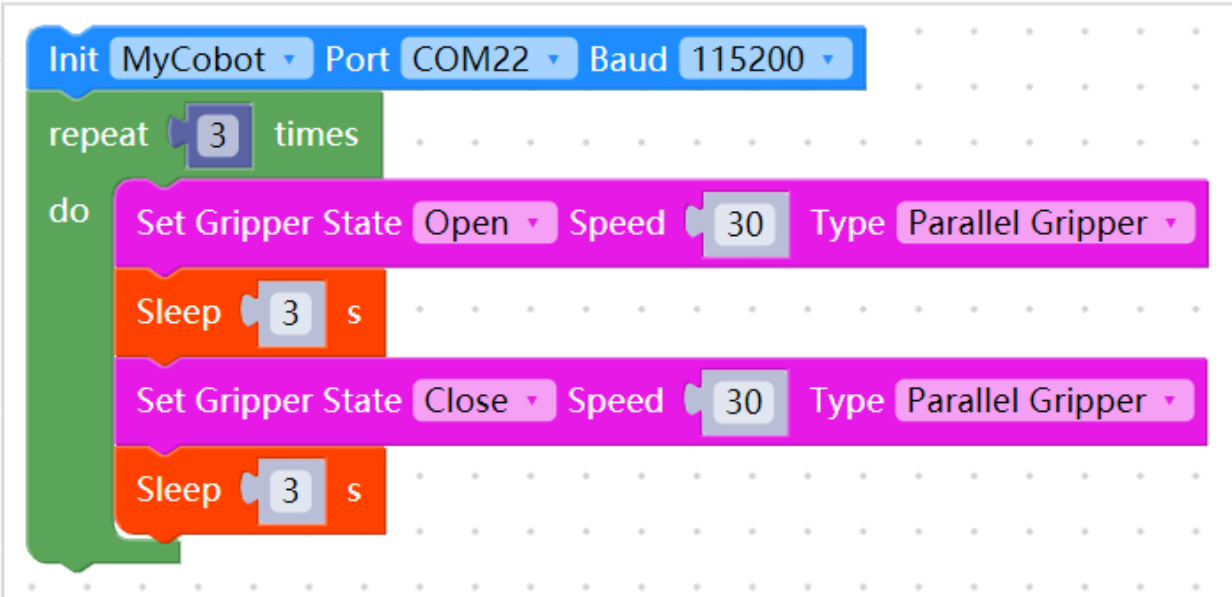
Q: What is the pin sequence and connection method of mycobot adaptive gripper?

Please refer to the following figure for the pin introduction of mycobot adaptive gripper:

Gripper connection method:



Q: Parallel gripper usage source code



Q: Is there anything to pay attention to between the gripping object and the movement of the robot arm?

When the load is > 500g, the speed needs to be less than 50%.

Other Issue

Q：How to use the mycobot test tool?

A：The "mycobot test tool" is intended for factory use only, and we do not recommend users to use it. Using this tool may lead to abnormalities in the zero position or PID, resulting in damage to the robot. Please delete this tool directly. If you have already used this tool and it has caused abnormal movement of the robot, please refer to the following instructions to readjust the PID and zero position. Furthermore, refrain from continuing to use this factory test tool in future operations. Resetting PID method reference link: https://drive.google.com/file/d/1UWhaaSTuwLFImuEGY1J2tvgxTQDwWxK_/view?usp=sharing Zero position calibration method reference link: https://drive.google.com/file/d/1XtKH-ykKWPH0q9Z_YHwzkgwNKRhstHhi/view?usp=sharing

Q: After the vertical suction pump is turned off, there is no air leakage and the adsorption can be done normally. However, the vertical suction pump is still in the state of adsorption when the program ends. What is the reason?

A: 1. First check if the GPIO port is connected incorrectly. The correct connection method is shown in the figure

Pi connection method

M5 connection method:

1. If the above is correct but still not working, you can try to swap the high and low levels in the code to find out the reason

```python
from pymycobot.mycobot import MyCobot
from pymycobot import PI_PORT, PI_BAUD  # 当使用树莓派版本的mycobot时，可以引
import time
import RPi.GPIO as GPIO

# 初始化一个MyCobot对象
mc = MyCobot(PI_PORT, PI_BAUD)

# 初始化
GPIO.setmode(GPIO.BCM)
# 引脚20/21分别控制电磁阀和泄气阀门
GPIO.setup(20, GPIO.OUT)
GPIO.setup(21, GPIO.OUT)


    # 开启吸泵
def pump_on():
        # 打开电磁阀
        GPIO.output(20,0)

    # 停止吸泵
def pump_off():
        # 关闭电磁阀
        GPIO.output(20,1)
        time.sleep(0.05)
        # 打开泄气阀门
        GPIO.output(21,0)
        time.sleep(1)
        GPIO.output(21,1)
        time.sleep(0.05)

pump_off()
time.sleep(3)
pump_on()
time.sleep(3)
pump_off()
time.sleep(3)

GPIO.cleanup() # 释放 pin channel
```

Figure 1 (source code)

```python
from pymycobot.mycobot import MyCobot
from pymycobot import PI_PORT, PI_BAUD  # 当使用树莓派版本的mycobot时，
import time
import RPi.GPIO as GPIO

# 初始化一个MyCobot对象
mc = MyCobot(PI_PORT, PI_BAUD)

# 初始化
GPIO.setmode(GPIO.BCM)
# 引脚20/21分别控制电磁阀和泄气阀门
GPIO.setup(20, GPIO.OUT)
GPIO.setup(21, GPIO.OUT)


    # 开启吸泵
def pump_on():
        # 打开电磁阀
        GPIO.output(20,0)

    # 停止吸泵
def pump_off():
        # 关闭电磁阀
        GPIO.output(20,1)
        time.sleep(0.05)
        # 打开泄气阀门
        GPIO.output(21,1)
        time.sleep(1)
        GPIO.output(21,1)
        time.sleep(0.05)

pump_off()
time.sleep(3)
# pump_on()
# time.sleep(3)
# pump_off()
# time.sleep(3)

GPIO.cleanup() # 释放 pin channel
```

Figure 2 (modified)

According to the modified code, it can be checked whether the closed solenoid valve and the vent valve are high-level venting or low-level venting, and so on.

Q: How to reset to factory settings when the machine is abnormal?

Restoring to factory settings mainly depends on resetting the firmware, image, pid and zero position. The following is the reset solution:

- **About resetting the firmware**: It is recommended to ensure that mystudio is updated to the latest version, and then download the corresponding latest Atom version firmware, minirobot firmware (only available in M5 series machines) and pico firmware (only available in 320 series models). For the method of resetting the firmware, please refer to the mystudio chapter of gitbook
- **About resetting the image**: When resetting the image, all contents in the original system will be cleared. If there are important files, please save them in advance. For the method of resetting the image, please refer to the system usage chapter of gitbook
- **About resetting pid**: Generally, when the machine has severe joint shaking, abnormal joint movement speed, and joints curled up, the pid can be reset. For the reset method, refer to: https://drive.google.com/file/d/1UWhaaSTuwLFImuEGY1J2tvgxTQDwWxK_/view?usp=sharing
- **About resetting zero position**: Generally, when the machine has an incorrect zero position or the joint limit is abnormal, the zero position can be recalibrated. For the reset method, refer to: https://drive.google.com/file/d/1XtKH-ykKWPH0q9Z_YHwzkgwNKRhstHhi/view?usp=sharing

Q: Where is the download path for the urdf file?

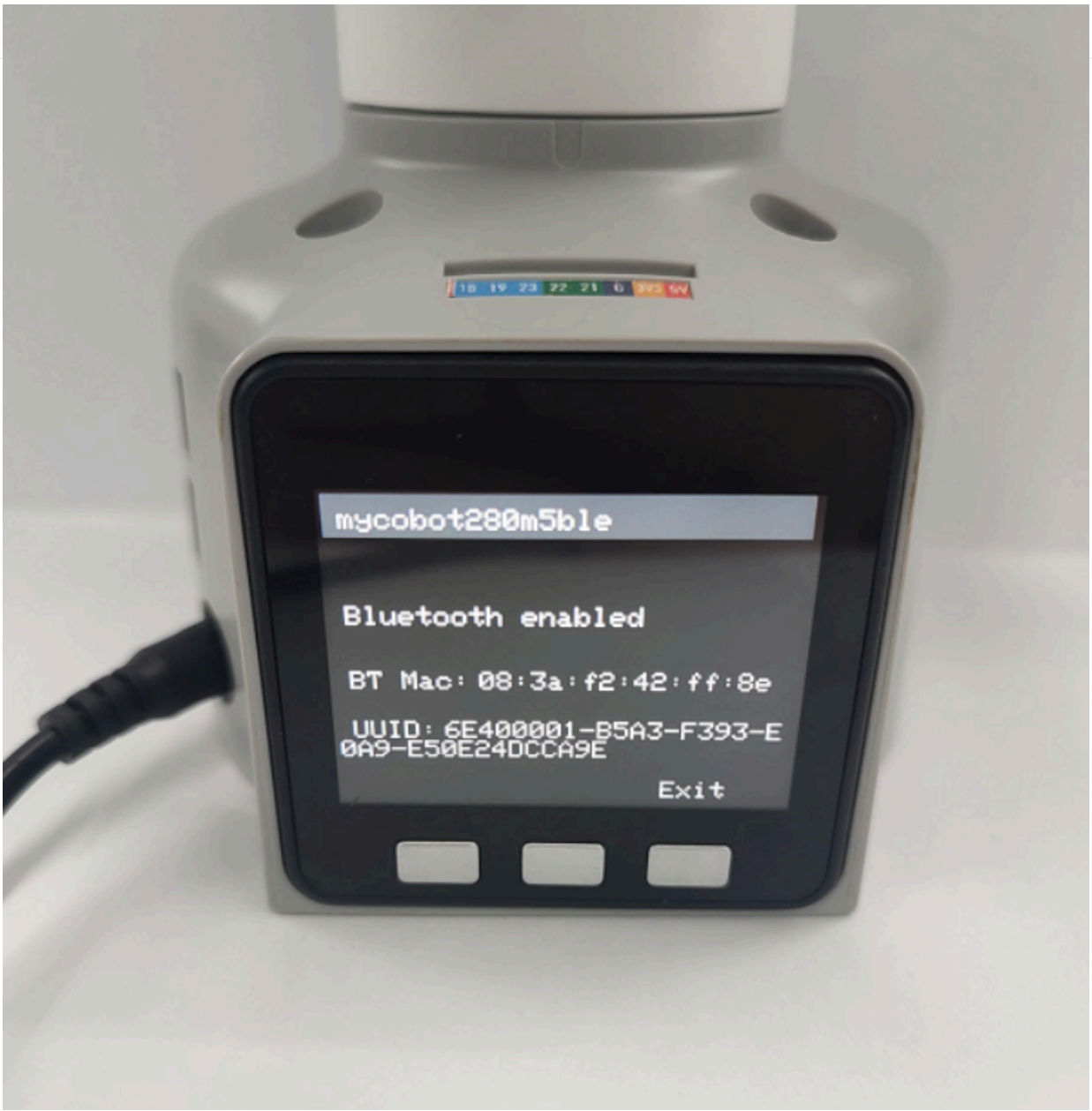
- A: Please refer to the following path. The urdf of all mycobot models is in this path: https://github.com/elephantrobotics/mycobot_ros/tree/noetic/mycobot_description/urdf

Q: How to troubleshoot if the robot arm cannot be controlled when using Bluetooth or WiFi?

A: The M5 robot arm supports three communication methods, namely USB serial port, WiFi and Bluetooth communication. The most commonly used USB serial port communication method is required. Before using each communication method, you need to ensure that the LCD screen of the M5 is adjusted to the corresponding mode and maintain this communication state to control the robot arm normally.

wifi communication mode: When using the TCP/IP example in the python chapter, you need to keep the M5's LCD screen in the wifi communication interface, as shown below:

bluetooth communication mode: When using the mobile phone APP control, you need to keep the M5's LCD screen in the Bluetooth communication interface, as shown below:

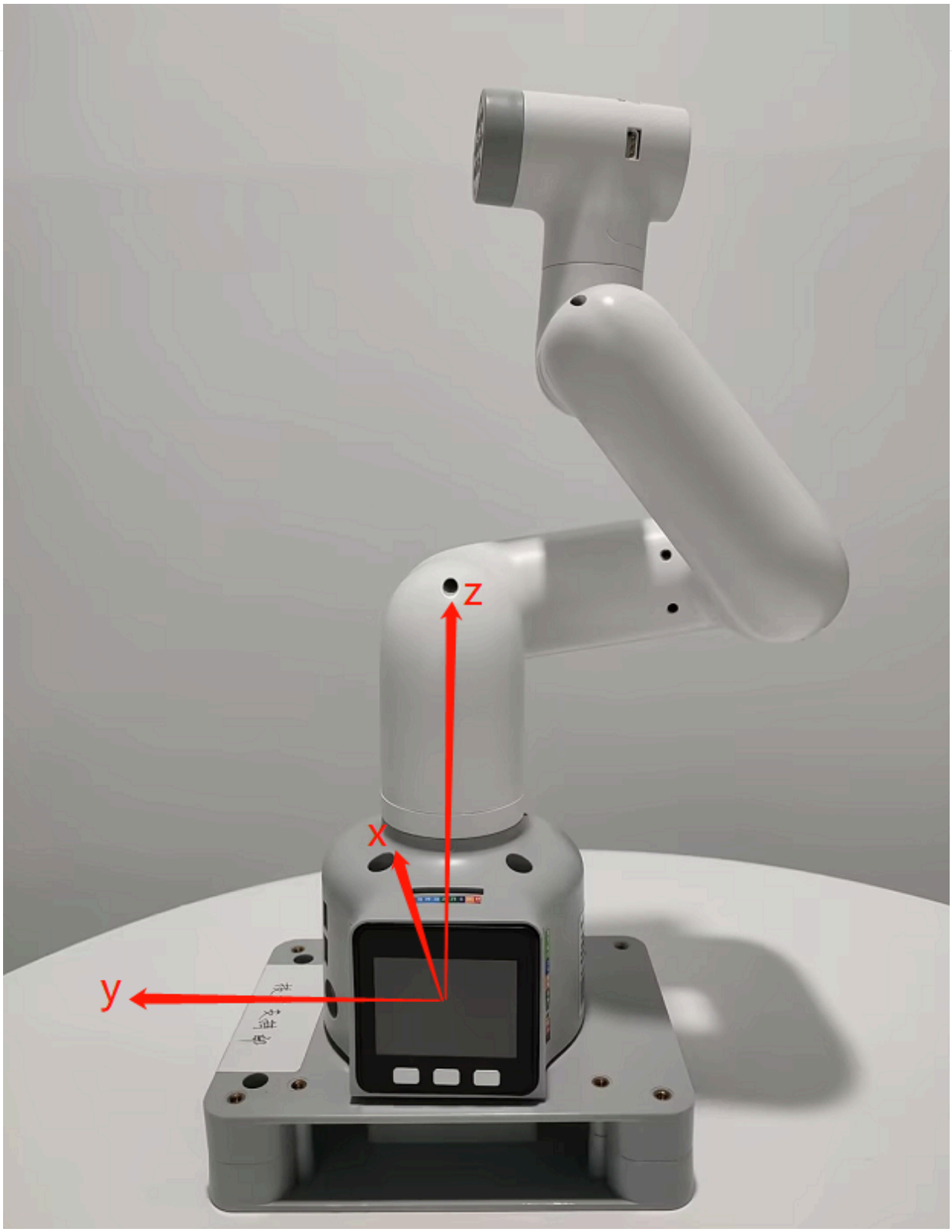


After ensuring that the communication mode status is selected correctly, try to control the robot arm again

Q: How long is the command transmission delay when controlling the motor through the robot's controller via serial port or socket communication? Is there a communication timing diagram? How about real-time performance?

There is no delay test data for serial or socket communication. According to the feedback from our development and use, the real-time performance is still quite high and there will be no lag.

Q: What is the base coordinate system of the 280M5 robot?



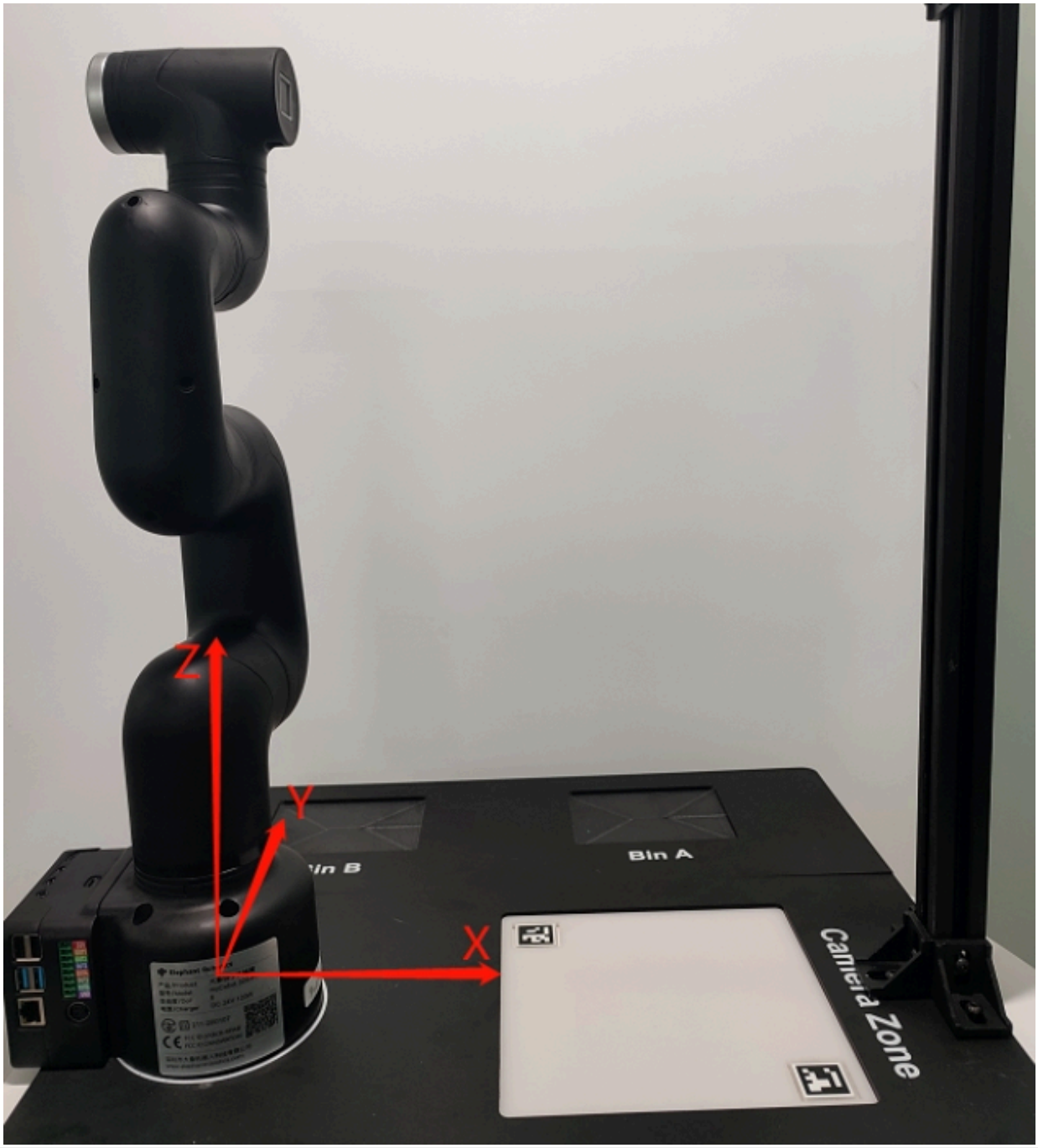
Q: Are the joints of 280 controlled by the serial bus?

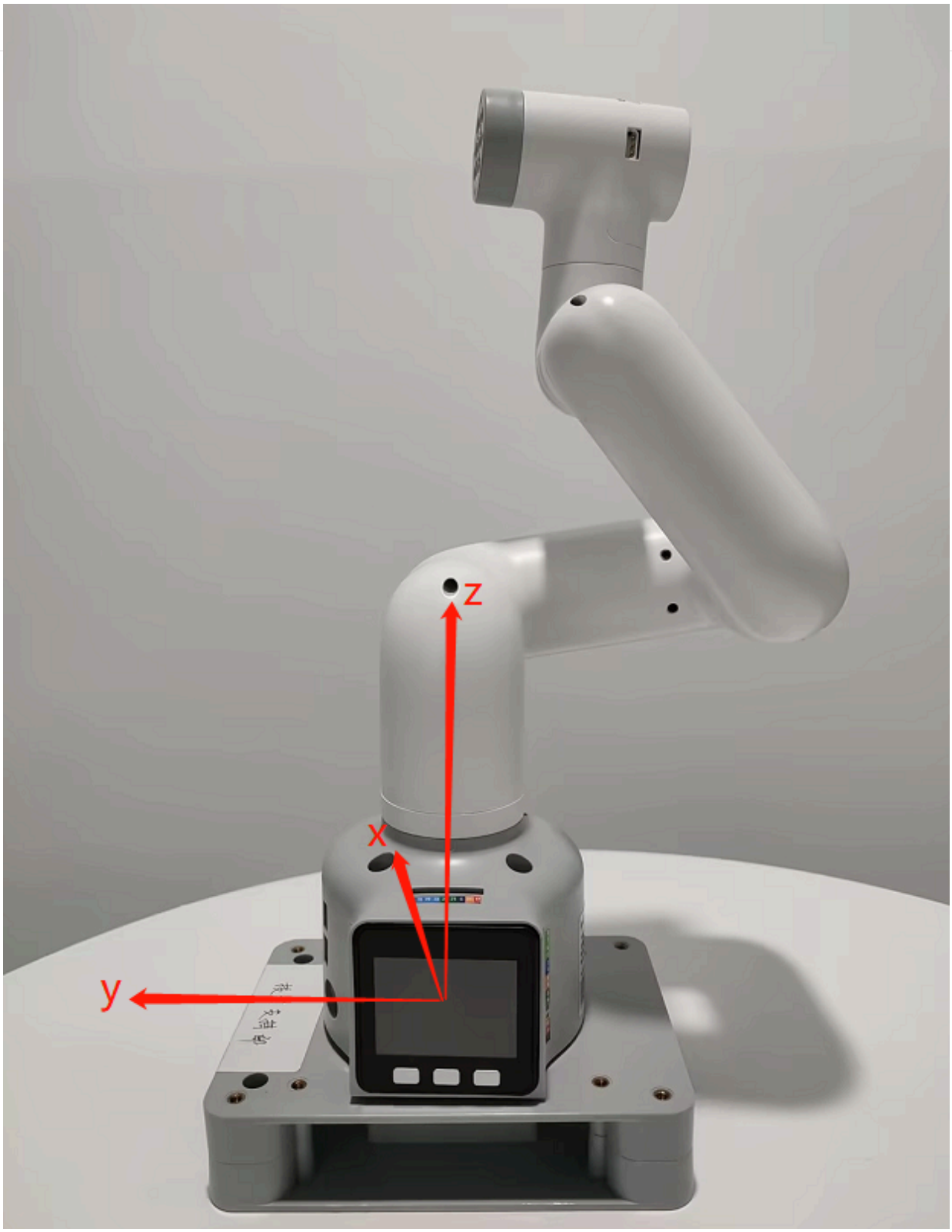
A: Yes

Q: Is there more explanation about the understanding of coordinates?

A: The API for controlling coordinate movement is send_coords([x,y,z,rx,ry,rz], speed) **x, y, z coordinates:** Control the position of the end effector of the robot in space. Changing these coordinate values will move the robot to different spatial positions, thereby achieving positioning in three-dimensional space. **rx, ry, rz attitude angles:**

Control the attitude or orientation of the end effector of the robot. These values are usually given in the form of Euler angles, describing the rotation of the end effector of the robot relative to the base coordinate system, and the order of Euler angles is zyx. Changing these values will rotate the end effector of the robot to different angles or directions. For example: When you adjust +X, this means that the position of the end effector of the current robot arm moves a certain distance along the positive direction of the X axis of the current end effector. This action will cause the robot to move in a certain direction as a whole. And when you adjust RX, this means that the attitude of the end effector of the current robot arm rotates a certain angle around the X axis of the current end effector. This action will cause the robot to rotate as a whole and the direction of the end effector will change. In general, the adjustment of +X and RX will directly affect the motion state of the robot arm. +X controls the movement of the position, while RX controls the change of attitude. If you want to see the changes more intuitively, we recommend that you use myblockly's serial control tool to adjust a parameter at a time and observe its changes in the coordinate system. Please note that when observing rx, ry, and rz, if you want to be more intuitive, please pay attention to adjusting x and ry when the J1 joint is 0, and adjusting y and rx when the joint is 90. You can refer to the coordinate system diagram below:





Q: Is there more explanation about the Offset of the DH parameter? Is the Offset rotated around z?

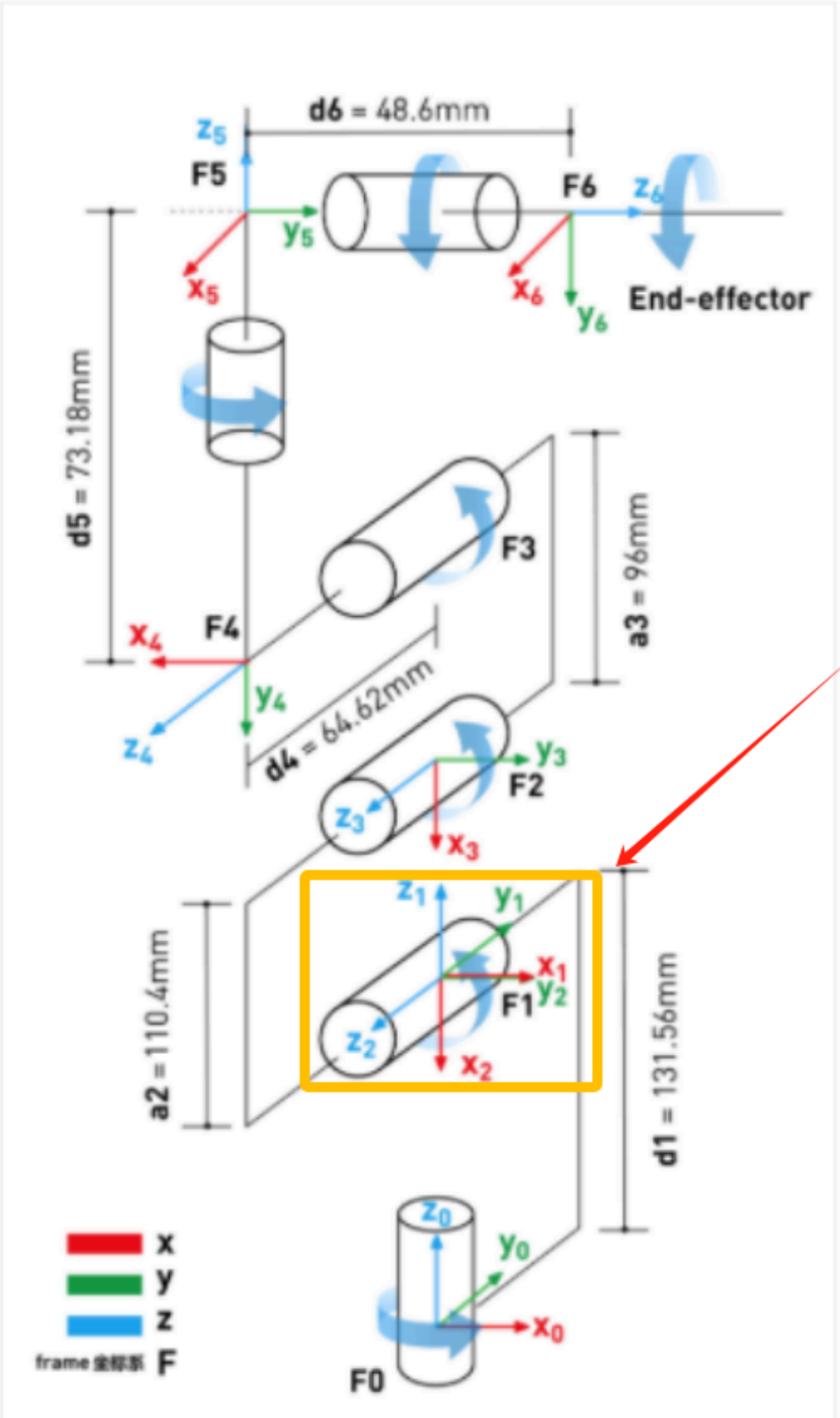
A: The DH parameter describes the geometric and kinematic relationship between adjacent links in the robot arm. In the DH parameter table, the Offset parameter indicates the effect of the previous link rotating around its z-axis on the position of the next link, that is, the offset when connecting two links. For the Offset parameter in the robot arm, it generally indicates the effect of the previous link rotating around its own z-axis on the position of the next link, rather than rotating around the z-axis of the next link. Therefore, Offset is not a rotation around z, but a displacement when connecting two links.

Q: What is the voltage range of the 280 robot arm power supply? How much is the instantaneous current?
A: 12V plus or minus 10%, 5A

Q: What is the inner diameter of the J1 joint of the 280M5? A: 70mm

Q: Why are two coordinate systems defined at F1 in this DH model of the 280m5?

3 DH参数


d6 = 48.6mm
z5
F5
y5
x5
F6
z6
x6
y6
End-effector
d5 = 73.18mm
F3
a3 = 96mm
x4
F4
y4
z4
d4 = 64.62mm
y3
F2
z3
x3
z1
y1
x1
y2
F1
z2
x2
a2 = 110.4mm
d1 = 131.56mm
z0
y0
x0
F0
x
y
z
frame 坐标系 F

Q: Following the above question, why are the physical distances of axis 1-2 different, but the origin settings are overlapping?

A: Because the rotation axes intersect, DH modeling has regulations. If the rotation axes of adjacent joints intersect, the origin must be set at the intersection

Q: If the servos of each axis are controlled and feedback is obtained, what is the shortest communication cycle?

A: This needs to be determined according to the speed. The minimum response time is 50ms

Q: Does the mycobot series machine have collision detection?

A: 280 has algorithmic collision self-interference, which has been integrated into the API for setting joint angles and coordinates

Q: What are the input parameters of Atom's USB interface?

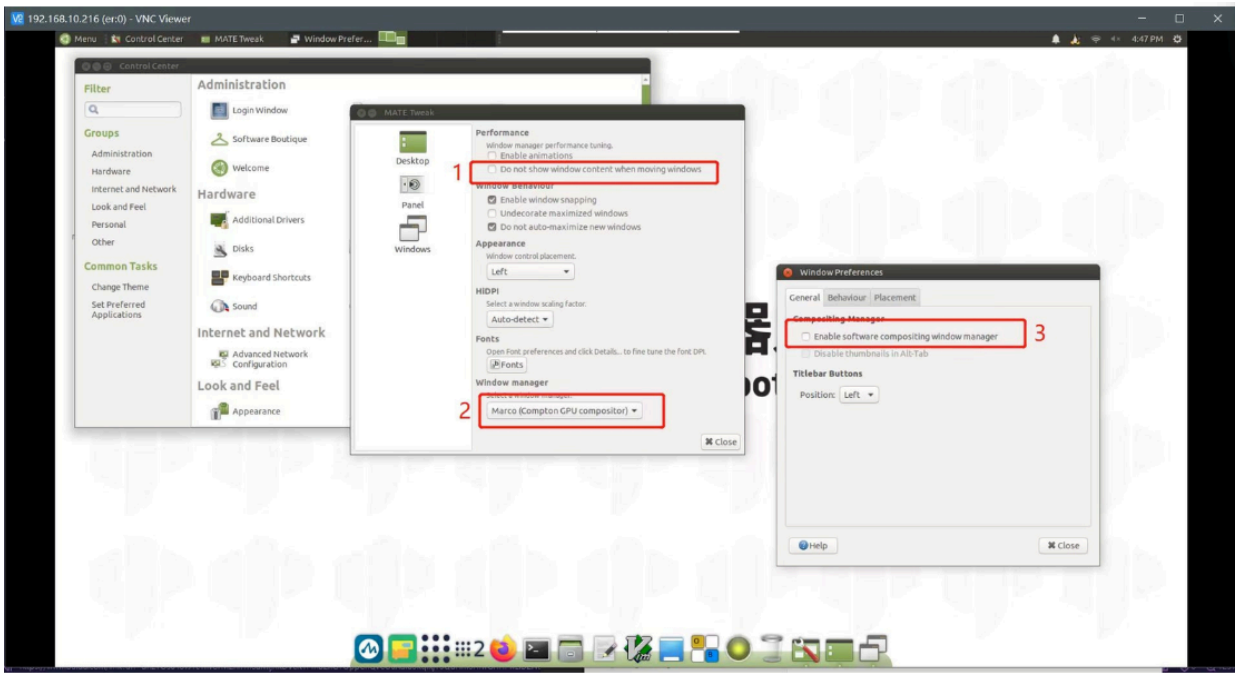
A: 5V @ 500mA

Q: How to deal with the 270 j3 joint not being able to display joint values in real time?

A: Reference link: https://drive.google.com/drive/folders/1BrvMxJltcLsr8T8-4kKOB7SH0D_qZkIP?usp=sharing The corresponding firmware has been replaced, and the corresponding python file can be run directly

Q: How to deal with the VNC dragging jam?

A: If the jam is caused by dragging any window in VNC, you can make some configurations according to the picture below. The options need to be consistent with the picture below. After successful setting, the problem of VNC disconnection caused by dragging the window will be solved.



Q: When replacing the second joint of 280, I found that 4 screws were stripped. How to remove them?

Regarding the replacement of joints, the 4 screws do not need to be removed. Please remove the large screw in the middle, then fix the J2 joint body back, and then use force to pull out the entire coupling. I recorded a video for you to refer to for specific operations

Q: Is the joint torque information provided?

A: Our machines only provide the overall information of the entire joint, and do not provide the internal torque, voltage and current of the servo and motor actuator. The overall parameters of the robot arm are disclosed, such as repeatability, power supply voltage, etc.

Q: How do you understand the relationship between the two coordinates in the following figure?

- **查看两个坐标系之间的关系**

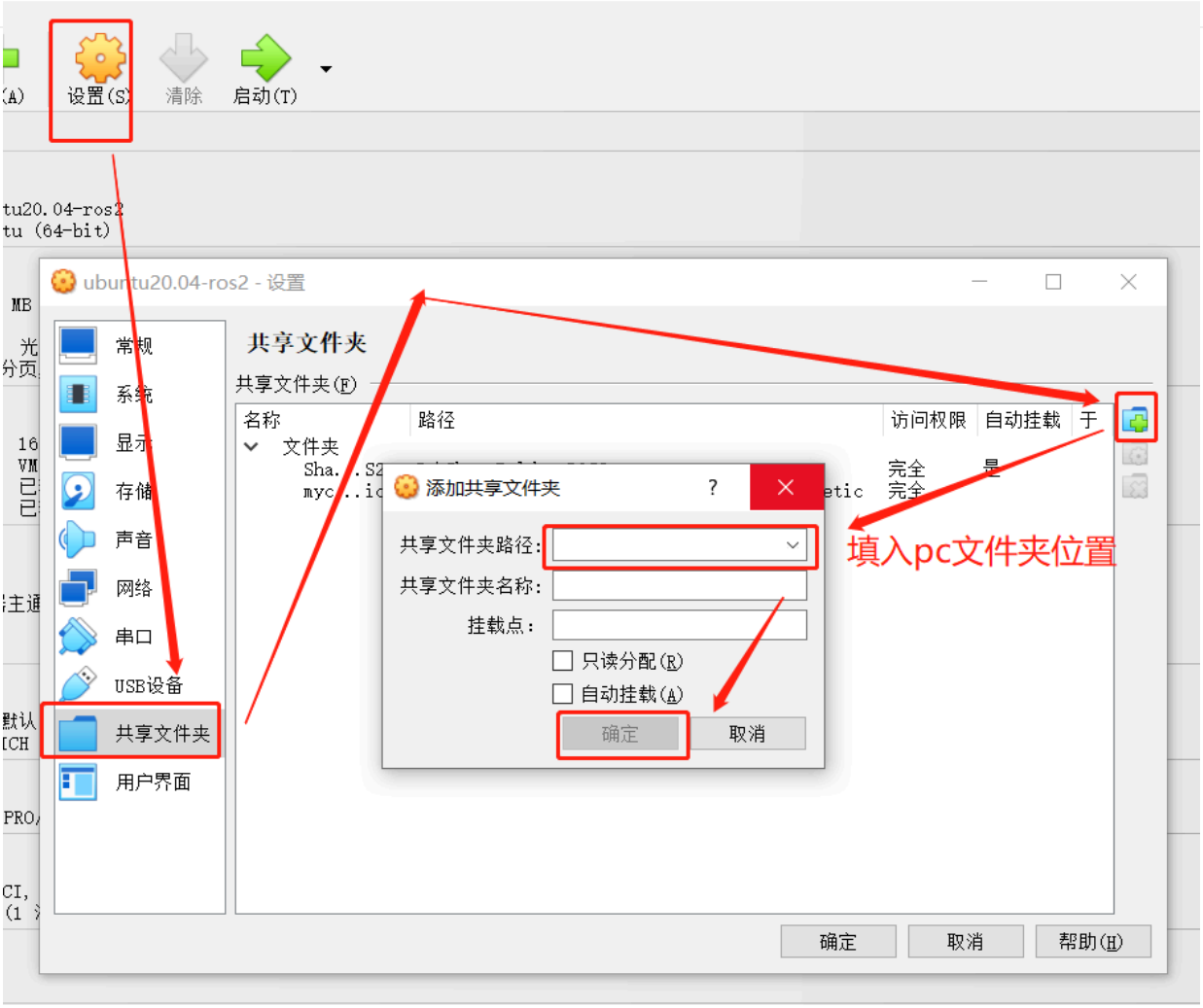
```
ros2 run tf2_ros tf2_echo [reference_frame] [target_frame]
ros2 run tf2_ros tf2_echo turtle2 turtle1
```

A: If you want to view the transformation relationship between the coordinate system named "turtle1" and the coordinate system named "turtle2", you can use this command. In layman's terms, when you run this command, it will tell you the position and direction information of an object ("turtle1") relative to another object ("turtle2"). Just like you can know the position of a city relative to another city on a map

Q: The environment of ROS2 has been accidentally changed. Can I just delete the 280pi ROS and reinstall it myself? A: Regarding the issue of reinstalling ROS, we do not recommend users to reinstall it themselves, because the construction of the ROS environment is relatively complex and prone to errors. If you need to reset the ROS environment, we recommend users to re-write the system image. For specific methods, please refer to Development and Use Based on ROS

Q: How to transfer files from the host to the virtual machine

A: Set up a shared folder as shown below to transfer files from the PC to the virtual machine



Q: How to solve the problem of excessive repeated positioning deviation after the robot arm is in place at the same position?

Both new and old machines can adjust pid to reduce deviation as much as possible.

Appendix: https://docs.qq.com/doc/DU0VhT2JNVUdNUEJS, https://drive.google.com/file/d/1UWhaaSTuwLFImuEGY1J2tvgxTQDwWxK_/view?usp=sharing However, the old version of the machine has gear gaps in the 2nd and 4th joints of the robot arm, which is easy to produce joint deviations under the action of gravity, which ultimately affects the end precision. The forces of the 2nd and 4th joints in these four sets of joint values are inconsistent, so the precision is also different. It is currently recommended to adjust through the program. When the machine reaches the point, you can read the point again at this point to check if there is a deviation. On this basis, adjust the specific deviation value of the single joint to achieve the effect of reaching the specified point.

Q: What is the difference between API and serial port instructions to directly control joints?

API provides a simplified and abstract interface to make development more efficient and easy, suitable for rapid development and integration. Serial port commands provide direct, low-level control, suitable for scenarios that require fine-tuning or development of custom functions, but are usually more complex to develop and debug. In general: Using serial port commands to directly control the robot arm is more flexible, but also more complex, requiring a deep understanding of the communication protocol; while using API control is simpler and more convenient, but may be limited by the functions and performance provided by the API.

Q: Windows runs git commands and reports errors

A: This is caused by not installing git. You need to install git first and then use git commands

Q: When using Arduino with 280M5, if you use a vertical suction pump, you cannot use the 2 and 5 IO ports. These two IO ports are occupied by the serial port. You can use other IO ports to control it. You can use the following code to control it.

```
#include <MyCobotBasic.h>


void setup()
{
  pinMode(1,OUTPUT);
  pinMode(3,OUTPUT);


}


void loop()
{


  delay(100);
  digitalWrite(1,1);
  delay(100);
  digitalWrite(3,0);
  delay(100);
  digitalWrite(1,0);
  delay(100);
  digitalWrite(3,1);
  delay(1000);


}
```

Q: What is the difference between MDI and JOG?

A: MDI (Manual Data Input) is called the set value direct given operation mode. That is, after the upper controller directly sets the target position, speed, acceleration and deceleration, the axis automatically moves to the target position. MDI is also the most commonly used positioning function in practical applications. JOG moves continuously in a certain direction.

Q: Overseas maintenance policy form

伺服电机	
保修期保修服务	
≤1个月	大象机器人公司免费提供新的伺服电机，并承担费用。
1—3个月	大象机器人免费提供新的伺服电机，运费由海关承担。
≥3个月	客户需要自己购买。
电气零件（M5五金件）	
≤3个月	客户需要在拆卸后将其退回，大象机器人将免费送回新的，并承担运费出境和返家。
3—6个月	客户需要在拆卸后将其退回并承担运费到家后，大象机器人将免费寄送新的。
≥6个月	客户需要自己购买。
结构零件，包括壳牌零件	
<1年	大象机器人免费提供一次新部件，运费由海关承担。
≥1年	客户需要自己购买。

servo motor	
Warranty Period	Warranty Services
≤1 months	Elephant Robotics offers a free new servo motor and bear the freigh.
1-3 months	Elephant Robotics offers a free new servo motor, customs shall bear the freight.
≥3 months	Customers need to buy it themselves.
Electrical Parts (M5 Hardware)	
≤3 months	Customers need to send it back after disassembly, Elephant Robotics shall send a new one for free and bear the freight out and home.
3-6 months	Customers need to send it back after disassembly and bear the freight out and home, Elephant Robotics shall send a new one for free.
≥6 months	Customers need to buy it themselves.
Structure Parts, including Shell Parts	
≤1 year	Elephant Robotics offers free new components once, customs shall bear the freight.
≥1 year	Customers need to buy it themselves.

Q: What is the latest supported version of pymycobot for each model?

机型	最新支持版本
260	3.9.7
270	
280	
320	
myAVG	
myArm	
myArm M&C	
UltraArm	
630-pico	
水星6轴	一层闭环(不支持头部两个舵机)：3.5.0dev5 无闭环(不支持头部两个舵机)：3.5.0dev6 完整闭环：3.5.0dev15 一层闭环(支持头部两个舵机)：3.5.0dev8（待测试，未发布，可以找开发要）
水星7轴	无闭环：3.5.0b19 一层闭环（到位指令为0）：3.5.0b14 完整闭环：3.9.7

Q: How to distinguish between standard and improved DH tables

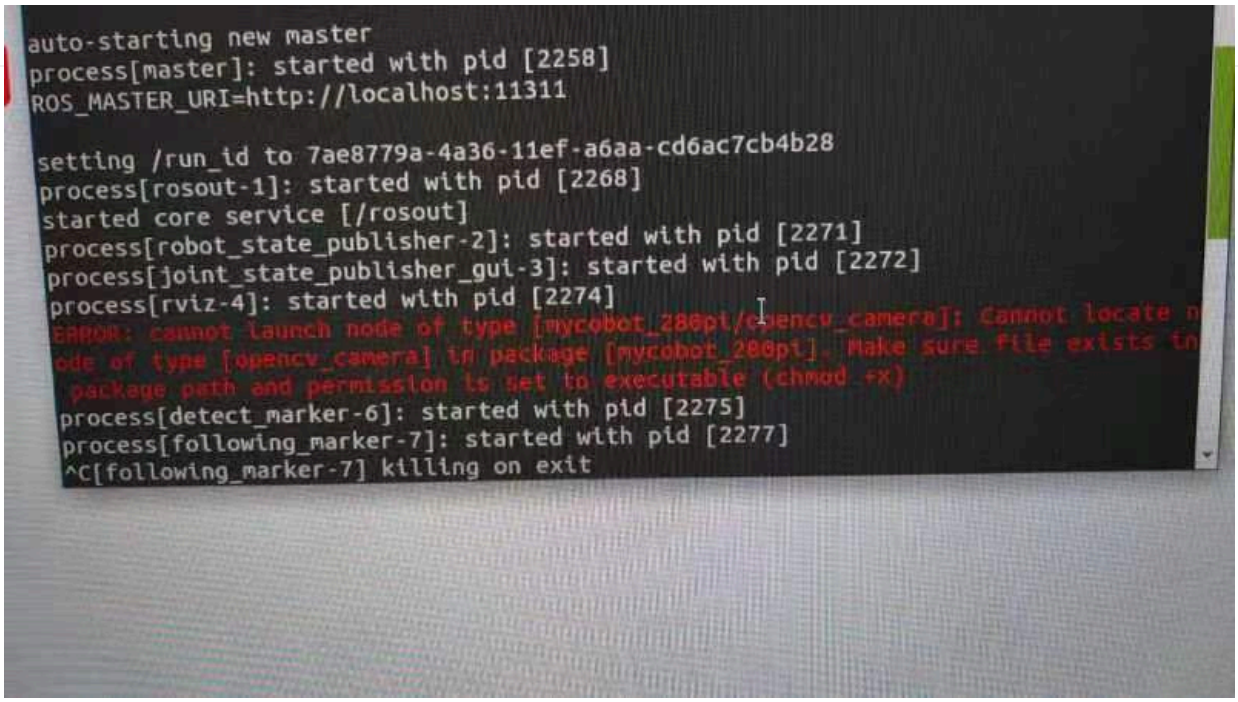
sdh, std, standard mdh, modify, improved We provide standard DH tables. Customers can convert them by themselves if necessary. They are just two different description methods.

SDH参数表

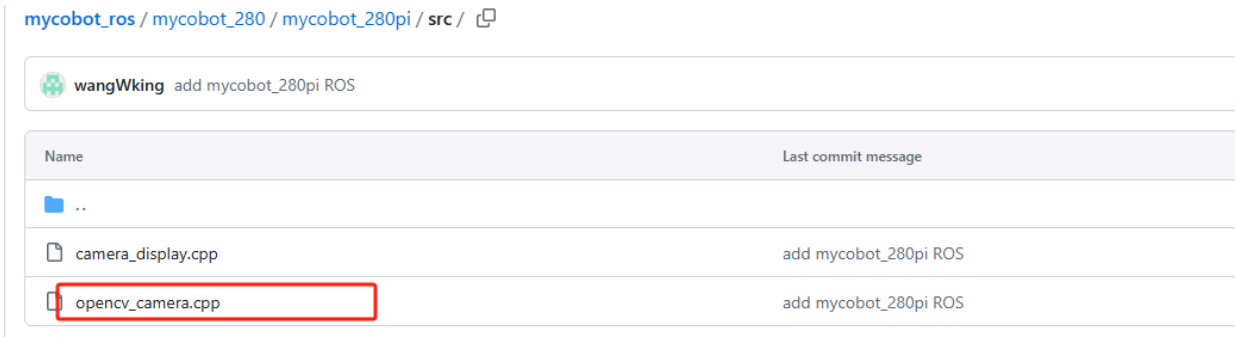
mycobot280:: 6 axis, RRRRRR, stdDH, slowRNE

j	theta	d	a	alpha	offset
1	q1	131.22	0	1.5708	0
2	q2	0	-110.4	0	-1.5708
3	q3	0	-96	0	0
4	q4	63.4	0	1.5708	-1.5708
5	q5	75.05	0	-1.5708	1.5708
6	q6	45.6	0	0	0

Q: How to deal with the error of missing opencv_camera?



A: The error message shows that the executable permission is missing. You may need to add the permission.



Change to using mycobot_280 instead of pi itself, because the m5 side has occupied the file. Both sides cannot occupy it at the same time, otherwise it will cause the subsequent compilation to fail.

```
<node name="opencv_camera" pkg="mycobot_280pi" type="opencv_camera" args="$(arg num)"/>
```

Q: How to check the data transmission speed? A: Use the following code:

```
import time
from pymycobot.mycobot import MyCobot
mc = MyCobot("COM8",115200, debug = True)
while 1:
    mc.get_angles()
```

```
13:39:38.670 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:38.764 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:38.764 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:38.856 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:38.857 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:38.949 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:38.950 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:39.042 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:39.043 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:39.138 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:39.139 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:39.233 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:39.234 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:39.327 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:39.328 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:39.422 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:39.422 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:39.517 DEBU [pymycobot.generate]  read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:39.518 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:39.611 DEBU [pymycobot.generate]  read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:39.611 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:39.703 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:39.704 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:39.796 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:39.797 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:39.891 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:39.892 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:39.986 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:39.986 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:40.080 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:40.080 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:40.173 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:40.174 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:40.267 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
13:39:40.268 DEBU [pymycobot.generate] _write: fe fe 2 20 fa
13:39:40.363 DEBU [pymycobot.generate] _read : fe fe e 20 34 a1 1c 41 2e 50 11 68 cc 81 ee 5b fa
```

Write indicates the acquisition command sent, read indicates the returned message, and the left side indicates the time. Here, 518write + 611read are displayed, indicating that a get_angles read was completed in about 100ms, with a frequency of 10hz.

Q: The indicator light of the adapter is not on

A: It is possible that the adapter is powered off for self-protection after a short circuit. Disconnect the adapter for a few minutes before using it. If it does not work after a few minutes, wait a little longer. After 15 minutes, power on the adapter separately to see if it lights up.

Q: A joint of the robot arm cannot move. How to deal with it?

A: You can use a python script to read the angle in a loop, and then manually turn the joint to see if the angle changes.

If there is a return value, check the following points and return the information to the technical support staff.

1. Use get_servo_status to check if the J2 servo has hardware problems such as undervoltage/overvoltage
2. Manually turn J2 to see if there is obvious resistance, and compare it with other joints; enable focus_servo(2) on J2 separately
3. Use the script to check if there is any problem with the parameters

代码消息 Python

```python
from pymycobot import MyCobot
import time
port = 'com5' #修改为你自己的串口号，可通过串口助手或者磁盘管理查看具体的端口号

m = MyCobot(port)
id = [1,2, 3,4,5,6]
j = 1
time.sleep(2)

for i in range (len(id)):
    print(id[i], end=": ")
    for j in range (70):
        print (m.get_servo_data(id[i], j), end=" ")
    print("")

```

Q: End zero position abnormality

A: After using the adaptive gripper to grip objects for a long time, the gripper and end zero position abnormality will occur, and the gripper needs to be stationary.

Q: What is forward kinematics and inverse kinematics?

A: Forward kinematics refers to solving the position and posture of the robot's end effector (such as the gripper of the robot arm) in Cartesian space when the angles (or displacements) of each joint of the robot are known. It is implemented in the get_coords() API, but the specific algorithm is not public. Inverse kinematics is the opposite of forward kinematics. It refers to solving the angles (or displacements) of each joint of the robot when the position and posture of the robot's end effector in Cartesian space are known. write_coords(), send_coords()

Chapter 5 Basic Functions

This chapter mainly explains the basic functions and basic software usage of the product. This chapter is very important and should be read carefully. Before actually applying the robot, please make sure you understand the described operations correctly.

- 5.1 System (Function) Instructions This section will introduce the drivers that need to be installed before using the product and the factory firmware introduction.
- 5.2 Software Instructions

  myStudio is a one-stop platform for the use of myRobot/myCobot and other robots. It is convenient for users to select different firmware and download them according to their own usage scenarios, and at the same time learn related teaching materials and browse tutorial videos online.
- 5.3 Firmware Function Description This section will introduce the difference between microprocessors and microcontrollers, firmware burning instructions, and how to use the four main functions of the factory firmware for microcontroller devices: miniRoboFlow.

← Previous Chapter | Next Chapter →

Basic Function Application

myStudio

Before you start using the device, you first need to **install the driver and update the device firmware**.

Install the driver

Users can click the button below to download the corresponding **CP210X** or **CP34X** driver package according to the operating system they are using. After unzipping the package, select the installation package corresponding to the operating system bit number for installation.

There are currently two driver chip versions, **CP210X** (for CP2104 version)/**CP34X** (for CH9102 version) driver package. If you are not sure about the USB chip used by your device, you can install both drivers at the same time. (**CH9102_VCP_SER_MacOS** may have an error during the installation process, but it has actually been installed, so just ignore it.)

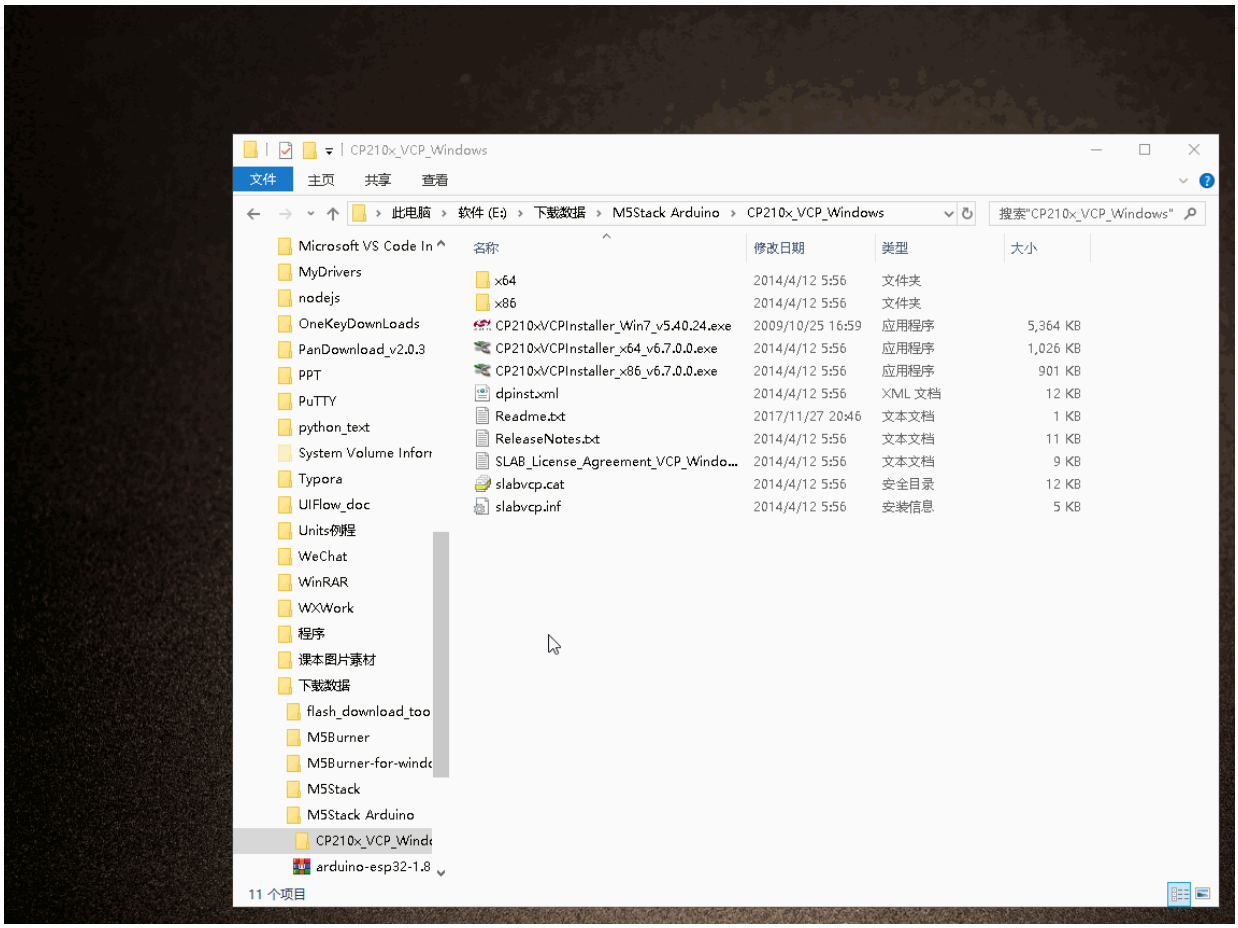
For Mac OS, make sure the system "Preferences->Security and Privacy->General" is set before installation, and allow downloads from the App Store and approved developers.

- Download the bottom **M5Stack-basic** serial port driver **CP210X**
- **Windows10**
- **MacOS**
- **Linux**

CP34X

- **Windows10**
- **MacOS**
- Download the terminal **Atom** serial port driver
- **Windows10**

Please follow this picture to complete the driver installation



Update device firmware

Before development, users should confirm whether the device firmware they are using is the latest version of the firmware, so that users can better use the device in subsequent development.

Users can update the device firmware through **myStudio**.

Factory firmware introduction

Drag teaching

Robot drag teaching means that the operator can directly drag the robot joints to move to the ideal posture and record it. Collaborative robots are the earliest systems with this function. This teaching method can avoid the various shortcomings of traditional teaching and is a technology with great application prospects in robots.

Calibrating the robot arm

Calibrating the robot arm is the prerequisite for precise control of the robot arm. Setting the joint zero position and initializing the potential value of the motor are the basis for subsequent advanced development.

Communication

The timeliness of communication is crucial for microcontroller manipulators. For microcontroller manipulators, we usually send control instructions to the **Basic** at the bottom. Through communication forwarding, the end effector will parse the instructions and then execute the target action. Currently, the communication methods of **microcontroller devices** are: **serial communication**, **Bluetooth communication**, **WIFI communication**. Users can choose the applicable communication method and perform programming operations.

Connection detection

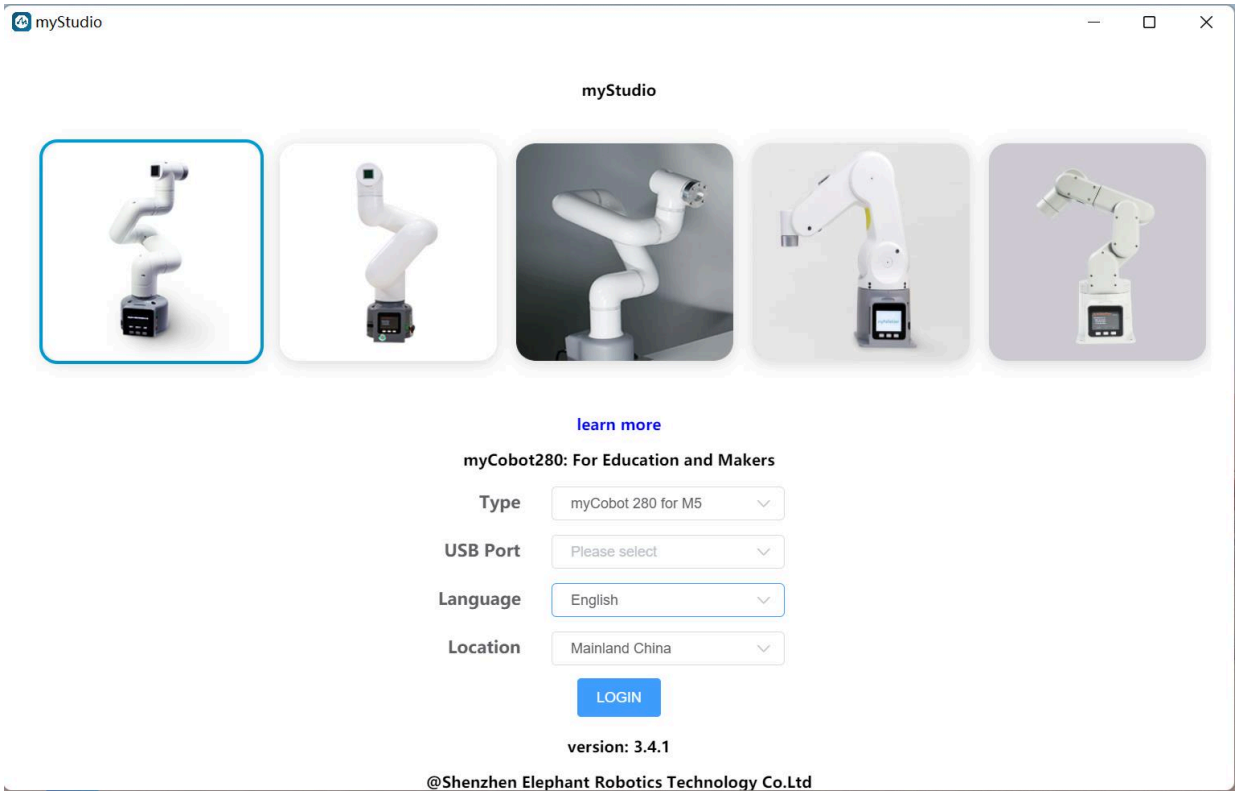
Connection detection is a detection function for the connection status of the motor and **Atom** in the manipulator. This function is convenient for customers to troubleshoot equipment failures.

In the connection detection, the device connection status of the manipulator can be seen, including **servo connection** and **Atom communication status**. **Microcontroller devices** The current firmware version of the device will be displayed on Basic.

First use

After understanding the existing functions of the firmware, please follow the steps in this section to start connecting and fixing the machine and start using the basic functions of the device.

myStudio



Original intention of myStudio design

- myStudio is a one-stop platform for using robots such as myRobot/myCobot.
- It is convenient for users to select different firmware and download them according to their own usage scenarios, and at the same time learn related teaching materials and browse tutorial videos online.

myStudio latest version and supported platforms

- Latest version: V3.5.8
- Applicable to: Windows, Mac, Linux

myStudio features

- Burn and update firmware
- Provide robot tutorials, such as user manuals, video tutorials, Q&A, etc.
- Information on maintenance and repairs

myStudio applicable devices

- myCobot 280
- **myCobot 280 M5**
- myCobot 280 PI

- myCobot 280 Jetson Nano
- myCobot 280 for Arduino

Firmware version recommendation

Different models of robotic arms require different firmware to be burned. The following are the firmware versions recommended for burning different models of robotic arms.

myCobot 280 series

The myCobot 280 series has 4 versions: M5 version, PI version, ardunio version and jetsonnano version. Different versions have different core models, and the firmware and versions required to be burned are also different.

Robot version number	Core	Required firmware to be burned	Recommended firmware and version
M5 version	M5Stack-Basic	miniRobot firmware	Recommended to burn v2.1 version, you can use drag teaching, wifi, Bluetooth and other functions
	Atom	atomMain firmware	For products with serial numbers ER28001202200415 and earlier, or products without serial numbers, it is recommended to burn v4.1; for products with serial numbers ER28001202200416 and later, it is recommended to burn v5.1

myStudio environment setup

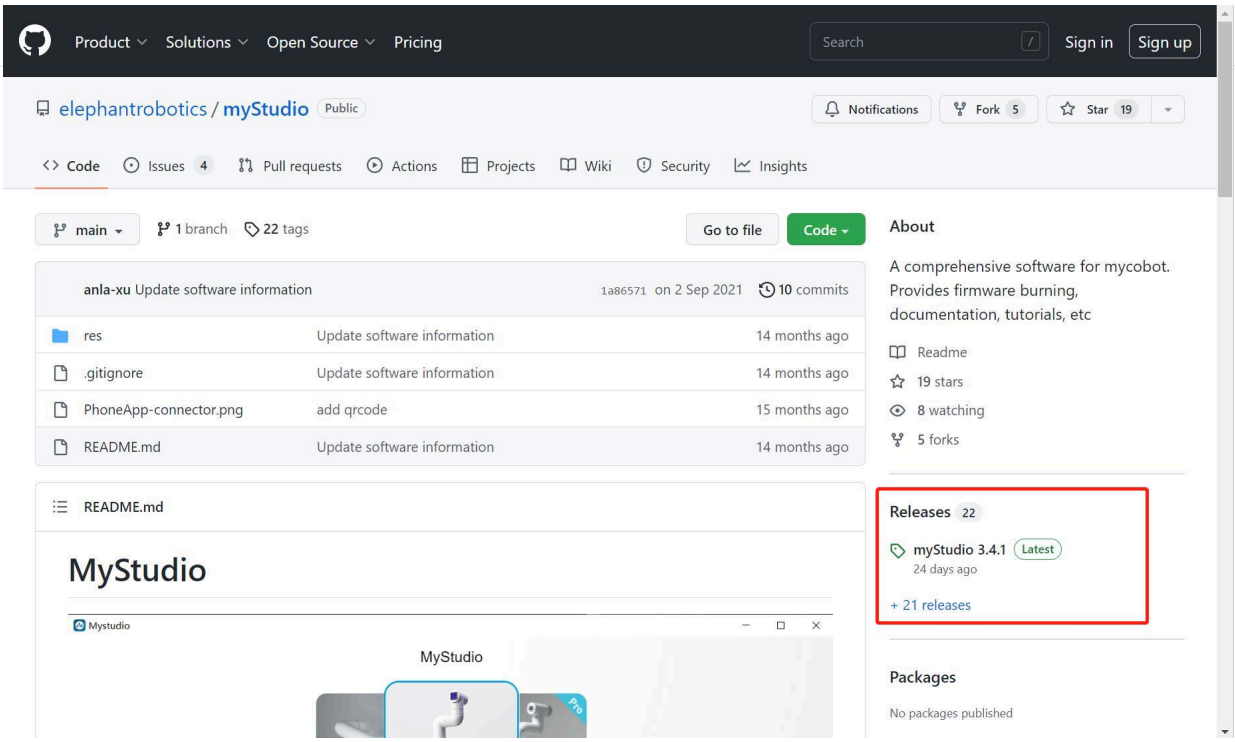
myStudio download and installation

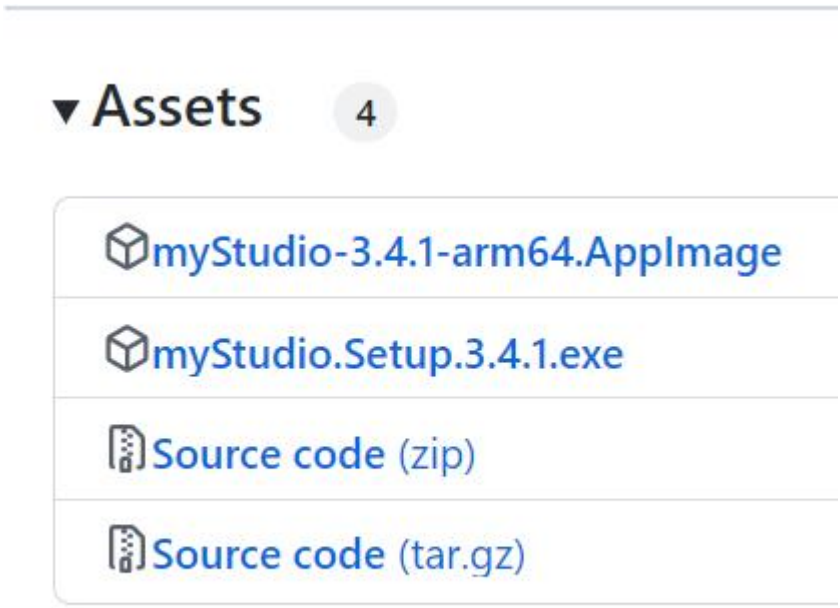
> Note: The installation path of myStudio cannot have any spaces

Download address:

1. GitHub address

- After entering the download address, click `myStudio` on the right and select the corresponding version to download.



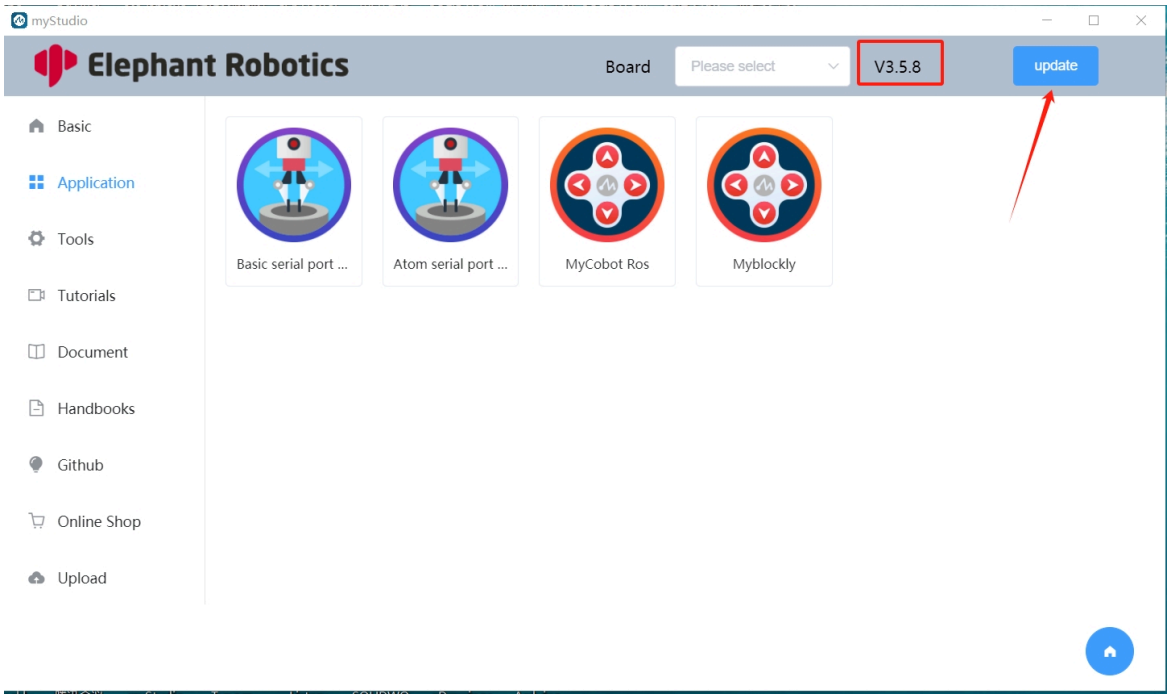


- Different suffixes represent different systems, please download the corresponding version:
- *.tra.xz —— Linux system
- *.dmg —— Mac system
- *.exe —— Window system

2. Official website address

You can download it according to your computer system.

> **Note:** Please download the latest version. You can view the current version in the downloaded myStudio interface and update to the latest version.



Driver Installation

Users can click the button below to download the corresponding **CP210X** or **CP34X** driver package according to their operating system. After decompressing the package, select the installation package corresponding to the operating system bit number for installation.

There are currently two driver chip versions, **CP210X** (for CP2104 version) and **CP34X** (for CH9102 version) driver package. If you are not sure which USB chip your device uses, you can install both drivers at the same time. (During the installation process, an error may appear for **CH9102_VCP_SER_MacOS**, but the installation has actually been completed, so just ignore it.)

For Mac OS, before installing, make sure that the system "Preferences->Security and Privacy->General" is set and that it allows downloads from the App Store and approved developers.

- Download the bottom **M5Stack-basic** serial port driver

- **CP210X**

- **Windows10**
- **MacOS**
- **Linux**

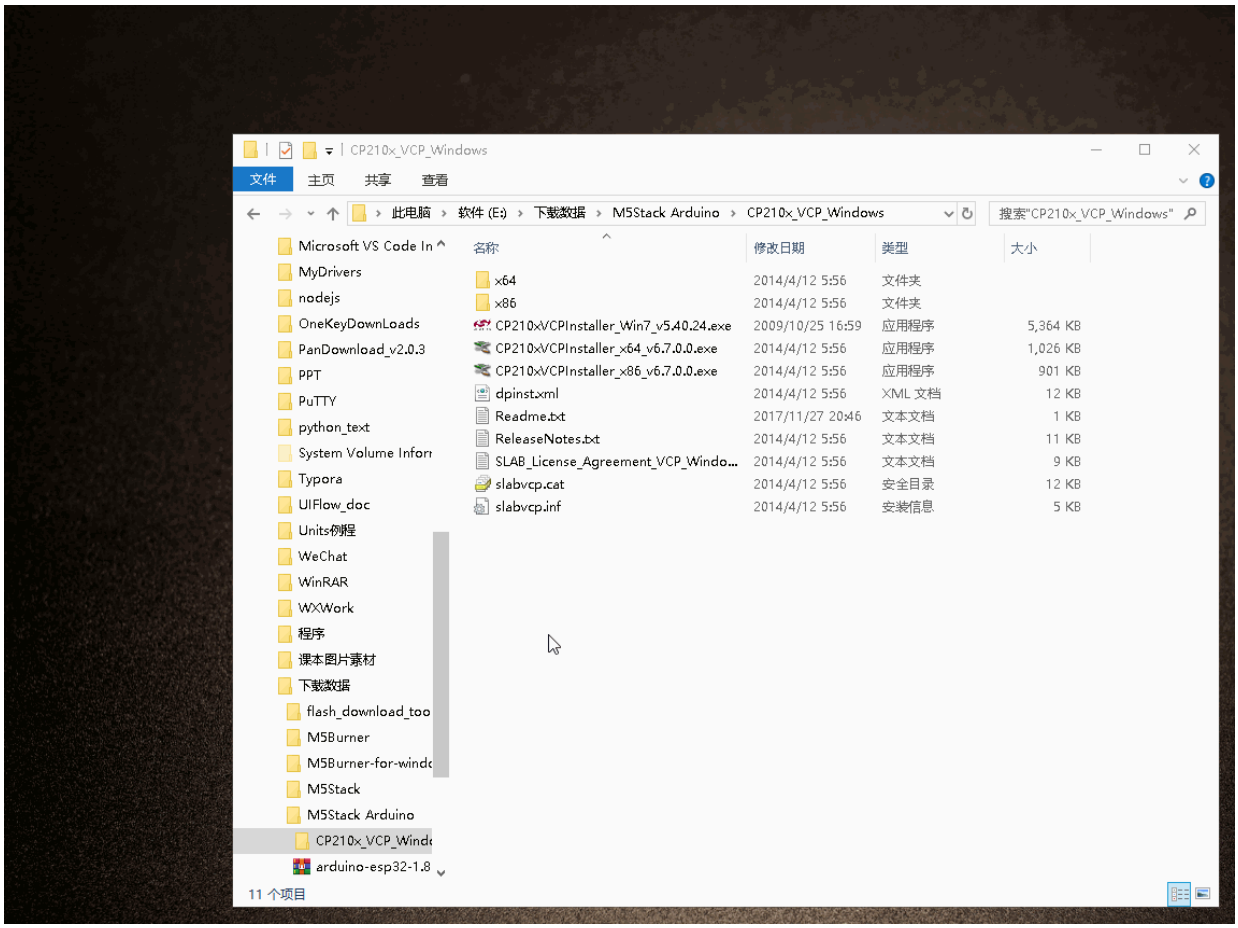
- **CP34X**

- **Windows10**

- **MacOS**

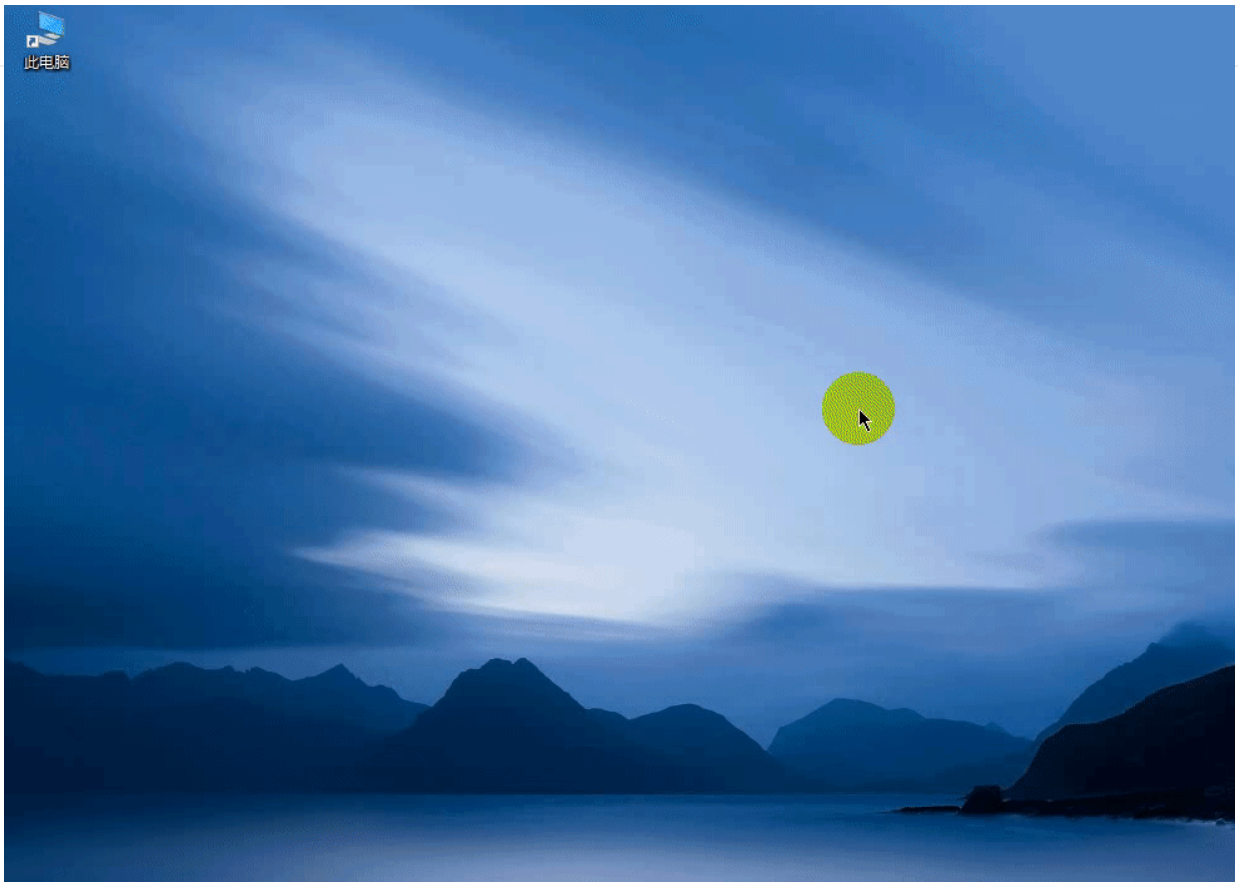
- Download the terminal **Atom** serial port driver

- **Windows10**

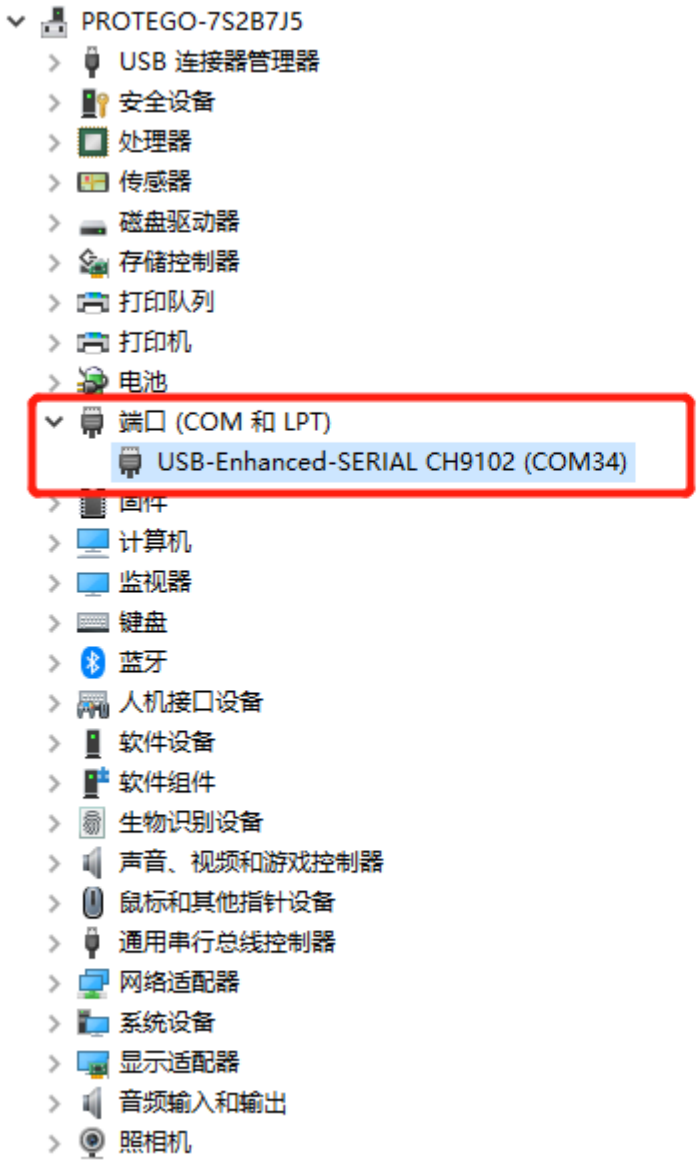


How to distinguish CP210X and CP34X chips

- As shown in the figure below, open **Device Manager** and check **Ports (COM and LPT)**



- If **Port (COM and LPT)** shows **USB-Enhanced-SERIAL CH9102**, it is **CP34X chip**



- If **Port (COM and LPT)** shows **Silicon Labs CP210x USB to UART Bridge**, it is **CP210X chip**

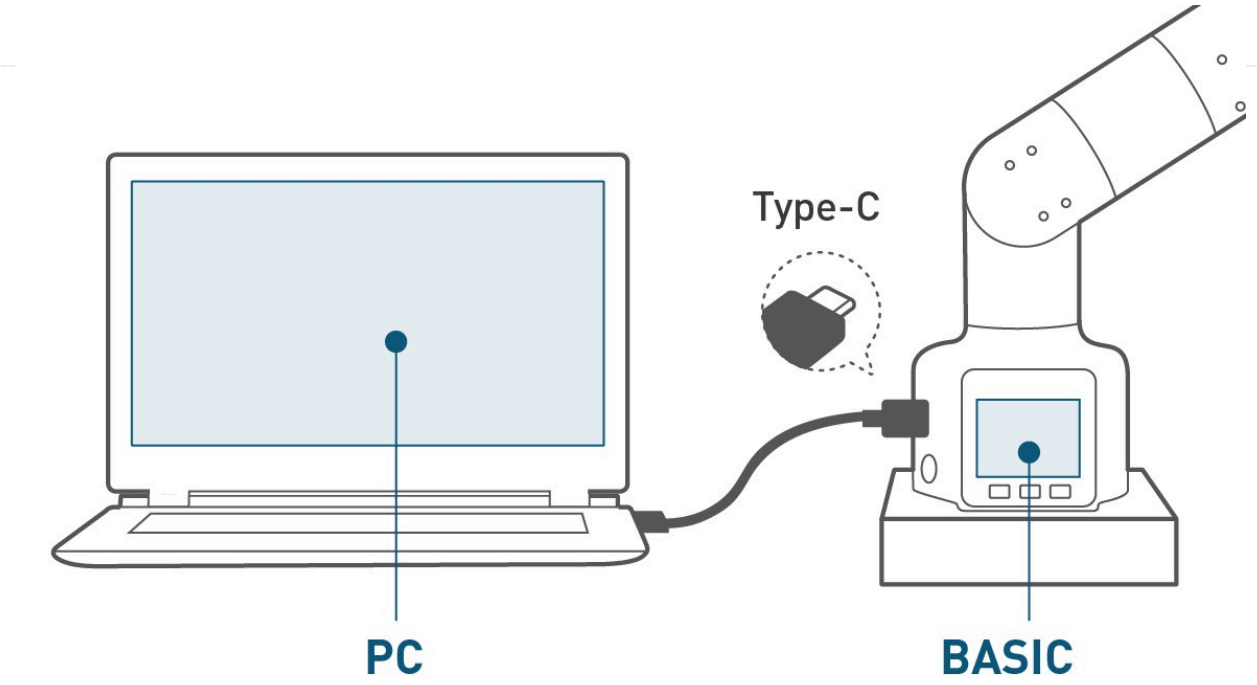
Burn and update firmware

myStudio video tutorial

Burn M5Stack-Basic firmware

> **Note: Pi series robot arms do not need to burn M5Stack-Basic firmware.**

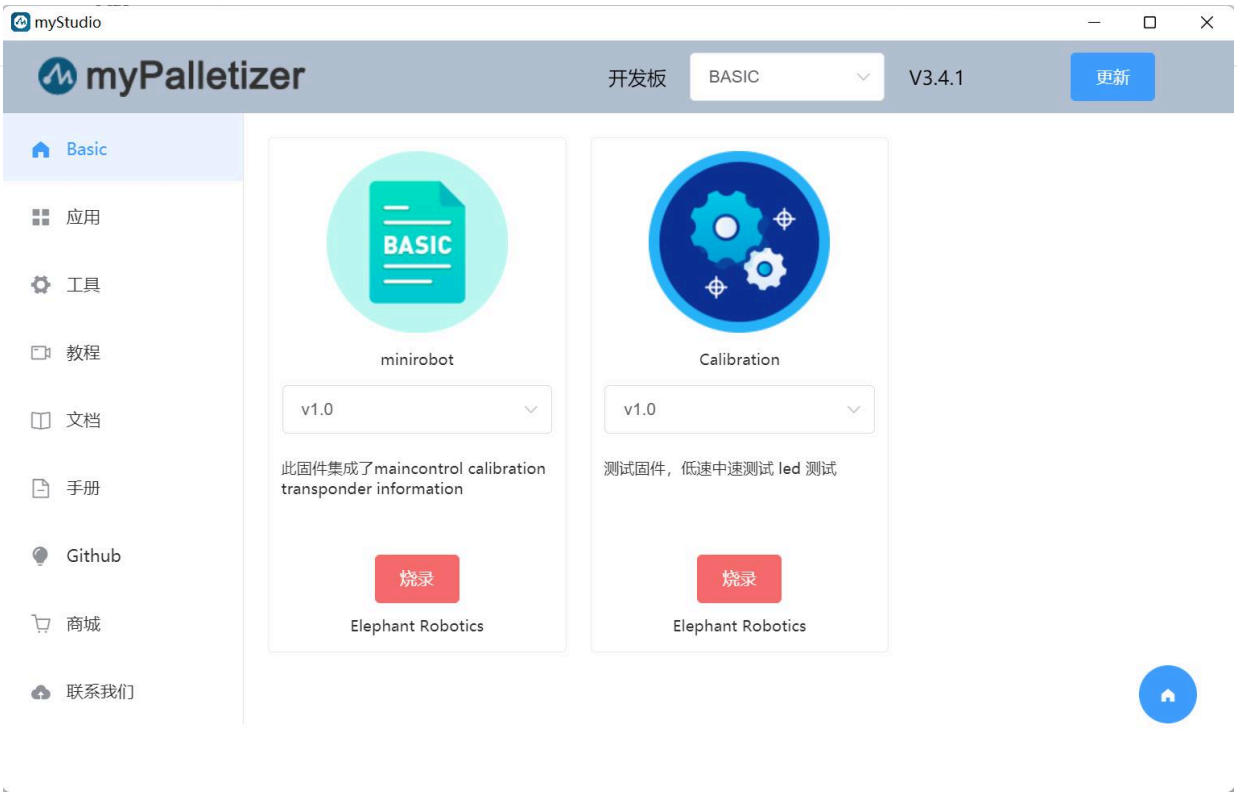
Step 1: Connect to PC. The connection method between M5Stack-Basic and PC is shown in the figure below:



Step 2: Select the port. After connecting, the `USB port` in the connection window of myStudio will show the connected development board (here is the myPalletizer 260M5 version as an example):

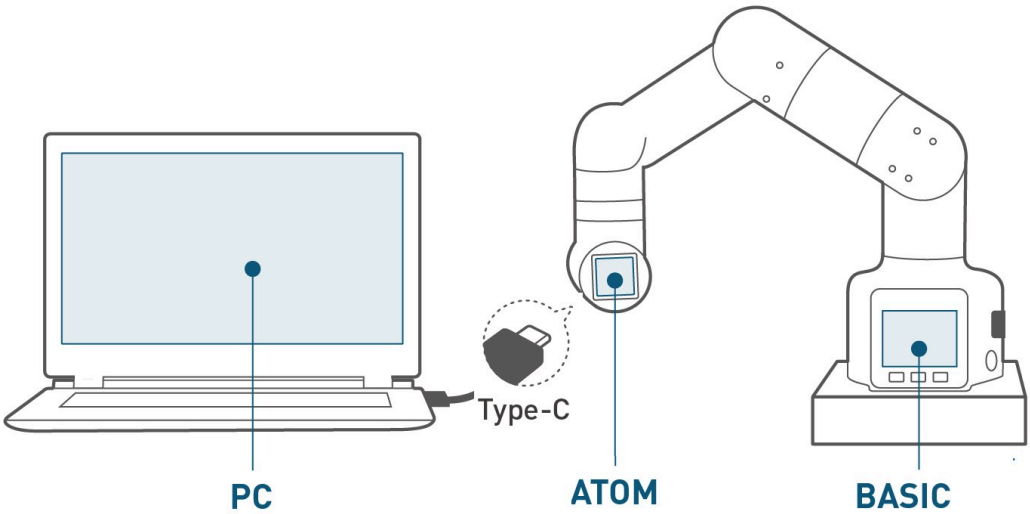
Step 3: Click `Login` -> `M5Stack-basic` to burn the required firmware:

> **Note:** The 280 PI/Jetson nano/Arduino version does not have M5Stack-basic, so it will display "No data" after connecting to myStudio.

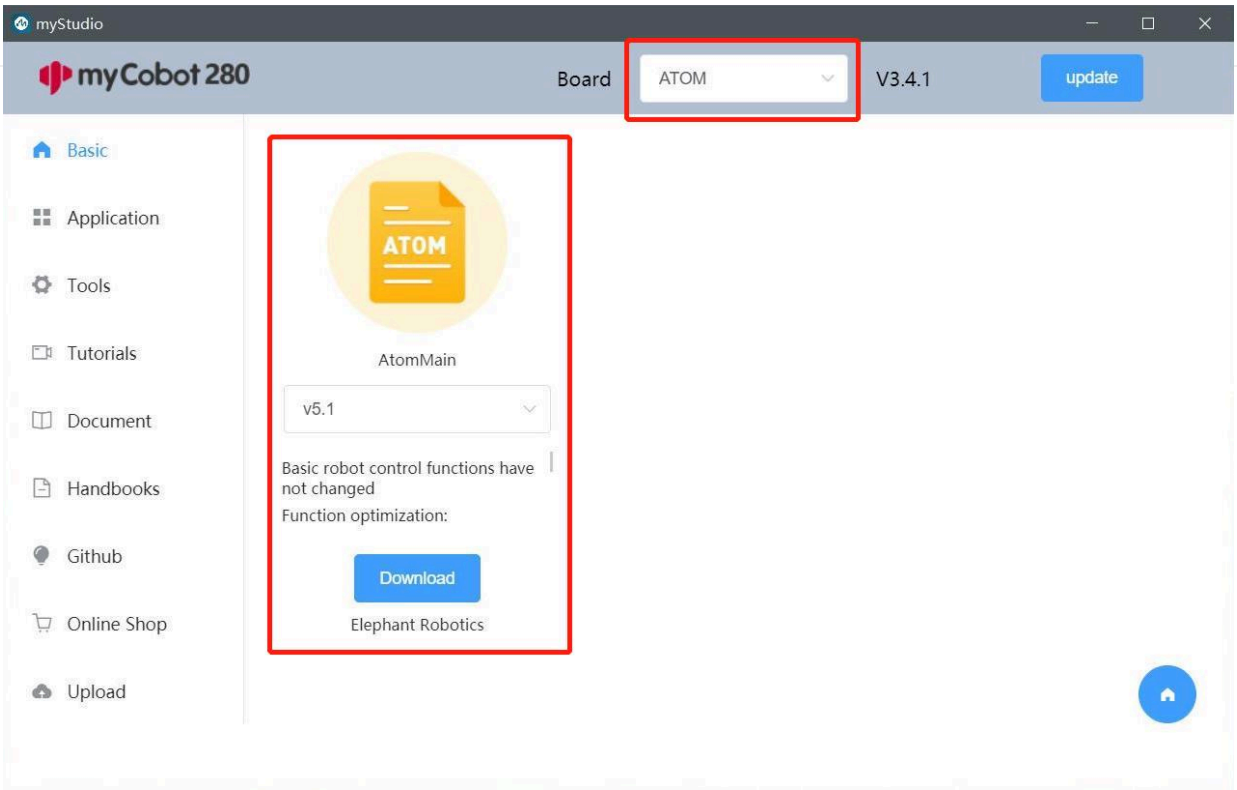


Burn Atom firmware

Step 1: Connect to PC. Connect the Atom at the end with USB.



Step 2: Select `ATOM` in the `Board` column, and the Atom firmware will appear in the `Basic` sidebar. There is only one Atom firmware, click to burn it (the following figure takes myCobot 280 as an example).



5.Power on and preliminary test

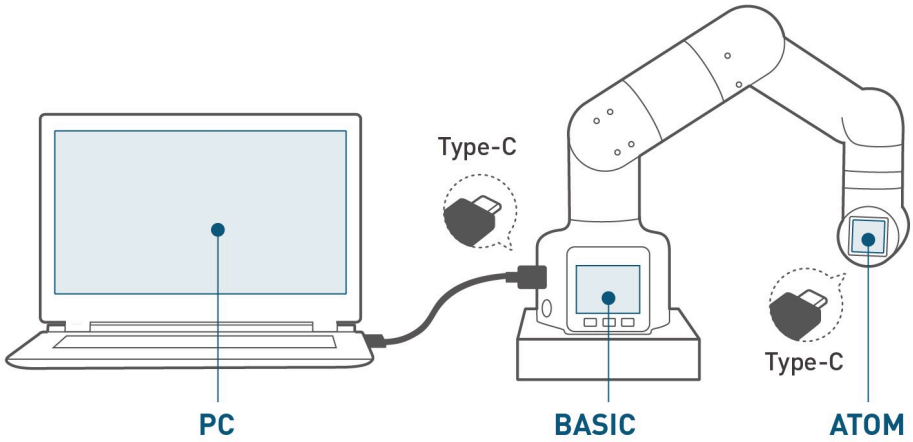
myCobot must be powered by an external power supply to provide sufficient power: Rated voltage: 12V

Rated current: 3-5A

Plug Type: DC 5.5mm x 2.1

Note that you cannot just use the TypeC plugged into the M5Stack-basic for power. Use the official power adapter to avoid damage to the robot.

Graphic guide



Connect the power supply

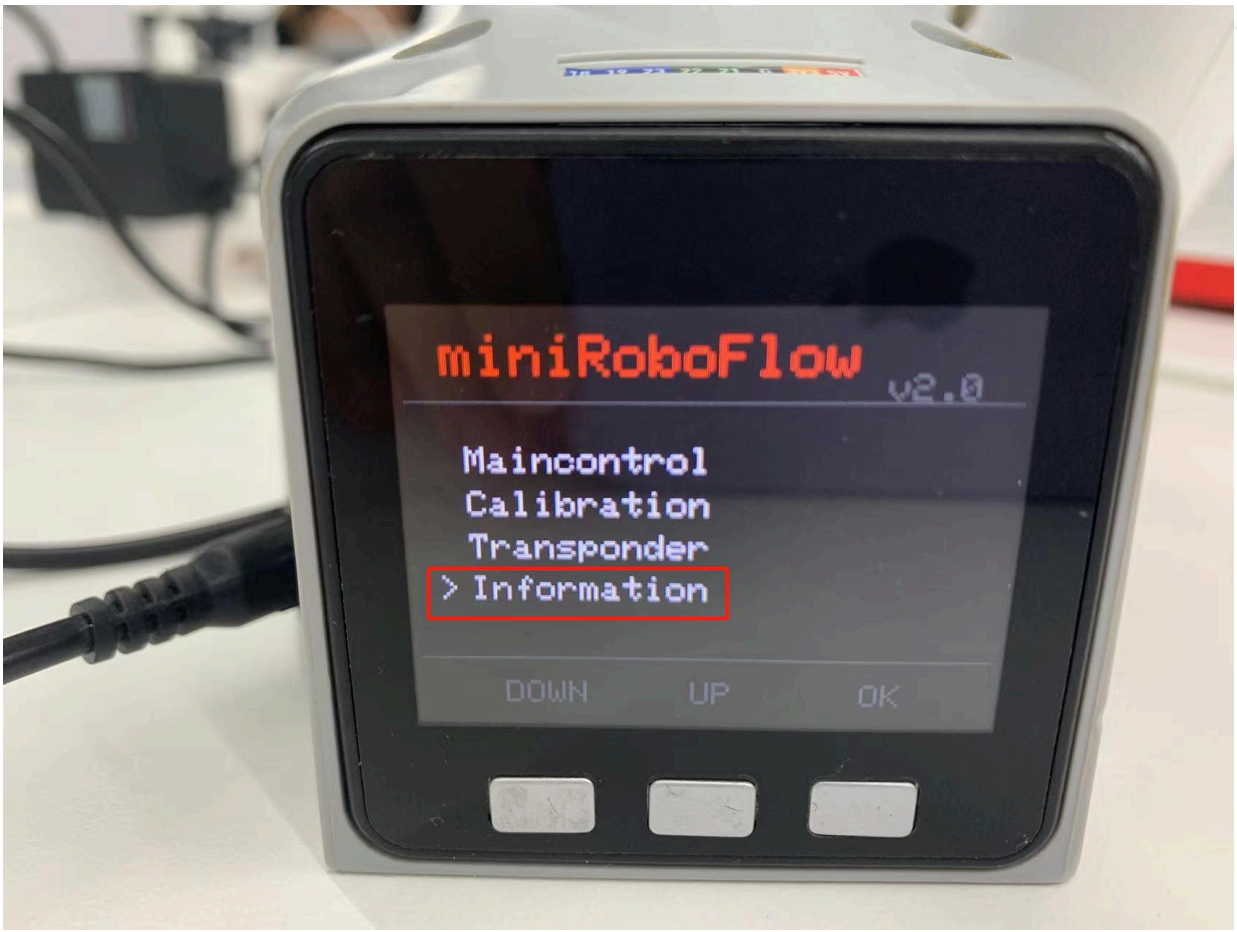
Start after connecting the power cord.

Use the Type-C cable to connect to the corresponding USB port of the computer and the robot M5Stack-basic, and perform a connection test. The connection test is a detection function for the motor and **Atom** connection status in the robot. This function is convenient for customers to troubleshoot equipment failures

Connection detection

Step 1: Atom burns the latest version of **atomMain**.

Step 2: M5Stack-basic burns **minirobot**, select **Information** function.

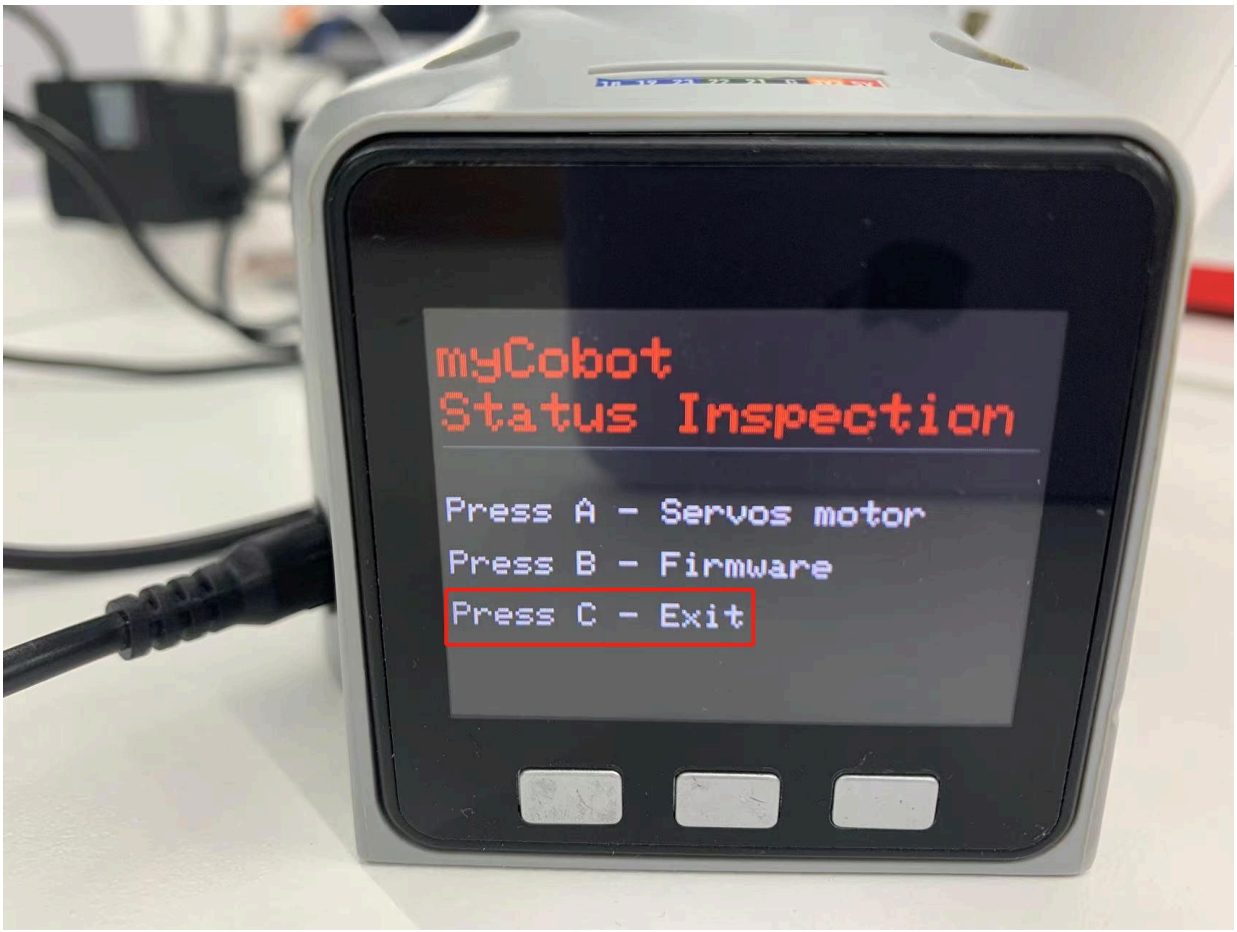


Step 3: Press **A** key to start connection detection. The screen displays **Atom** and the connection status of the six motors.

As shown in the figure, the motor connection is in good condition **Step 4**: Press the **B** key to start detecting the

version information. The screen displays the robot version and the **Basic** firmware version.

Step 5: Press the **C** key to exit this function



The power-on detection is completed.

Factory firmware introduction

Only introduce the myCobot series, myPalletizer series and mechArm series, which are divided into two categories: microcontrollers and microprocessors.

- Microcontroller devices:
- myCobot 280 M5
- myCobot 320 M5
- myPalletizer 260 M5
- mechArm 27 M5
- Microprocessor devices
- myCobot 280 Pi
- myCobot 320 Pi
- mechArm 270 Pi

The difference between microprocessors and microcontrollers is mainly concentrated in three aspects: hardware structure, application field and instruction set characteristics:

- Hardware structure. The microprocessor is a single-chip CPU, while the microcontroller integrates the CPU and other circuits in an integrated circuit chip to form a complete microcomputer system. In addition to the CPU, the microcontroller also includes RAM, ROM, a serial interface, a parallel interface, a timer and an interrupt scheduling circuit.
- Application field. Microprocessors are usually used as CPUs in microcomputer systems. They are designed for such applications, which is also the advantage of microprocessors. However, microcontrollers are usually used in control-oriented applications, and the system design pursues miniaturization and minimizes the number of components. Microcontrollers are suitable for those occasions where input/output devices are controlled with very few components, while microprocessors are suitable for information processing in computer systems.
- Instruction set characteristics. Due to different applications, the instruction sets of microcontrollers and microprocessors are also different. The instruction set of microprocessors enhances processing capabilities, giving them powerful addressing modes and instructions suitable for operating large-scale data. Microprocessor instructions can operate on nibbles, bytes, words, and even double words. By using address pointers and address offsets, microprocessors provide addressing modes that can access large amounts of data. The self-increment and self-decrement modes make it very easy to access data in units of bytes, words, or double words.

1. Factory firmware for microcontrollers: miniRoboFlow

miniRoboFlow has four main functions:

- Drag teaching (Maincontrol)
- Robot drag teaching, the operator can directly drag the robot joints to move to the ideal posture, and save the action in the machine through button operation. Collaborative robots are the earliest systems with this function. This teaching method can avoid the various shortcomings of traditional teaching and is a technology with great application prospects in robots.
- Calibration (Calliberation)
- Calibrating the robot arm is the prerequisite for precise control of the robot arm. Setting the joint zero position and initializing the motor potential value are the basis for subsequent advanced development.
- Computer control（Transponder)
- The timeliness of communication is very important for microcontroller robot arms. For microcontroller robot arms, we usually send control instructions to the M5Stack-basic at the bottom. Through communication

forwarding, the end effector will parse the instructions and then execute the target action. At present, the communication methods of myCobot 280 are: serial communication, Bluetooth communication, and WIFI communication.

- Connection detection（Information）
- Connection detection is a detection function for the connection status of the motor and Atom in the robot arm. This function is convenient for customers to troubleshoot equipment failures. In the connection detection, the device connection status of the robot arm is seen, including the connection of the servo and the communication status of the Atom. The current firmware version of the device will be displayed on the M5Stack-basic in the microcontroller device.

Implement drag teaching

Drag teaching

Robot drag teaching means that the operator can directly drag the robot's joints to move to the ideal posture and record it.

Collaborative robots are the earliest systems with this function. This teaching method can avoid the various shortcomings of traditional teaching and is a technology with great application prospects in robots.

Depending on the device type, the operation method is also different, the steps are as follows:

- **Atom** burn the latest version of **atomMain**
- **M5Stack-basic** burn **minirobot**, select **Maincontrol** function, microprocessor devices do not need to burn **M5Stack-basic**
- Press the record button/keyboard key
- Select the storage path, microprocessor devices do not have this step
- You can directly drag the joints of the robot arm to the expected position to complete a set of movements
- Press the specified button/keyboard key to save
- Press the play button/keyboard key/keyboard key
- Select the relative storage path, and the robot arm starts to move
- Press the exit button/keyboard key to exit this function

In this section, we will teach you how to get started easily and experience the fun of collaborative robot dragging teaching

Applicable devices

- myCobot 280 M5
- myCobot 320 M5
- myPalletizer 260 M5
- mechArm 270 M5

Operation steps

Step 1: Burn the latest version of atomMain in Atom.

Step 2: Burn minirobot in M5Stack-basic and select the Maincontrol function.

Step 3: Press the Record button.

Step 4: Select the storage path and press Ram or Flash.

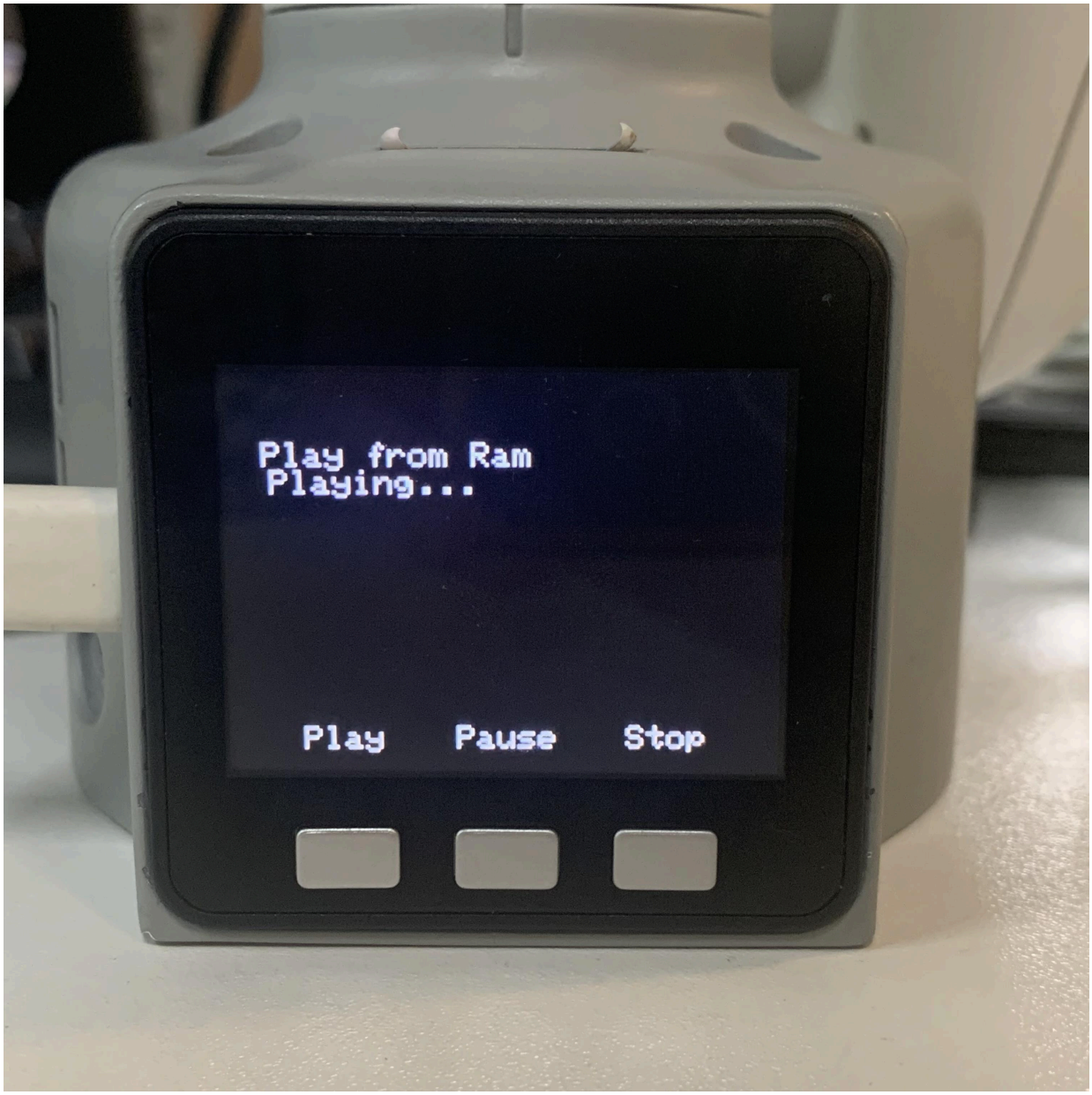
Step 5: Drag the joints of the robot arm to the desired position to complete a set of movements.

Step 6: Press any key to stop recording and save the record

Step 7: Press the Play button Play.

Step 8: Click the storage path just selected, press Ram/Flash, and the robot arm starts playing the saved record.

Step 9: Press Pause to pause the movement, press Stop to stop the movement, and press Play to resume the movement.



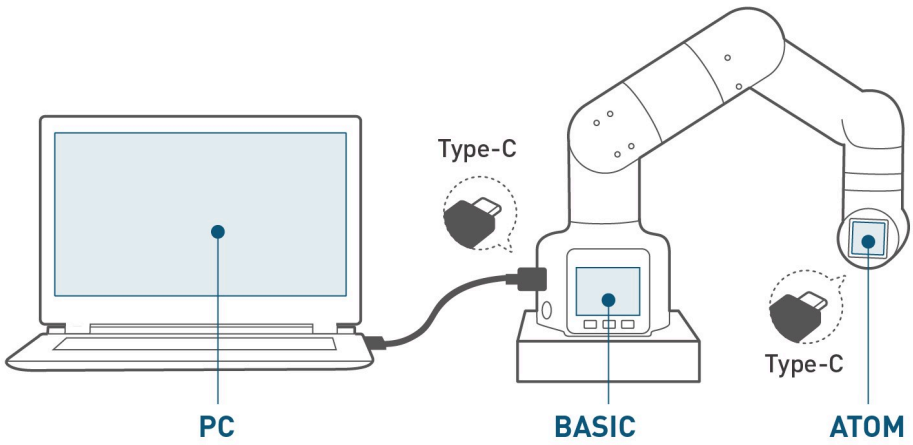
Video tutorial

Tutorial video address: https://www.bilibili.com/video/BV16t4y167vw/

Implement robot arm calibration

Calibrate the robot arm

Tip: By default, the robot has already been operated before leaving the factory, so there is no need to repeat the operation. Incorrect use of this function may cause damage to the robot. If your robot works normally, please do not use it. Thank you for your cooperation.



Calibrating the robot arm is the prerequisite for precise control of the robot arm. Setting the joint zero position and initializing the motor potential value are the basis for subsequent advanced development.

Depending on the device type, the operation method is also different, the steps are as follows:

- **Atom** burn the latest version of **atomMain**
- **M5Stack-basic** burn **minirobot**, select **Calibration** function, microprocessor devices do not need to burn **Basic**
- Turn each joint of the robot arm to the zero position state (zero position scale line is aligned), press the calibration button to start calibrating the robot arm
- Press the test button to test the zero position of each joint of the robot arm
- Press the exit button to exit this function

In this section, we will teach you how to calibrate the robot arm step by step, and after calibration, test and verify the joints of the robot arm.

Applicable devices

- myCobot 280 M5
- myCobot 320 M5
- myPalletizer 260 M5
- mechArm 270 M5

Operation steps

Step 1: Atom burns the latest version of atomMain.

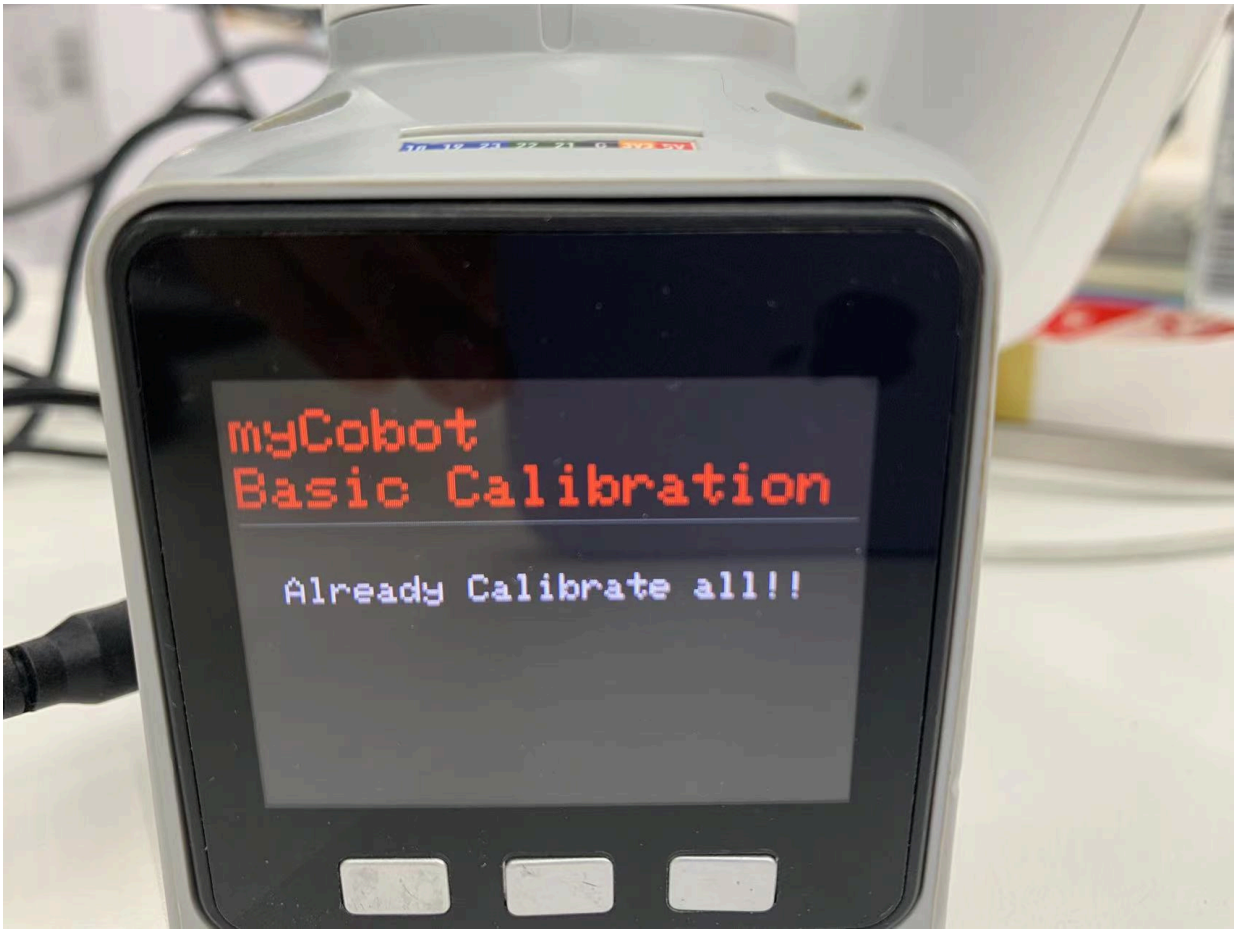
Step 2: Basic burn minirobot, select Calibration function.

Step 3: Press A key to start calibrating the robot arm.

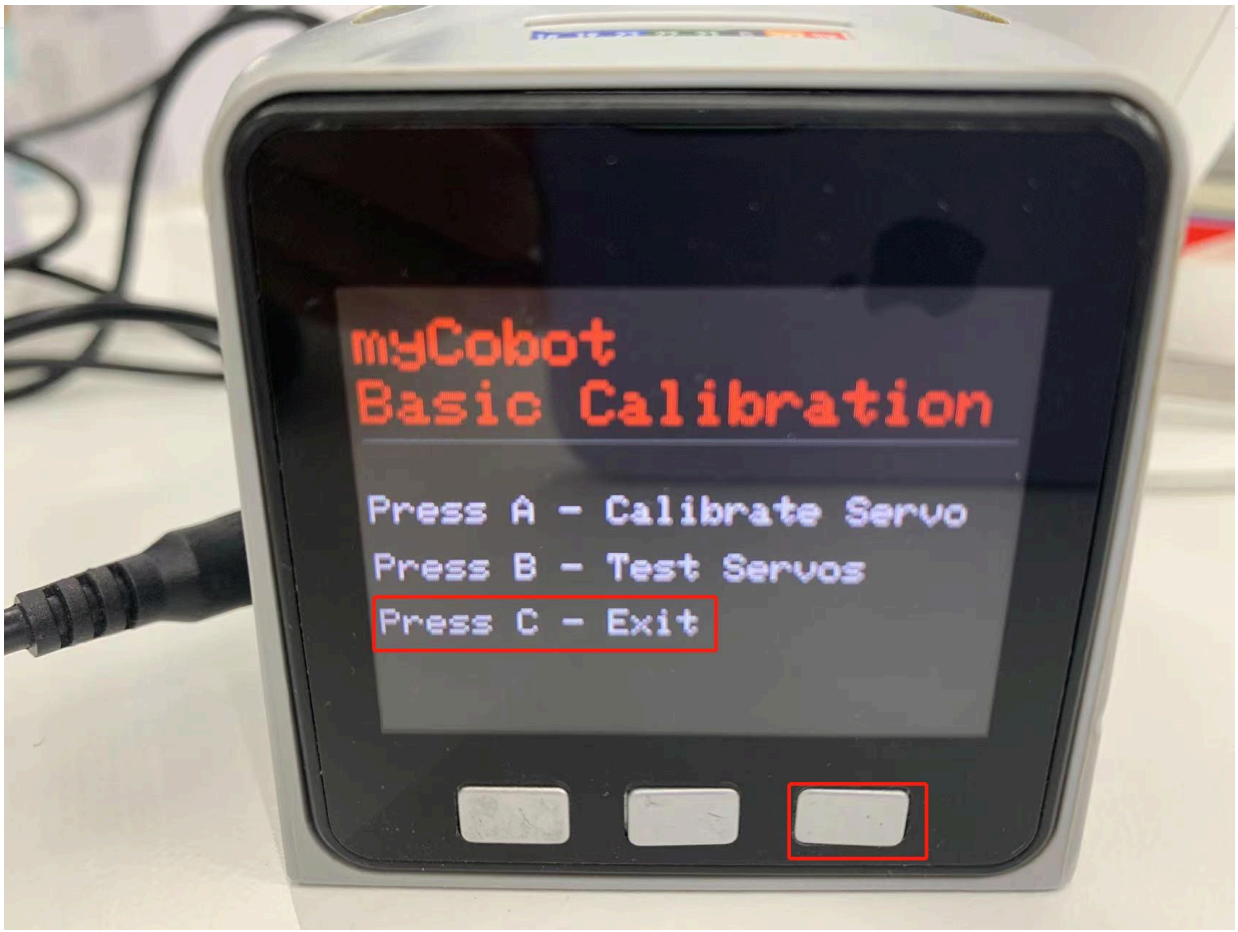
Step 4: First drag the robot arm to make joint 1 reach the zero position (zero position scale line is aligned).

Step 5: According to the motor number (1~6) indicated on the screen, drag the robot arm to make each joint reach the zero position (align the zero position scale line)

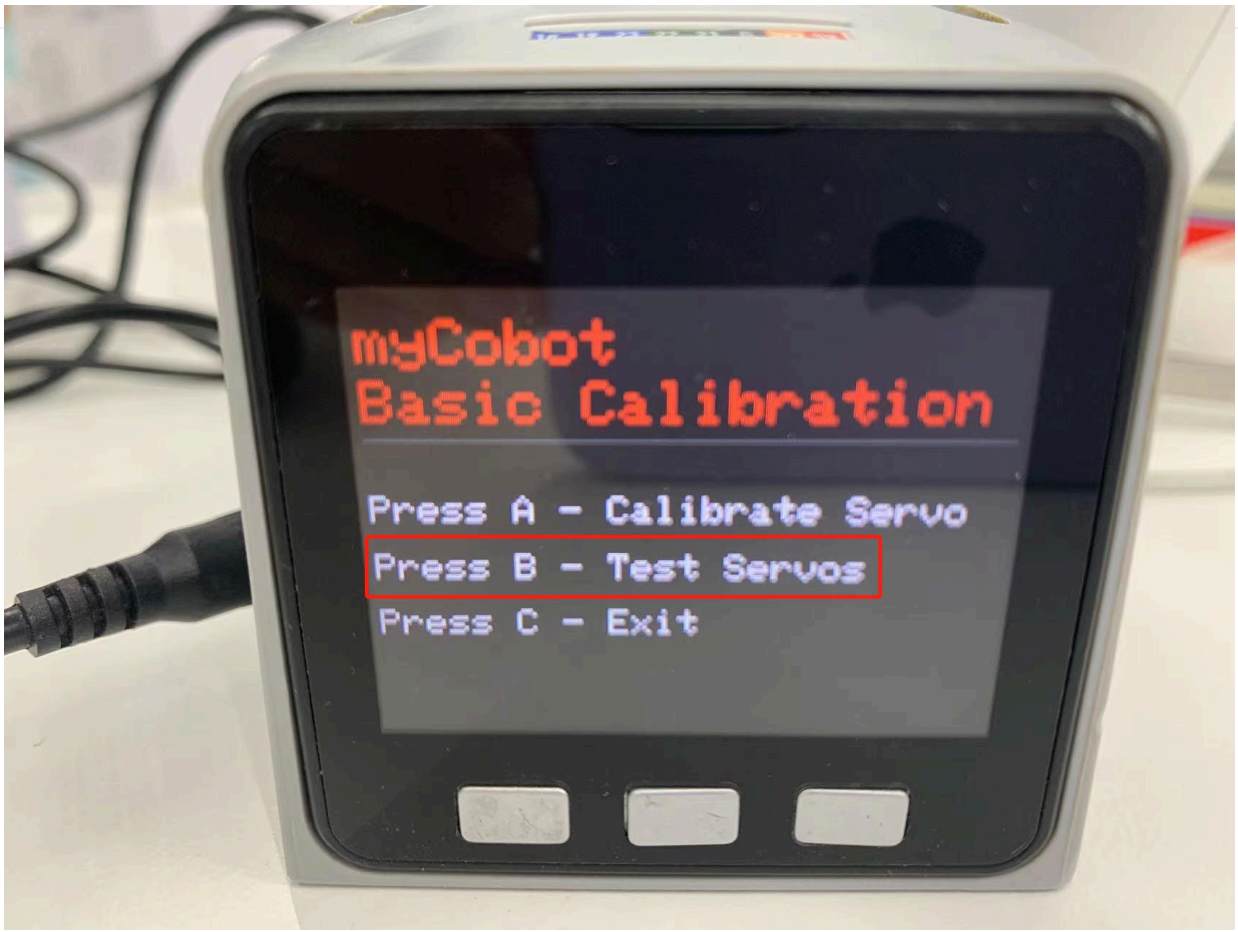
Step 6: Press NEXT in sequence to enter the next motor calibration until Already Calibrate all!! appears, and the calibration is completed.



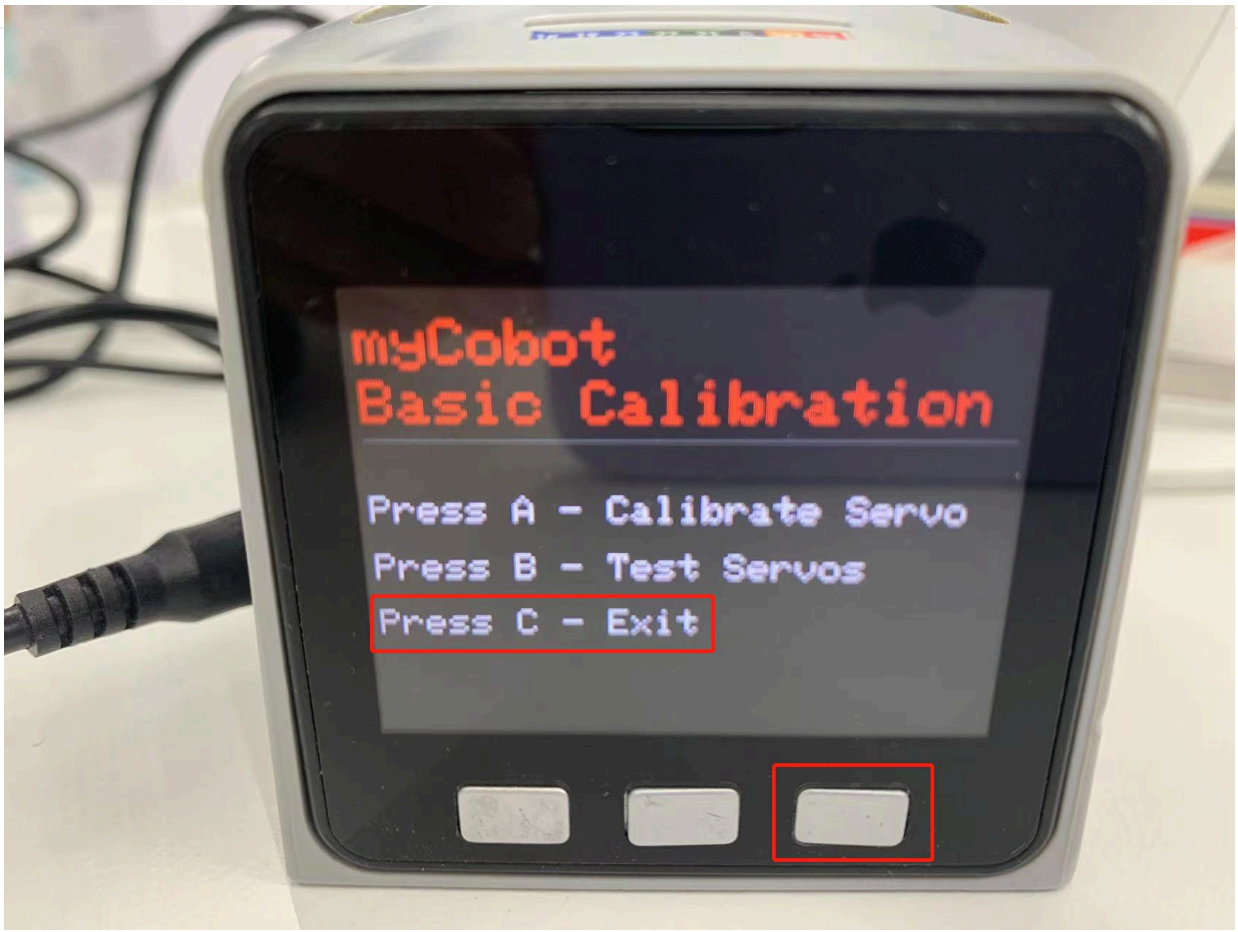
Step 7: Press EXIT to exit the calibration.



Step 8: Press the B key to test the zero position of each joint of the robot arm.



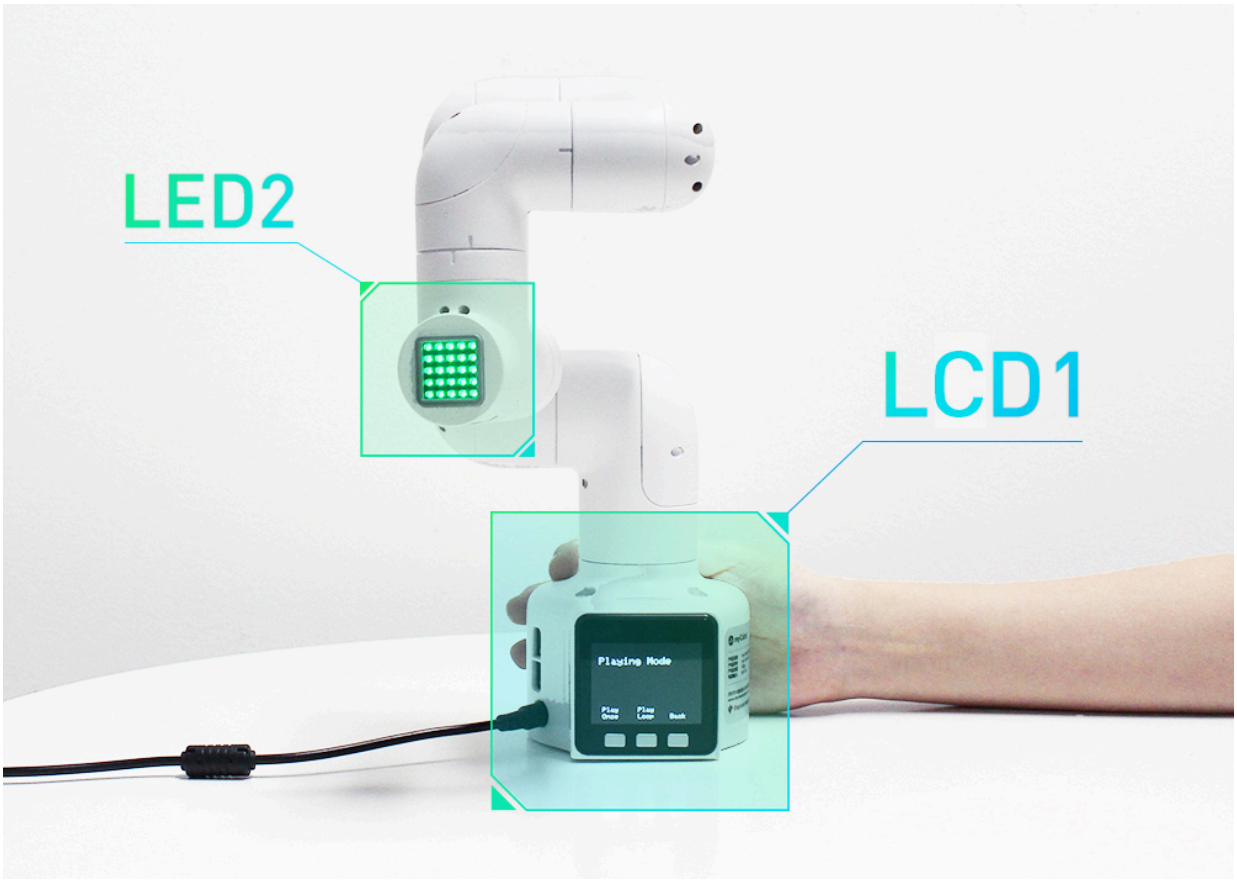
Step 9: Press the C key to exit this function.



Video tutorial

Address: https://www.bilibili.com/video/BV1FT4y1P7BV/

Computer control



The timeliness of computer control is crucial for microcontroller robotic arms. For microcontroller robotic arms, we usually send control instructions to the Basic of the base, forward them through computer control, and the end effector will parse the instructions and then perform the target action.

This function is currently mainly used by customers to develop robotic arms in different environments.

Depending on the device type, the operation method is also different, the steps are as follows:

- **Atom** burns the latest version of **atomMain**
- **M5Stack-basic** burns **minirobot**, selects **Transponder** function, microprocessor devices do not need to burn **M5Stack-basic**
- Press the detection key to detect whether Basic and the end effector Atom are communicating normally
- Press the exit button to exit this function

In this section, we can detect in real time whether Basic and the end effector Atom are communicating normally.

Realize communication forwarding

Applicable devices

- myCobot 280 M5
- myCobot 320 M5

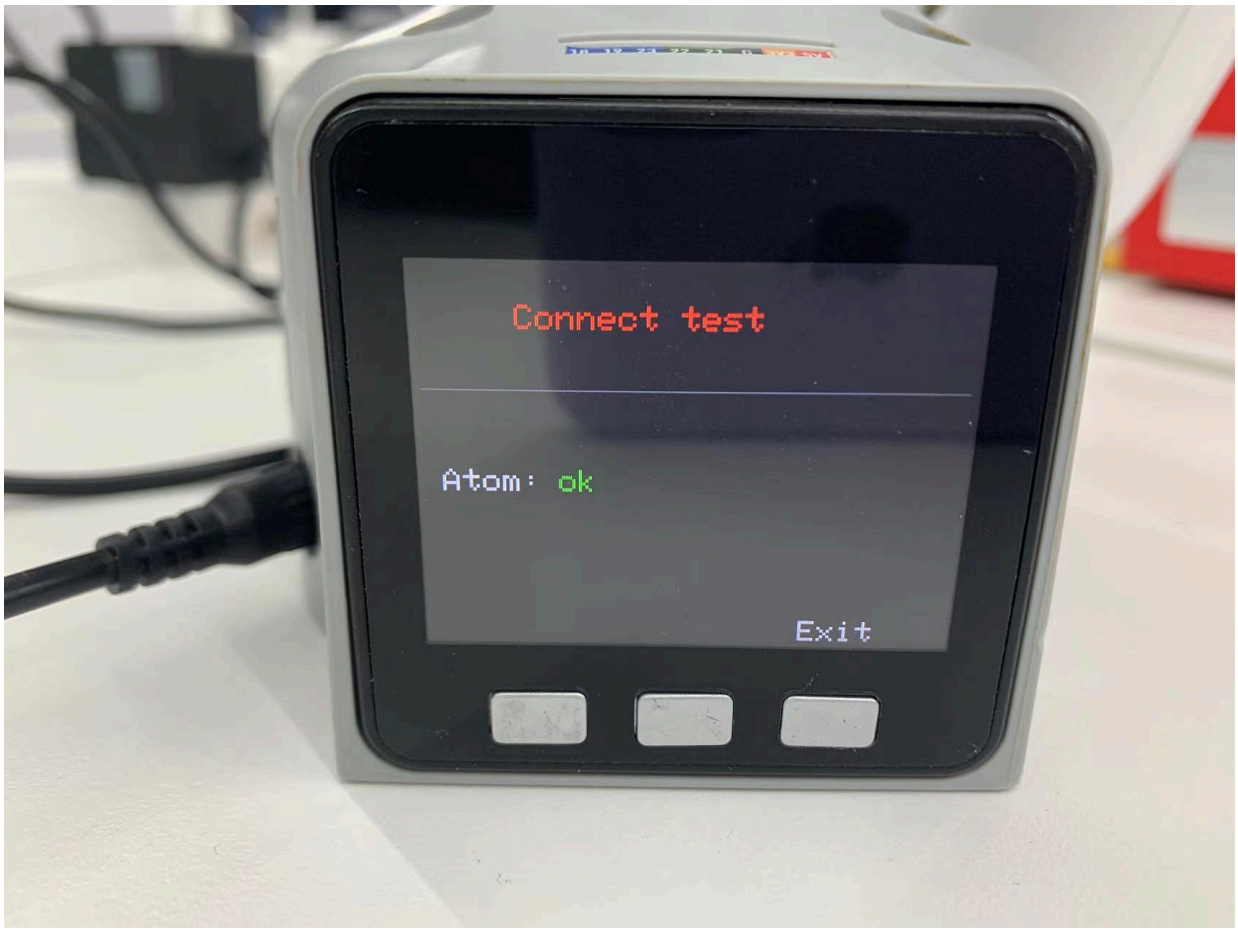
- myPalletizer 260 M5
- mechArm 270 M5

Operation steps

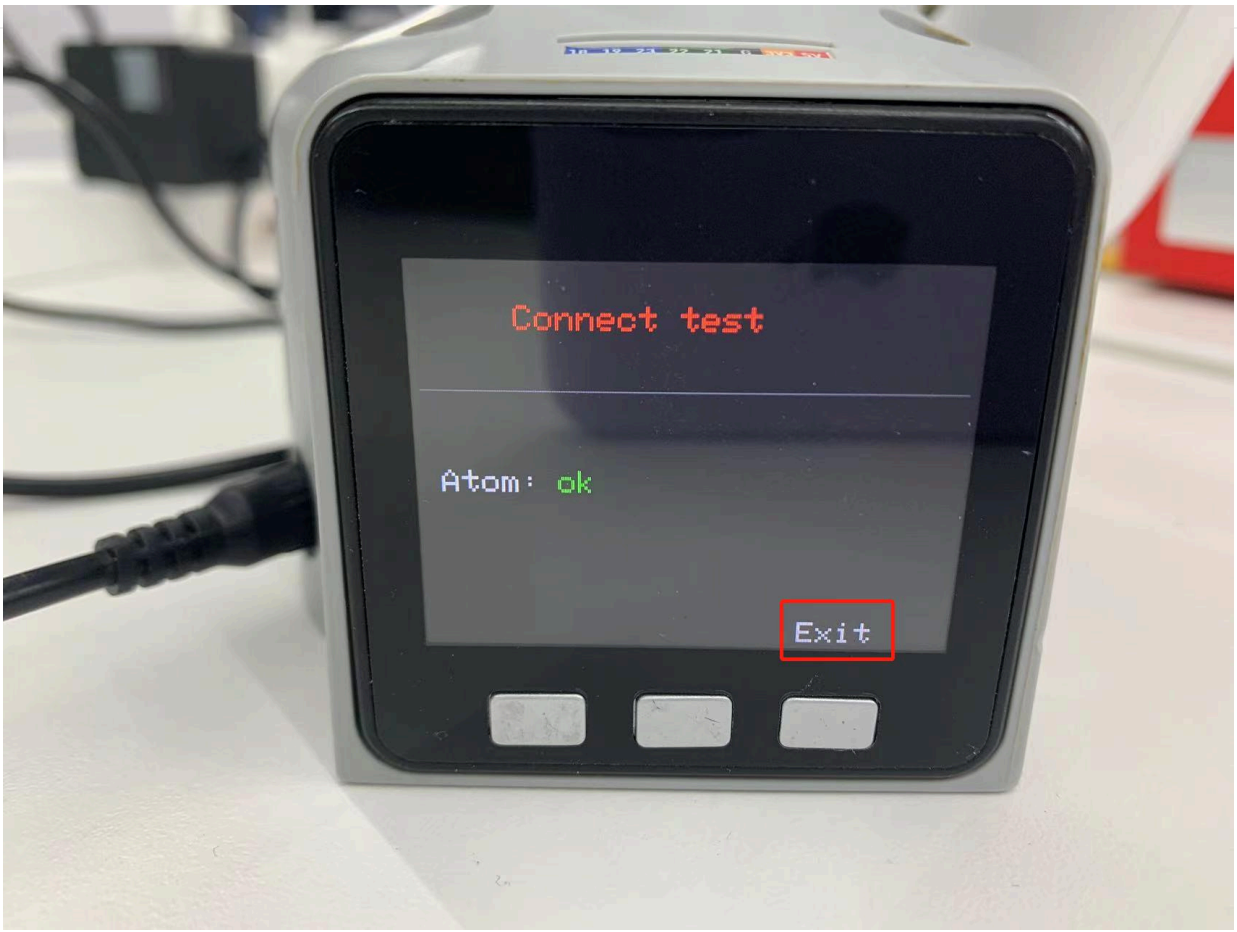
Step 1: Atom burns the latest version of atomMain.

Step 2: M5Stack-basic burns minirobot, selects the Transponder function.

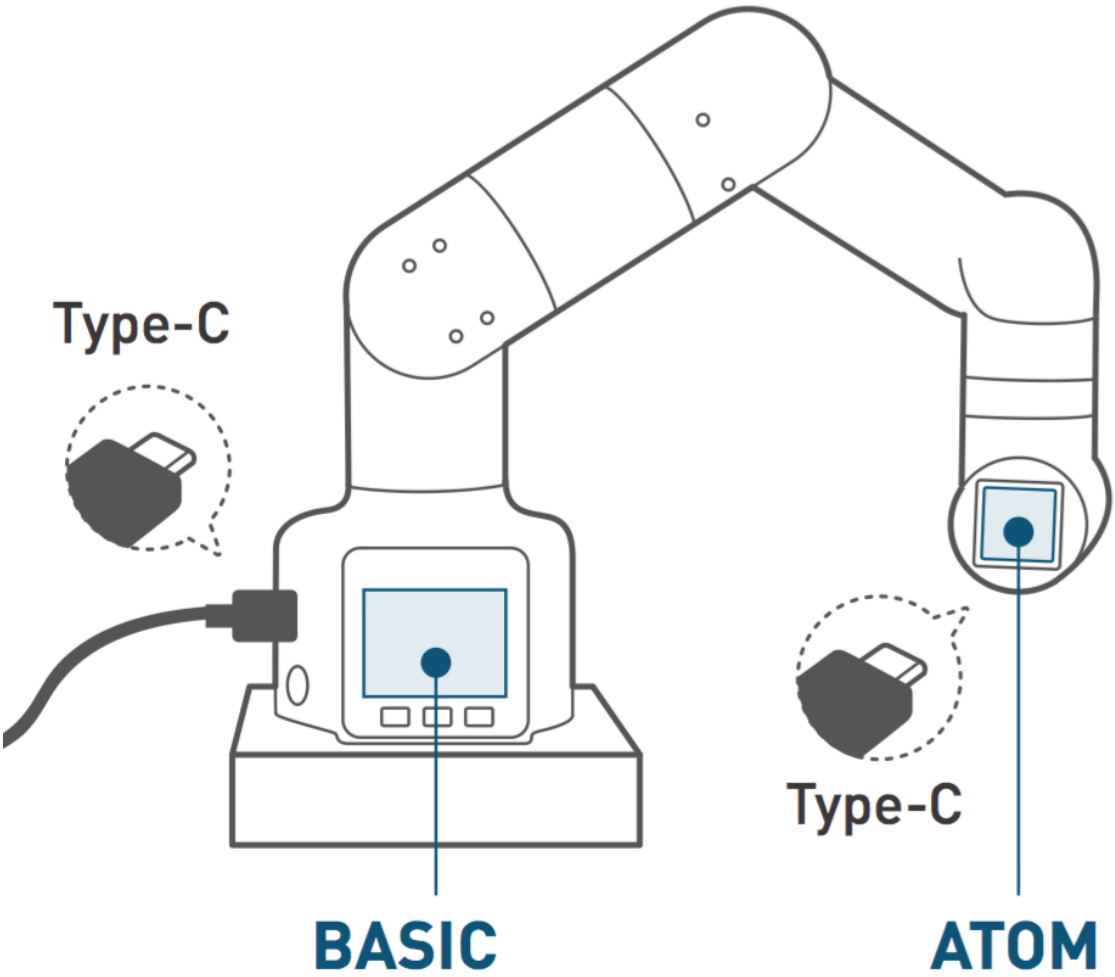
Step 3: Check the connection of Atom (ok means the connection is normal, otherwise it will display no).



Step 4: Click Exit to exit this function.



Connection detection



Connection detection is a function that detects the connection status of the motor and **Atom** in the robot arm. This function is convenient for customers to troubleshoot equipment failures.

In the connection detection, the device connection status of the robot arm is displayed, including **servo connection** and **Atom communication status**. The current firmware version of the device will be displayed on M5Stack-basic in **microcontroller devices**.

Depending on the device type, the operation method is also different, the steps are as follows:

- **Atom** burn the latest version of **atomMain**
- **M5Stack-basic** burn **minirobot**, select **Information** function, microprocessor devices do not need to burn **M5Stack-basic**
- Press the detection button to detect the device connection status
- Press the firmware view button to view the current firmware version
- Press the exit button to exit this function

In this section, we can learn how to use the device detection function for different types of devices.

Applicable devices

- myCobot 280 M5
- myCobot 320 M5
- myPalletizer 260 M5
- mechArm 270 M5

Operation steps

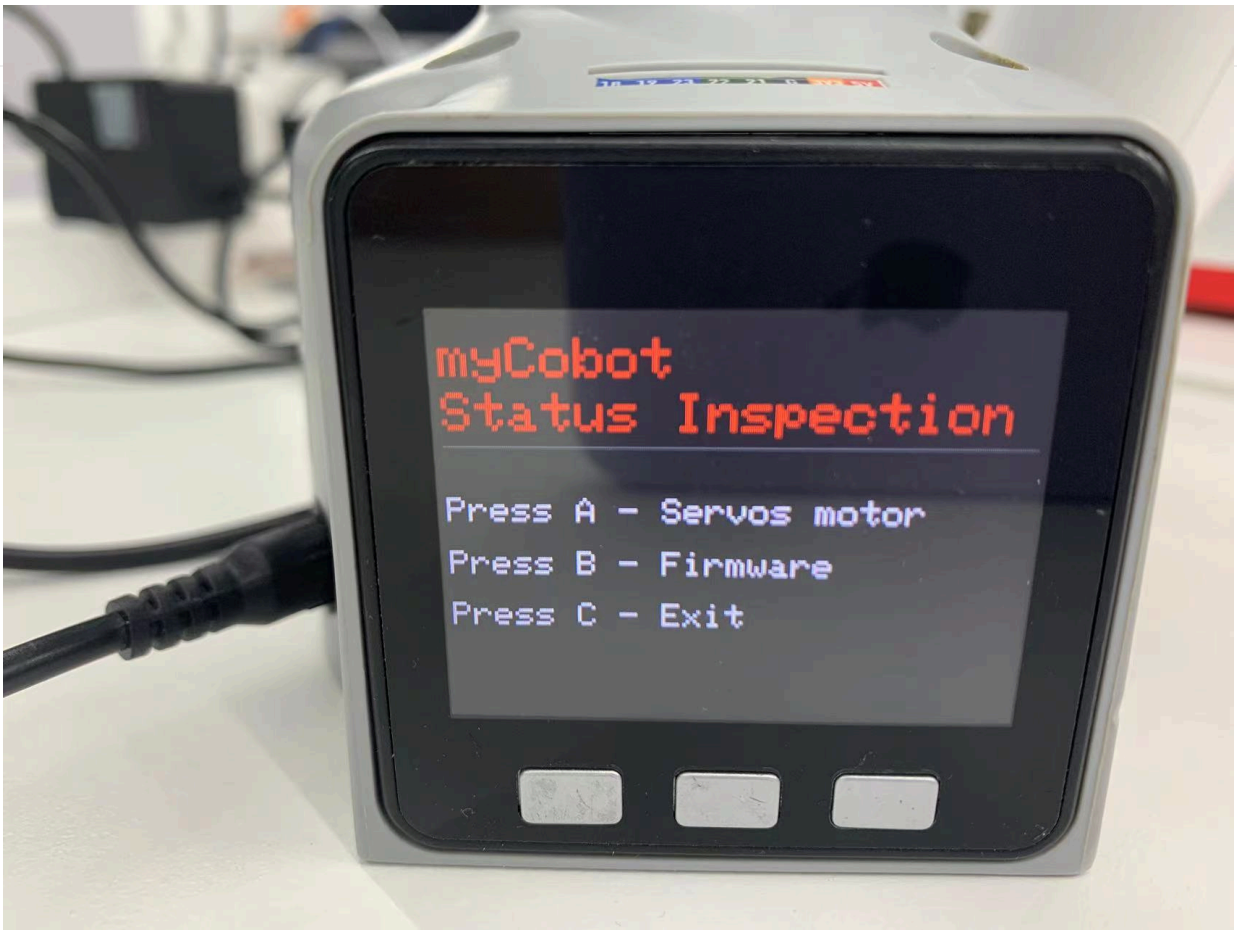
Step 1: Atom burn the latest version of **atomMain**.

Step 2: M5Stack-basic burn **minirobot**, select **Information** function.

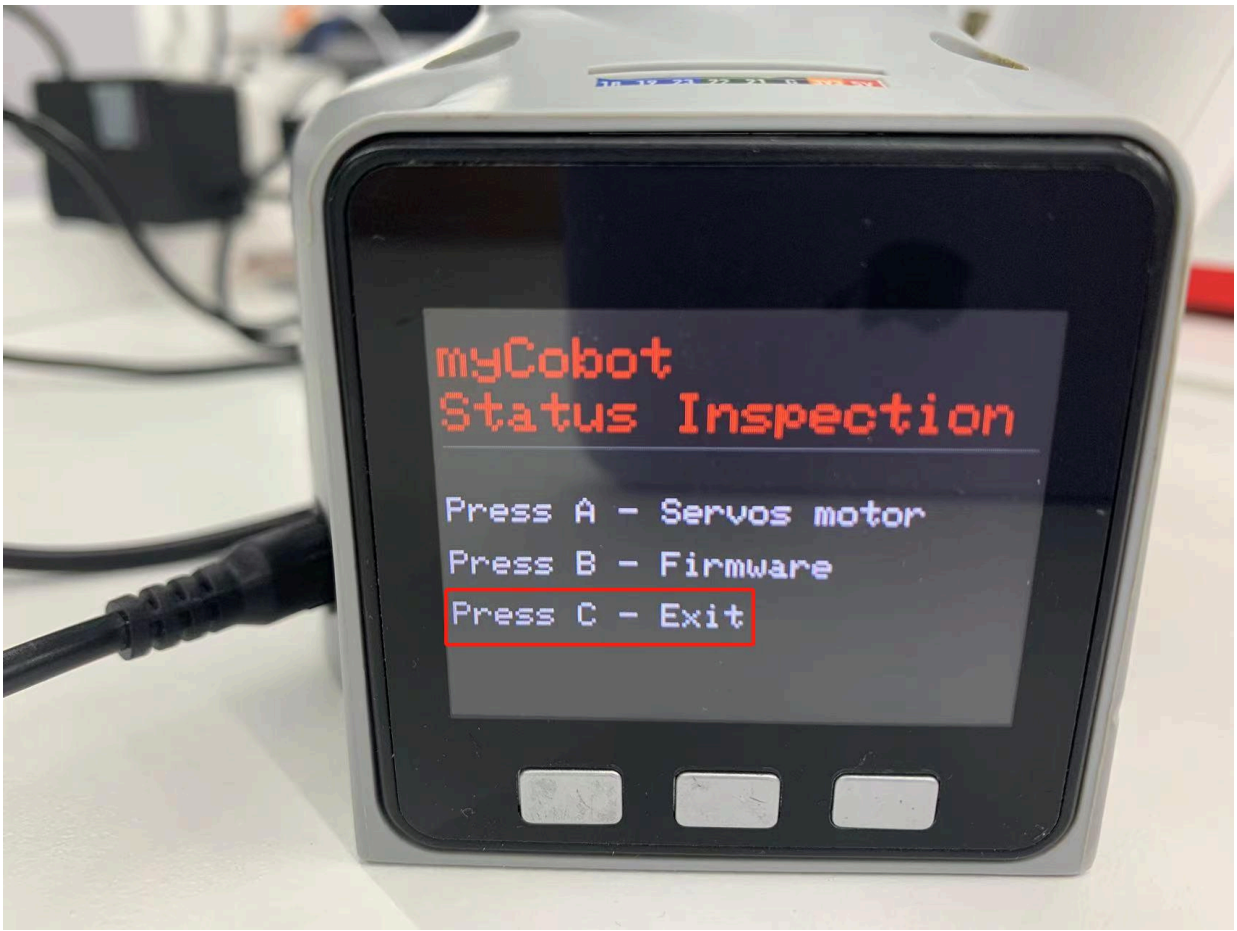
Step 3: Press the **A** key to start the connection detection. The screen displays **Atom** and the connection status of the six motors.


connect test
atom - ok
servo 1 - ok
servo 2 - ok
servo 3 - ok
servo 4 - ok
servo 5 - ok
servo 6 - ok

Step 4: Press the **B** key to start the version information detection. The screen displays the robot version and **Basic** firmware version.



Step 5: Press the **C** key to exit this function.



Introduction to Motor PID

Modification of the PID parameters can be a trade-off between the control accuracy of the robotic arm and the stability of the movement, we provide two sets of PID parameters, which are suitable for occasions requiring high stability of the movement, and for occasions requiring high precision of the movement.

Applies to PID parameters with smooth motion, where motion accuracy is affected by false positives:

```
'''
This document is applicable to the myCobot 280 series of robotic arms.
The function is to modify the joint motor configuration parameters
and verify the modification results.Please ensure that the robot
control port is not occupied when using it. If you encounter failure,
please run the file again.

#Import dependent library files.
import time
from pymycobot import *

#Define data address and data.

#Define the serial port of the robotic arm, Please check your robot model and fill in the corresponding content.
# _port = '/dev/ttyAMA0'
_port = 'COM30'
_baud = 115200

#Instantiate a hardware serial port.
try:
    mc = MyCobot280(_port, _baud)
except Exception as e:
    print(e)
    print("Error: The current serial port can not be used, please check whether the serial port serial number is correct,
    exit()



#Loop modification and display modification results.
#joint_id = 1 - 6.
for i in range(1,6):
    mc.set_servo_data(i,23,0)
    time.sleep(1)
    print(mc.get_servo_data(i,23))
input("The program ends, please press any key to exit.")
exit()
```

PID parameters suitable for high-precision scenarios will cause the arm to continuously adjust the steady state error:

```
'''
This document is applicable to the myCobot 280 series of robotic arms.
The function is to modify the joint motor configuration parameters
and verify the modification results.Please ensure that the robot
control port is not occupied when using it. If you encounter failure,
please run the file again.

#Import dependent library files.
import time
from pymycobot import *

#Define data address and data.

#Define the serial port of the robotic arm, Please check your robot model and fill in the corresponding content.
# _port = '/dev/ttyAMA0'
_port = 'COM30'
_baud = 115200

#Instantiate a hardware serial port.
try:
    mc = MyCobot280(_port, _baud)
except Exception as e:
    print(e)
    print("Error: The current serial port is not available, please check whether the serial port serial number is correct
    exit()



#Loop modification and display modification results.
#joint_id = 1 - 6.
for i in range(1,6):
    mc.set_servo_data(i,23,4)
    time.sleep(1)
    print(mc.get_servo_data(i,23))
input("The program ends, please press any key to exit.")
exit()
```

Chapter 6 Software Development Guide

Usage Environment

mycobot280 M5 is developed and used based on PC. Since there is no built-in system in the robot arm, the robot arm and PC need to be combined during use. Please prepare the PC before use.

Development Environment

In order to meet the diverse application needs of robots in different scenarios, we have adapted the robot to multiple programming languages. So far, we have adapted the following mainstream programming languages, and we think you can use any of the following languages for development. Please be sure to follow the instructions strictly. Any omitted steps may cause the corresponding language to fail to run successfully. I wish you a smooth use of the robot.

6.1 Python

Our robot supports Python, and the development of the Python API library is also becoming more and more perfect. The robot's joint angles, coordinates, grippers and other aspects can be controlled by Python.

6.2 ROS1

ROS (Robot Operating System), as an open source robot operating system, provides unlimited possibilities for robot development and control. Our robot can be controlled in a modular way through ROS's rich control functions. Whether it is joint control, path planning or sensor feedback, ROS provides corresponding tools and libraries to make the control process more flexible and efficient.

6.3 ROS2

ROS 2 (Robot Operating System 2) is a flexible software framework designed for robot software development. Our robot can make application development more efficient and modular through a series of services and functions such as hardware abstraction, device drivers, library functions, visualization tools, messaging, and package management.

6.4 Communication

If you have a certain understanding of information theory, coding and robot communication functions, then you should understand that all communication originates from data transmission. In order to facilitate users to operate the robot, we have opened a communication protocol based on serial communication. You can use the serial assistant or encapsulate it into any programming language you are familiar with to control the robot.

6.5 Arduino

Arduino is an easy-to-use and easy-to-use open source electronic prototyping platform. Users can use the Arduino IDE to easily download the BSP and required function libraries related to the development board you have to write your program. The MyCobotBasic library is an Arduino open source robot control library developed by our company. This library can be used to control our robots through Bluetooth, WiFi, serial ports, etc.

6.6 Blockly

myBlockly is a puzzle-style programming software developed by the R&D team of Shenzhen Elephant Robot Company. It is based on the python environment and the pymycobot dependency library, allowing users to program and control the mycobot robot in a building block-like manner.

6.7 C++

C++ is the inheritance of C language. It can be used for both procedural programming in C language and object-based programming characterized by abstract data types. Using C++ language, you can freely develop (coordinate control, angle control, io control, gripper control, etc.) through the C++ dynamic library developed by our company, and control some robots that our company has developed.

6.8 C#

C# is an object-oriented programming language derived from C and C++ released by Microsoft, and a high-level programming language that runs on .NET Framework and .NET Core (completely open source, cross-platform).

Using the C# language, you can freely develop (coordinate control, angle control, io control, gripper control, etc.) through the C# dynamic library provided by our company, and control some robots that our company has developed.

6.9 JavaScript

JavaScript is a scripting language that runs on the client; it does not need to be compiled, and the js interpreter interprets and executes each one during the running process. Our company's robots support development using JavaScript.

← Previous Chapter | Next Chapter →

What is Python?

Our products are very friendly to Python, and the development of Python API library is also improving day by day. Through Python, the robot's joint angles, coordinates, grippers and other aspects can be controlled. There are many options. If you want to control our robot arm through Python programming, you can learn this chapter.

Python was designed by Guido van Rossum of the Netherlands Institute for Mathematical and Computer Science Research in the early 1990s as a replacement for a language called ABC.

Python provides efficient high-level data structures and simple and effective object-oriented programming.

Python syntax and dynamic typing, as well as the nature of interpreted languages, make it a programming language for writing scripts and rapidly developing applications on most platforms. With the continuous update of versions and the addition of new language functions, it is gradually used for the development of independent and large projects.

Python interpreter is easy to extend, and can be extended with new functions and data types using C or C++ (or other languages that can be called from C).

Python can also be used as an extension language in customizable software. **Python** has a rich standard library that provides source code or machine code for all major system platforms.

Python development and use guide

You can use Python to develop our robot arm according to the following guidelines

1. Environment construction
2. API description
3. Joint control
4. Coordinate control
5. IO control
6. Gripper control
7. TCP&IP
8. Handle control
9. Drawing patterns
10. Demonstration code and video

Environment setup

pymycobot is a Python package for serial communication with myCobot, supporting Python2, Python3.5 and later versions.

Before using pymycobot to control the robot arm, you need to build a Python environment. The following is a detailed description of Python download and installation.

Download and install Python

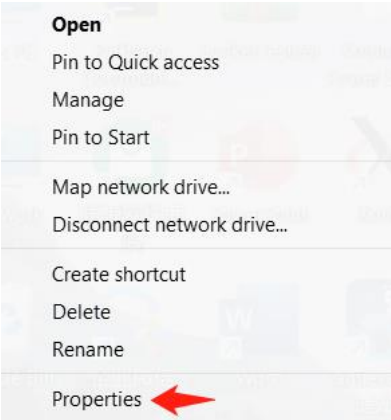
Applicable devices:

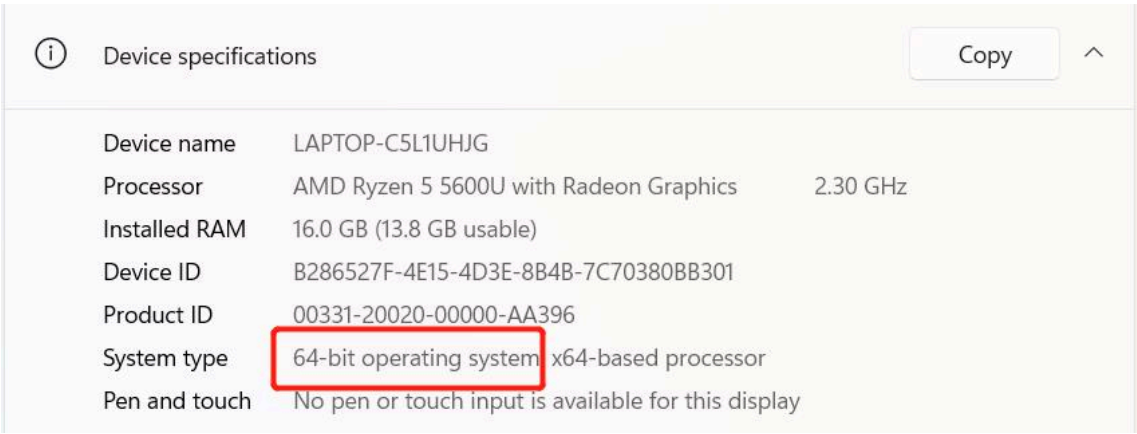
- myCobot 280:
- **myCobot 280 M5**
- myCobot 280 PI
- myCobot 280 Jetson Nano
- myCobot 280 for Arduino

Currently, there are two versions of Python, one is `2.x` version and the other is `3.x` version. These two versions are incompatible. As `3.x` version is becoming more and more popular, our tutorial will take the latest `3.10.7` version as an example.

Install Python

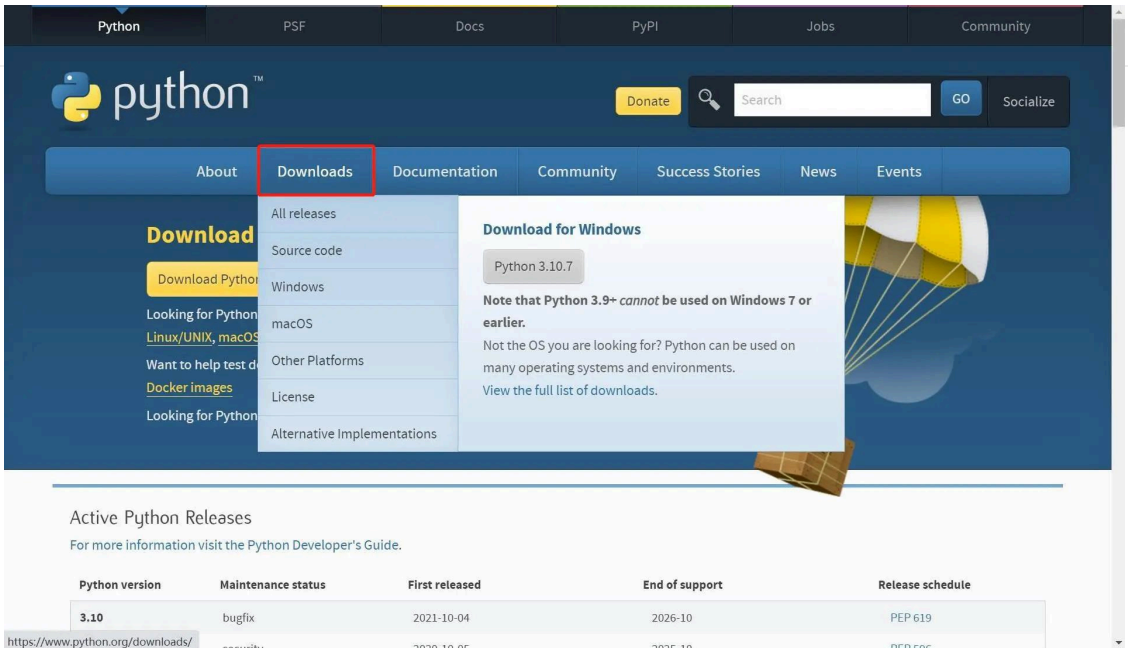
> **Note:** Before installing, please confirm whether your computer is 64-bit or 32-bit. Right-click `My Computer` and select `Properties`. As shown in the figure below, it is a 64-bit operating system, so select the 64-bit Python installation package.

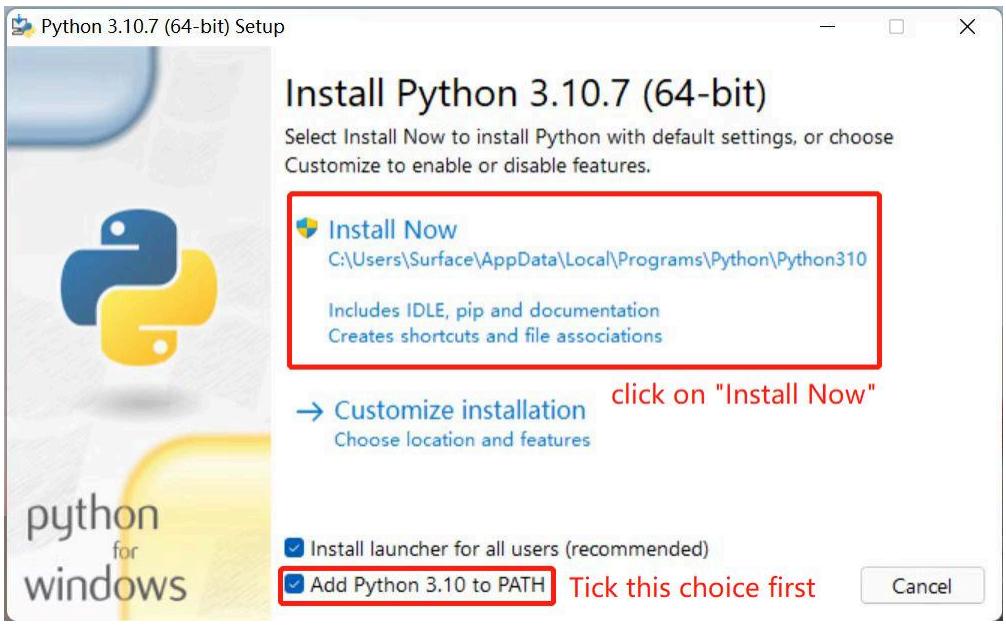


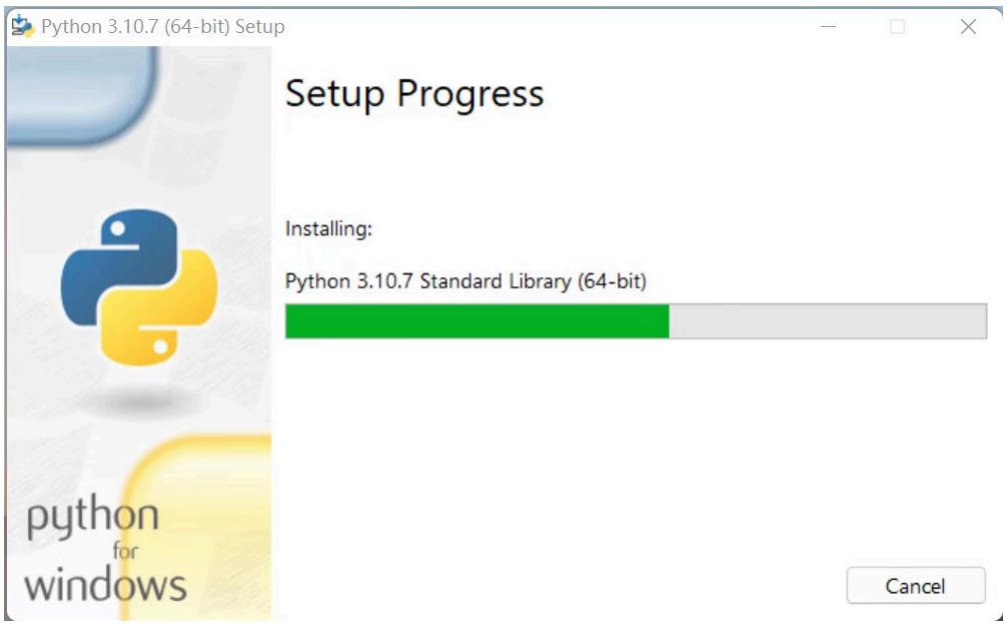


- **Python official download address: https://www.python.org/downloads/**

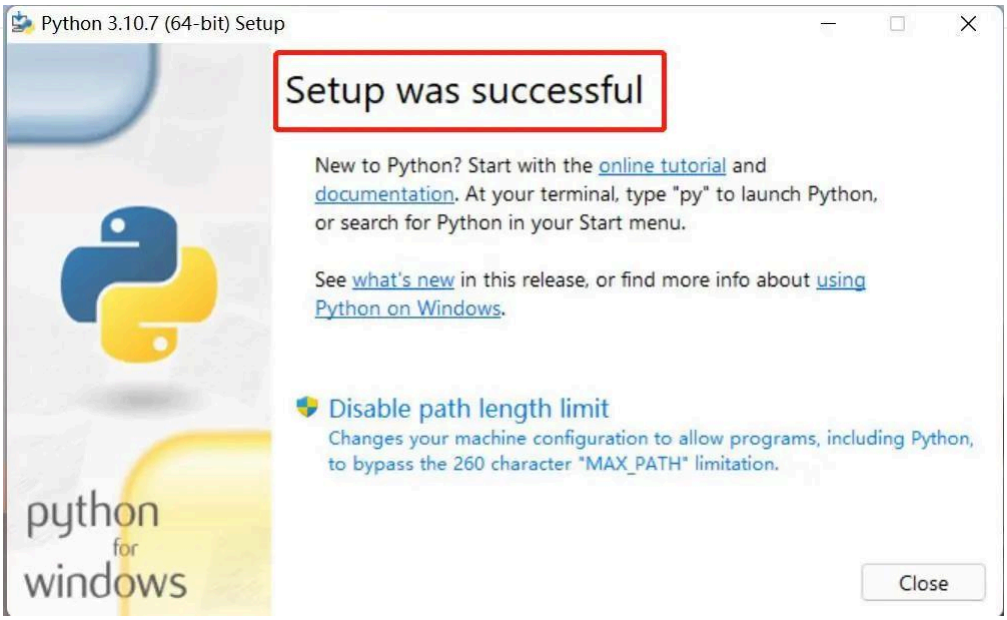
- **Click the `Downloads` option to start downloading Python, click `Add Python 3.10 to PATH` , click `Install Now` to start installing Python**


Python
PSF
Docs
PyPI
Jobs
Community
python
Donate
Search
GO
Socialize
About
Downloads
Documentation
Community
Success Stories
News
Events
All releases
Source code
Windows
macOS
Other Platforms
License
Alternative Implementations
Download for Windows
Python 3.10.7
Note that Python 3.9+ cannot be used on Windows 7 or earlier.
Not the OS you are looking for? Python can be used on many operating systems and environments.
View the full list of downloads.
Active Python Releases
For more information visit the Python Developer's Guide.
Python version
Maintenance status
First released
End of support
Release schedule
3.10
bugfix
2021-10-04
2026-10
PEP 619
https://www.python.org/downloads/


Python 3.10.7 (64-bit) Setup
Install Python 3.10.7 (64-bit)
Select Install Now to install Python with default settings, or choose
Customize to enable or disable features.
Install Now
C:\Users\Surface\AppData\Local\Programs\Python\Python310
Includes IDLE, pip and documentation
Creates shortcuts and file associations
click on "Install Now"
Customize installation
Choose location and features
python
for
windows
Install launcher for all users (recommended)
Add Python 3.10 to PATH
Tick this choice first
Cancel


Python 3.10.7 (64-bit) Setup
Setup Progress
Installing:
Python 3.10.7 Standard Library (64-bit)
python
for
windows
Cancel

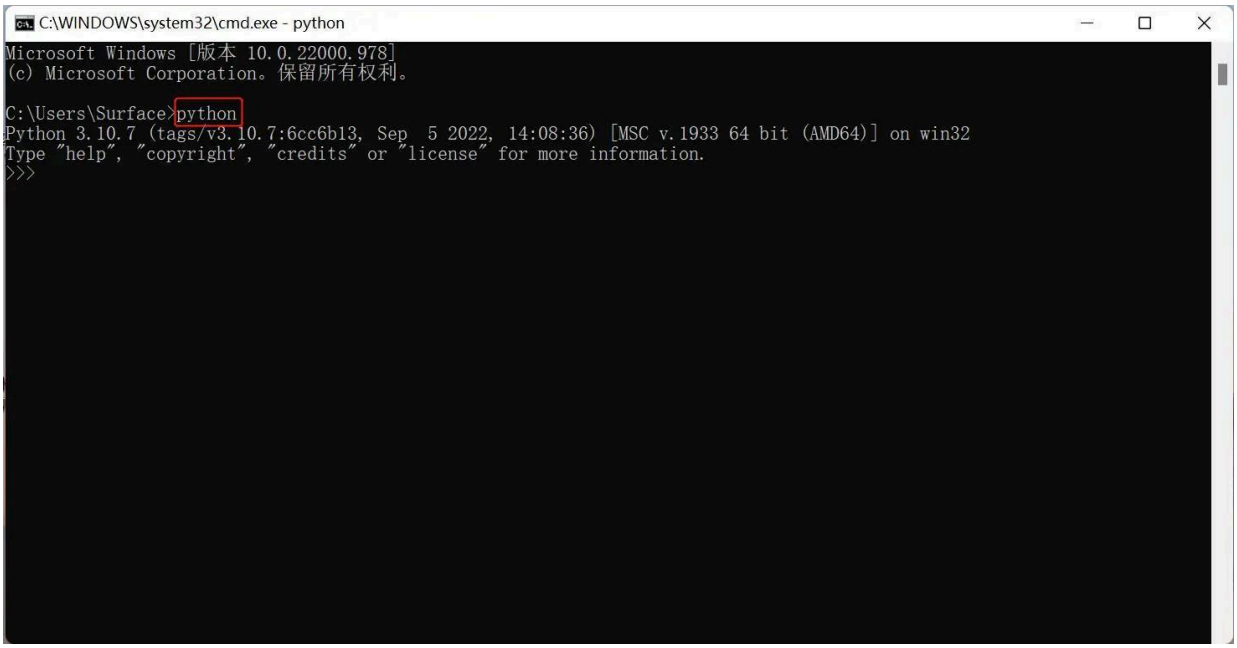
- **The prompt "Setup was successful" appears, indicating that the installation is complete**



Run Python

After successful installation, open the command prompt window (Win+R, enter cmd and press Enter), and type `python`. Two situations will occur.

Situation 1:



The prompt in the picture indicates that Python has been successfully installed.

The prompt `>>>` indicates that we are already in the Python interactive environment. We can enter any Python code and get the execution result immediately after pressing Enter.

Case 2:

If the input is wrong (for example, enter pythonn), an error message will appear:

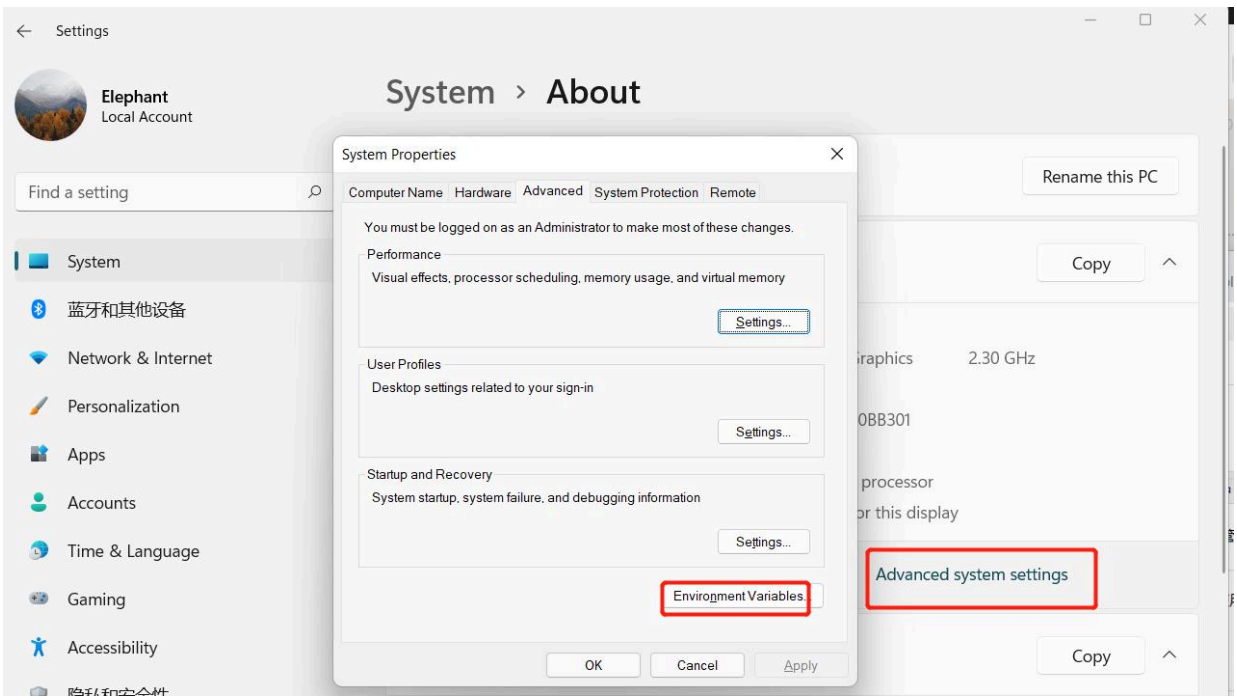
> **Note:** The error message is generally caused by not configuring the environment variables. You can refer to **1.3 Configure environment variables** to modify the environment variables.

Configure environment variables

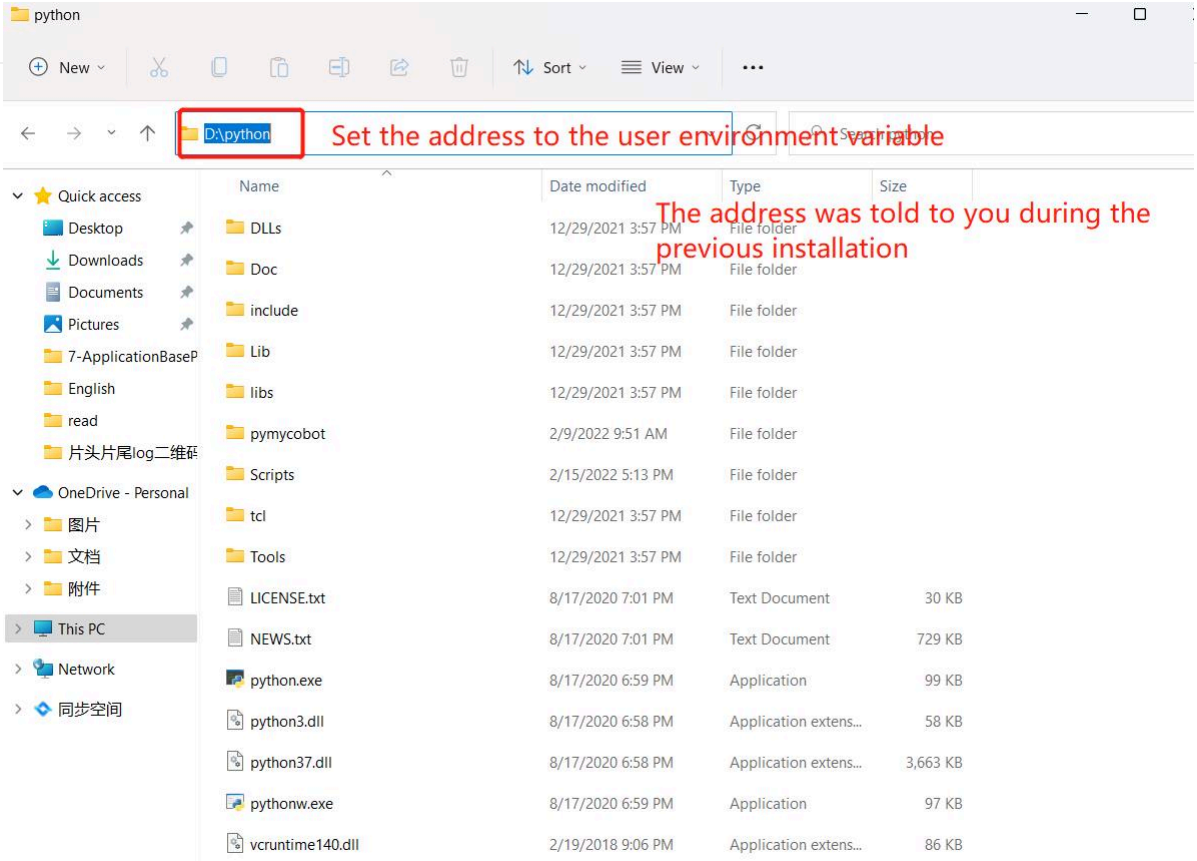
Since Windows will search for python.exe according to the path set by a Path environment variable, if it is not found, an error will be reported. Therefore, if you miss checking `Add Python 3.10 to PATH` during installation, you need to manually add the path where python.exe is located to Path, or reinstall Python and remember to check the `Add Python 3.10 to PATH` option.

The following are the steps to manually add the path where python.exe is located.

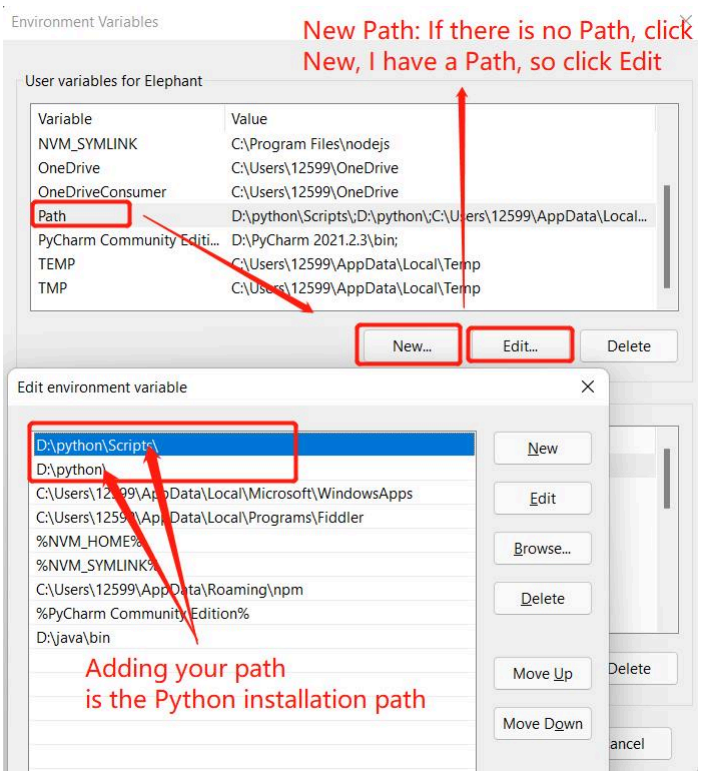
- Right-click My Computer –> Select Properties –> Select Advanced System Settings –> Select Environment Variables in the lower right corner:



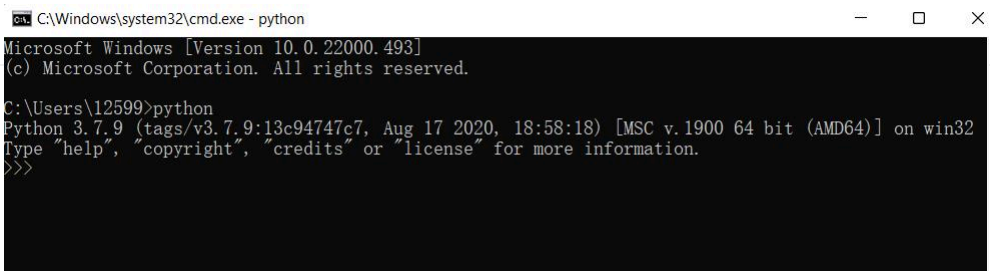
- Environment variables mainly include user variables and system variables. The environment variables that need to be set are in these two variables. As shown in the figure below:



- User variables are used to download programs that can be used in cmd commands. Write the absolute path of the program to the user variable and you can use it, as shown in the figure below:



- After completing the above steps, open the command prompt window (Win+R, then enter cmd, press Enter), type Python, and the prompt in the figure below indicates success:



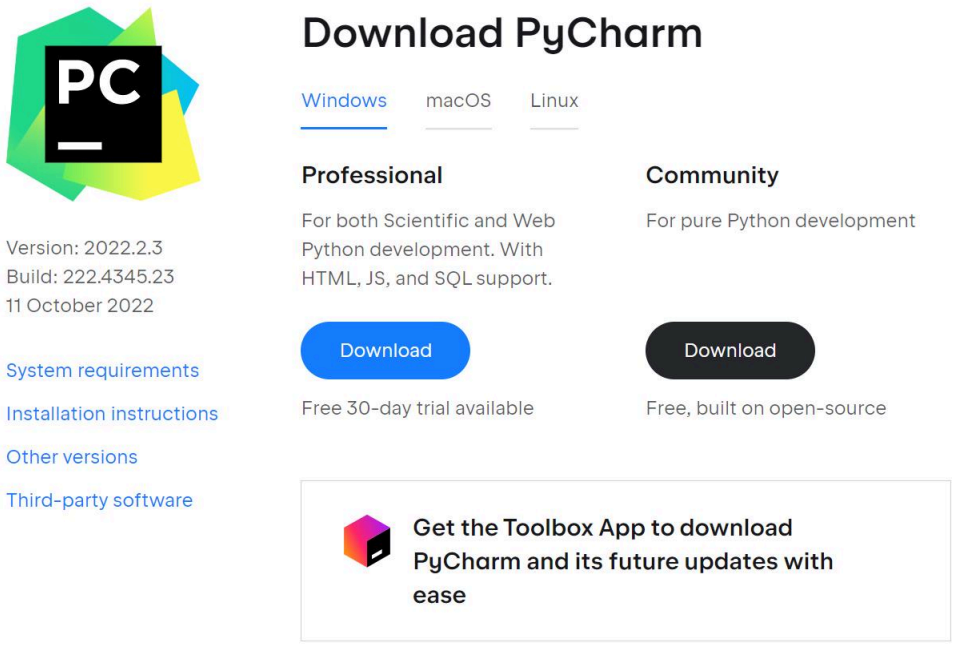
PyCharm installation and use

PyCharm is a powerful Python editor with cross-platform capabilities. First, let's introduce the installation steps of PyCharm in Windows system.

Download address: https://www.jetbrains.com/pycharm/download/#section=windows

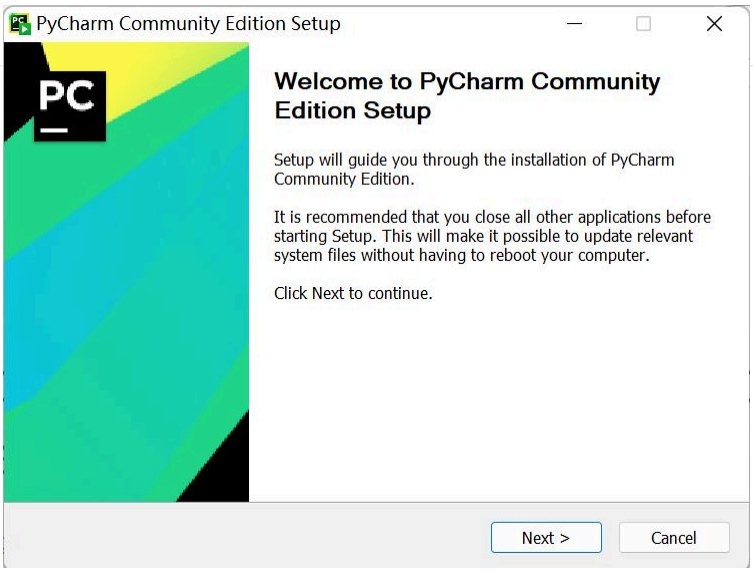
Download and install

- After entering the website, we will see the following interface:

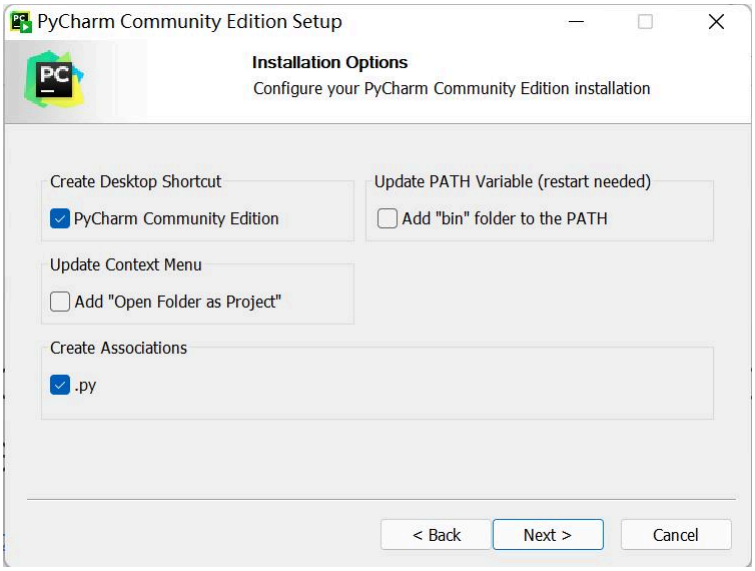


Download the file according to the interface introduction. Professional means professional version, and Community means community version. It is recommended to install the community version because it is free to use.

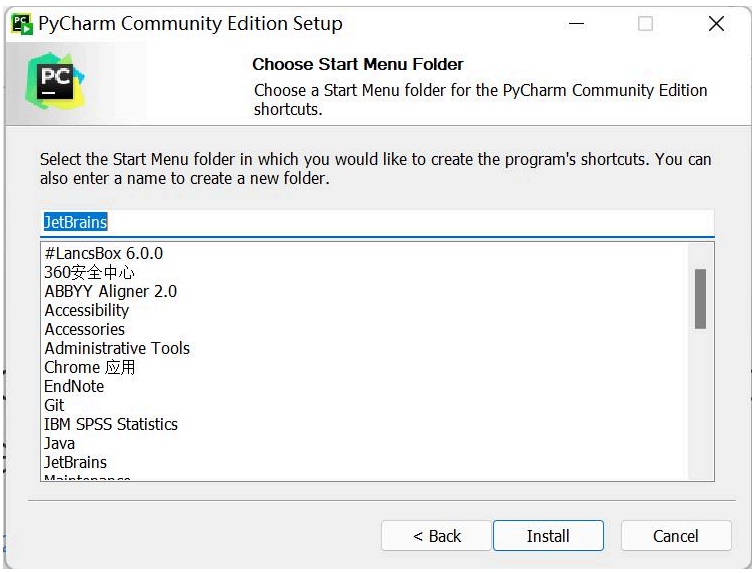
- After downloading, start installing and click `Next`:



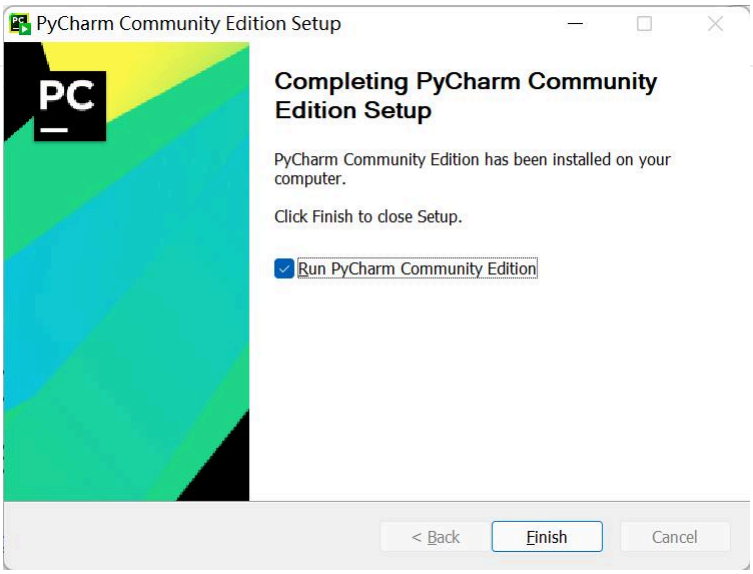
- Select the corresponding options according to your personal preferences, and then click `Next` :



- The following interface appears and continue to click `Next` :



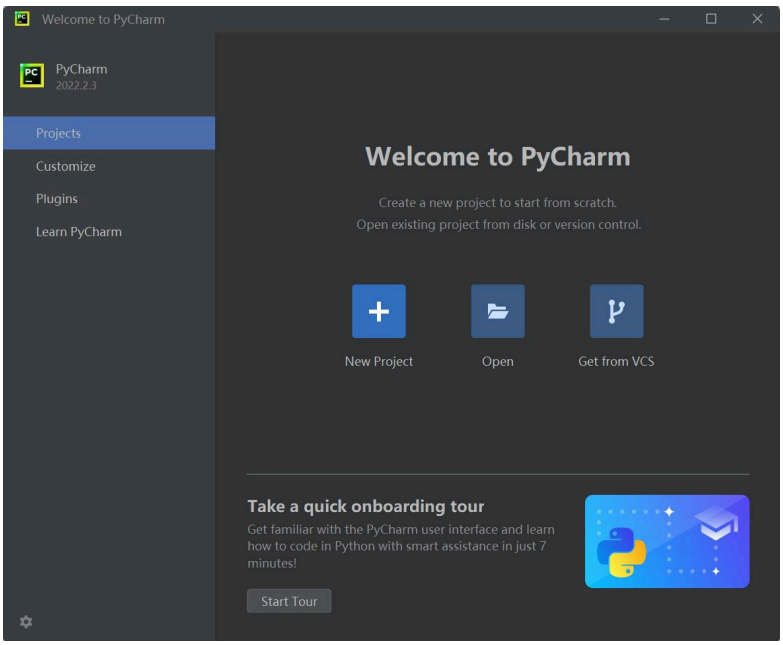
- Click `Finish` to complete the installation:



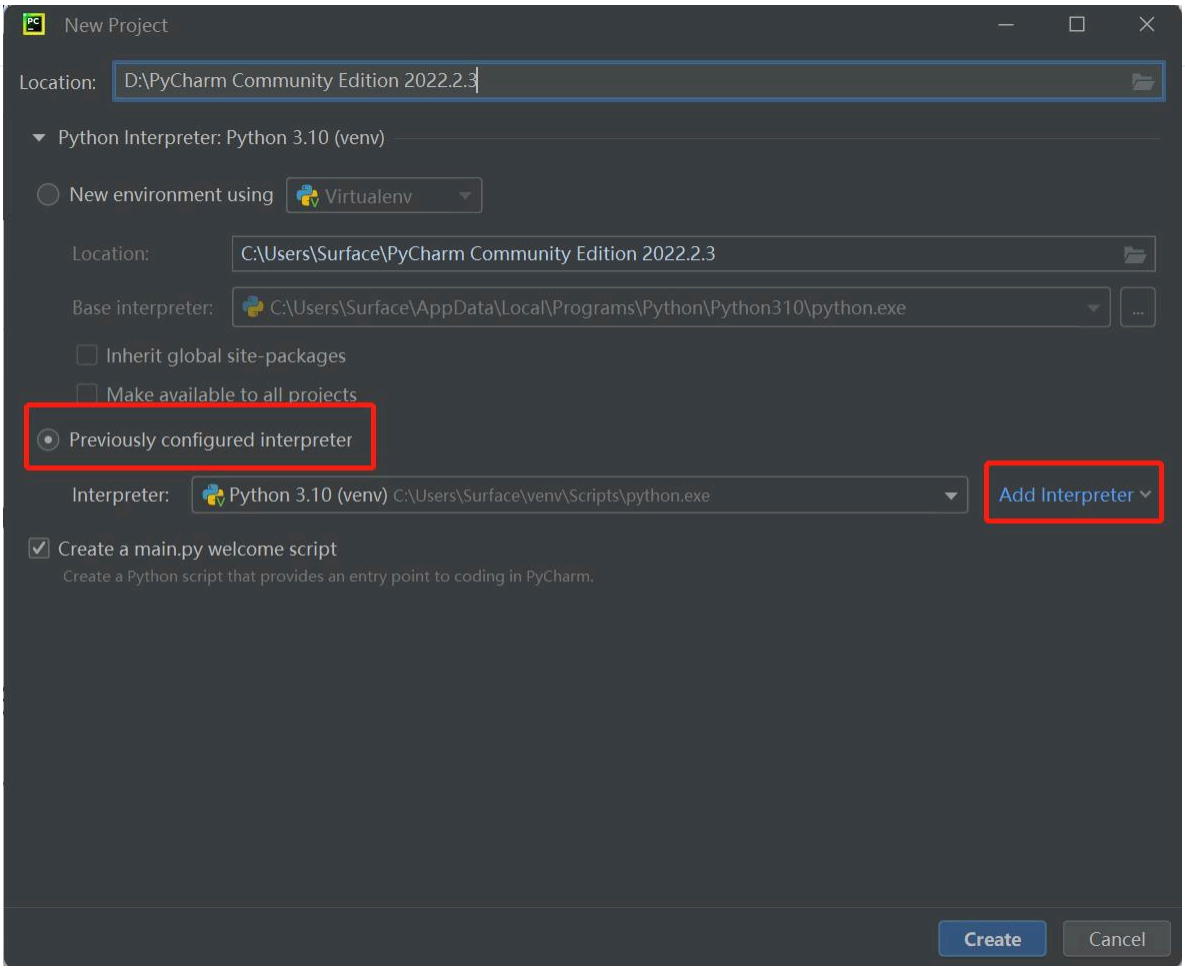
Create a project

After PyCharm is installed, enter the software and create the first program.

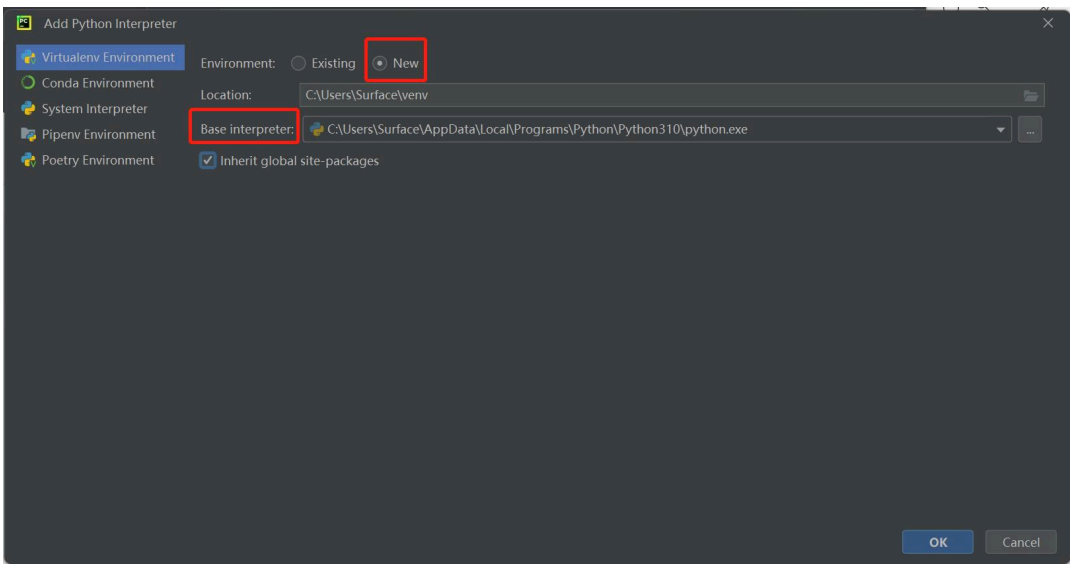
- Click the PyCharm icon on the desktop to enter PyCharm, as shown in the figure below, and click `New Project` :



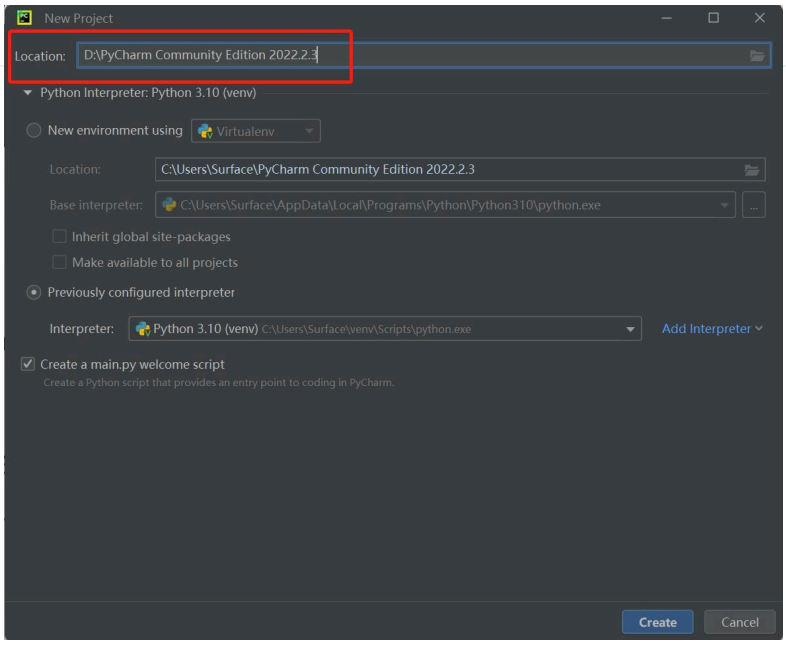
- After clicking, find `Interpreter` , start setting the interpreter, and click `Add Interpreter` :



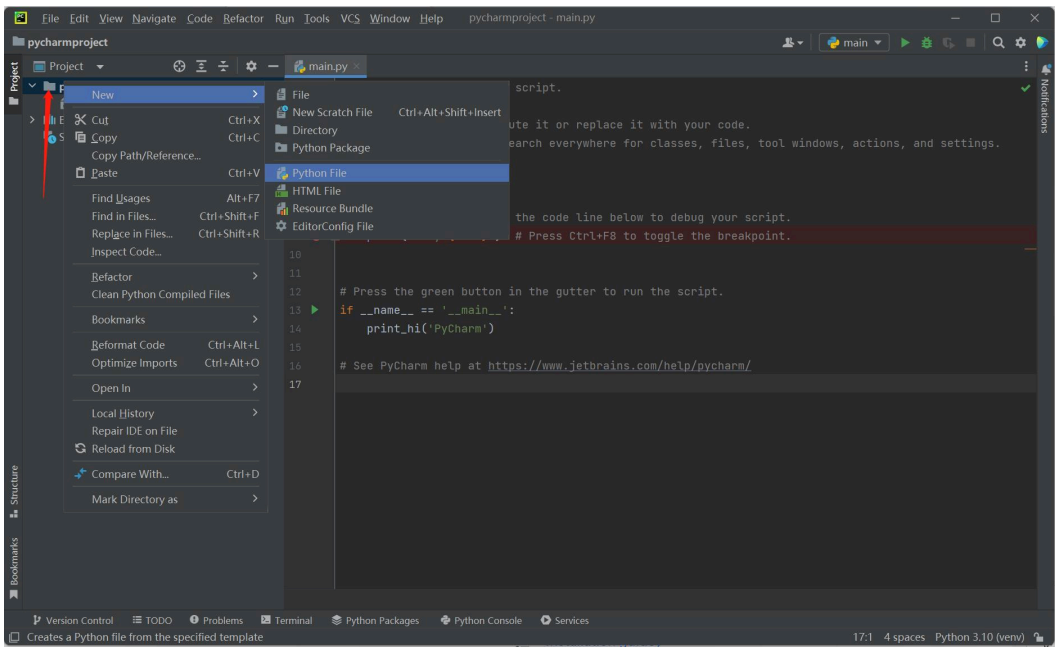
- Click `New` , find the python.exe storage location, and check the `Inherit global site-package` option:



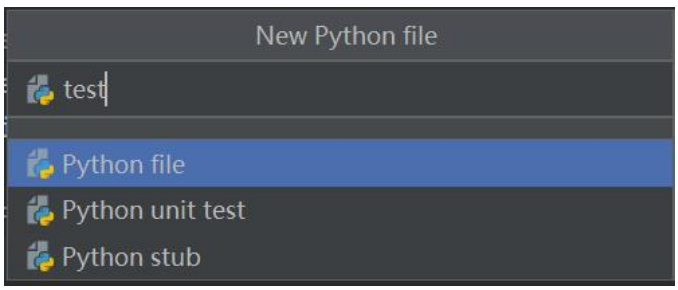
- Set `Location` . Location is where the PyCharm project is stored. You can choose it according to your needs.



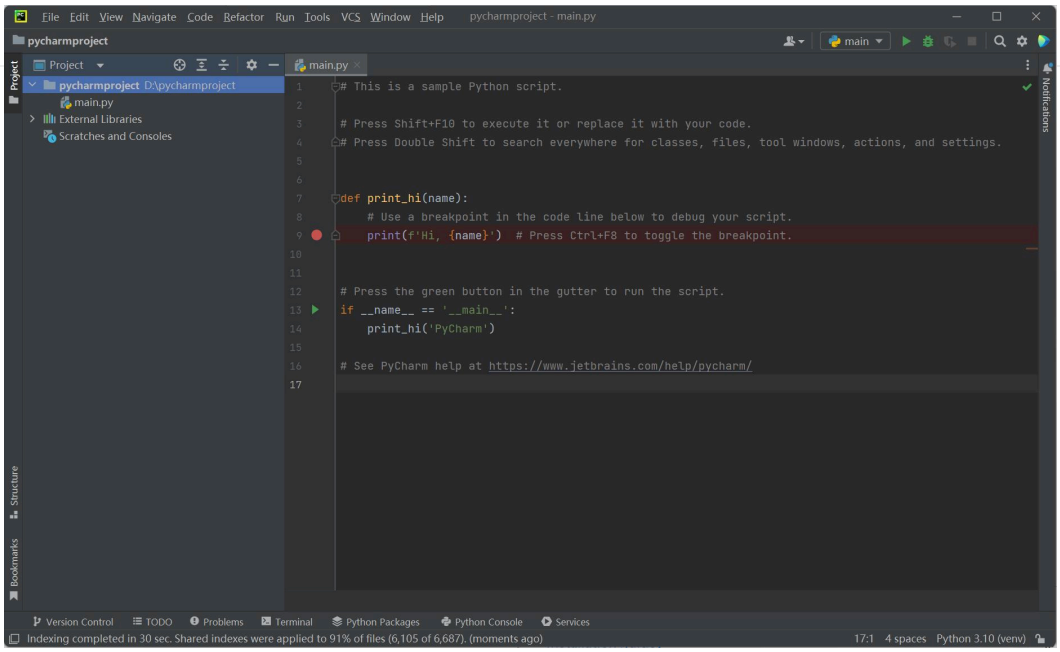
- Create a new PyCharm file. Right-click the document icon pointed by the arrow, click `New` , click `Python File` , and the new file is created successfully.



- Name Python File:



- After the file is successfully created, you will enter the following interface and you can write your own program

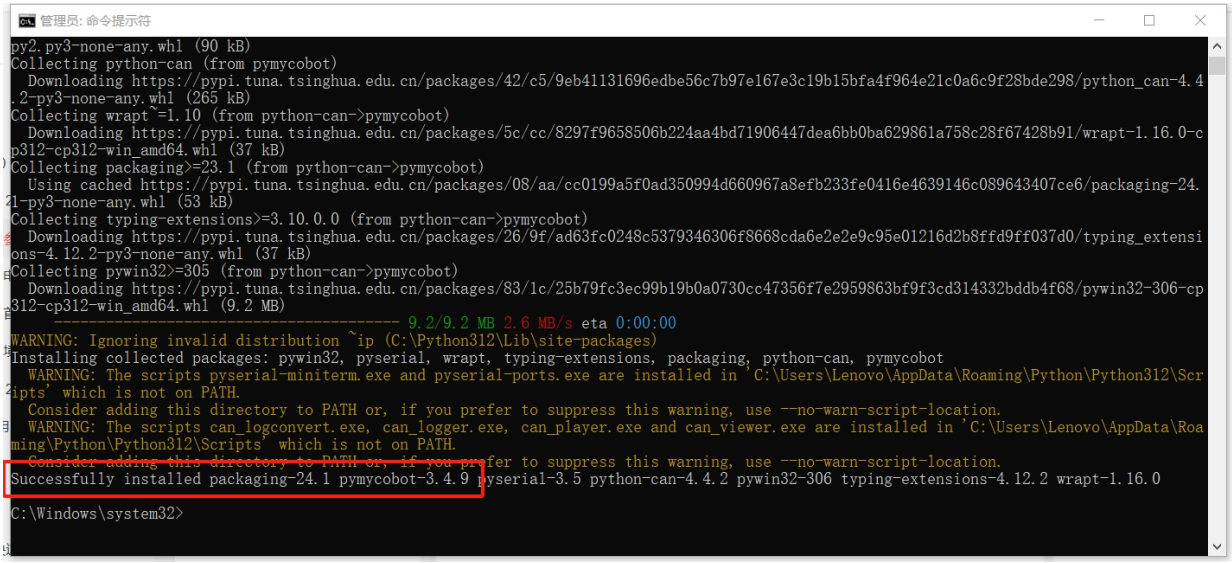


Before use

- Firmware burning. Firmware refers to the device "driver" stored inside the device. Only through firmware can the operating system implement the operation of a specific machine according to the standard device driver. Different versions of the robot arm need to burn different firmware (refer to the **MyStudio** chapter).
- **M5 version** The Basic at the bottom needs to burn minirobot. After the burning is completed, select the **Transponder** function (this function is used to receive and forward the instructions sent by the Basic at the bottom to perform the target action), click `Press A`, and the **Atom: OK** prompt message appears, which means success. In addition, the latest version of atomMain is burned in the Atom at the end of the M5 version. It is burned by default at the factory, and there is no need to burn it yourself.
- pymycobot installation. Open a console terminal (shortcut Win+R, enter cmd to enter the terminal), and enter the following command:

```
pip install pymycobot --upgrade --user
```

The following words appear, indicating that the pymycobot package has been successfully installed



- Source code installation. Open a console terminal (shortcut Win+R, enter cmd to enter the terminal), enter the following command to install:

```
git clone https://github.com/elephantrobotics/pymycobot.git <your-path>
#Where <your-path> fills in your installation address, if not filled in, the current path is used by default


cd <your-path>/pymycobot
#Enter the pymycobot folder of the download package


#Run one of the following commands according to your python version
# Install
python2 setup.py install
# or
python3 setup.py install
```

Simple use of Python

After the above preparations are completed, start to control the robot arm through Python code. Here, the MyCobot 280 M5 version is used as an example for demonstration.

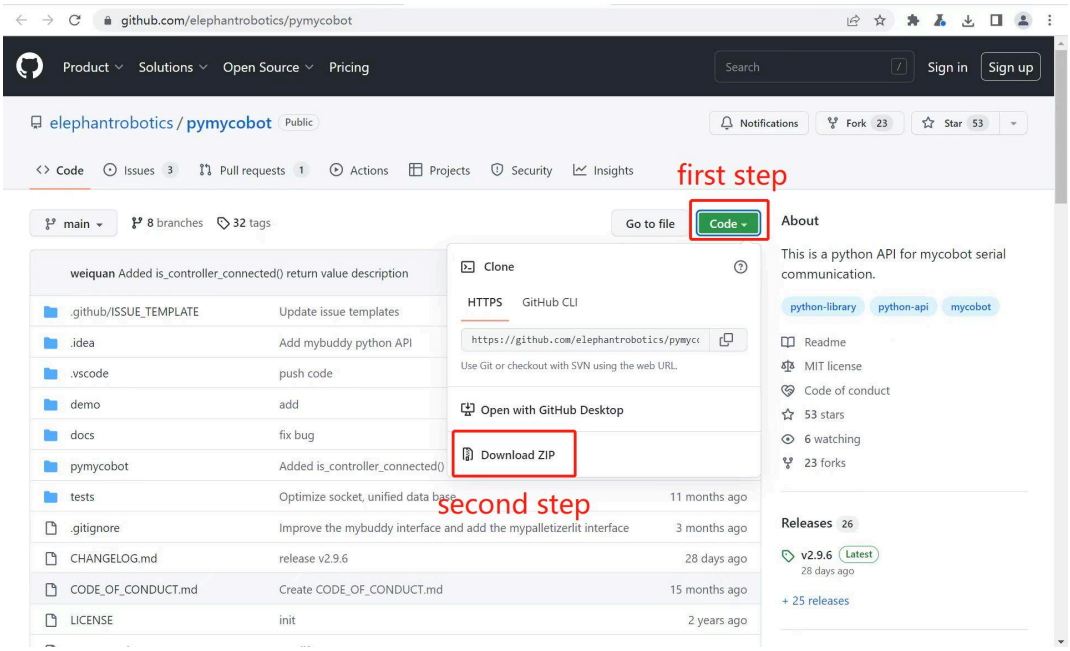
First, open the PyCharm you installed, create a new Python file, enter the following code, and import our library:

```
from pymycobot.mycobot280 import MyCobot280
```

Note:

1. If you enter `from pymycobot.mycobot280 import MyCobot280`, there is no red wavy line under the font, which proves that it has been successfully installed and can be used. If a red wavy line appears, you can refer to **How to install the API library** , **How to call the API library**.
2. If you do not want to install the API library through the above command, you can download the project to your local computer through the following github.

First, go to the project address: **https://github.com/elephantrobotics/pymycobot**. Then click the Code button on the right side of the webpage, and then click Download ZIP to download it locally. Put the pymycobot folder in the compressed package pymycobot file project into your python dependency library directory, and you can directly import and use it.



Simple Demonstration

Create a new Python file in PyCharm and enter the following code to execute the LED flashing (myCobot 280-M5, myCobot 320-M5 and myPalletizer 260 can refer to the following code).

> **Note:** The corresponding baud rates of various devices are different. Please refer to the information to understand their baud rates when using them. The serial port number can be viewed through **Calculator Device Manager** or the serial port assistant.

The following are the corresponding codes for myCobot.

- **myCobot**

```
# demo.py
from pymycobot.mycobot280 import MyCobot280

import time
#The above codes are required to be written, which means importing the project package

# MyCobot280 class initialization requires two parameters:
#   The first is the serial port string, such as:
#       linux:  "/dev/ttyUSB0"
#       windows: "COM3"
#   The second is the baud rate::
#       M5 version is:  115200
#
#    Example:
#       mycobot-M5:
#           linux:
#              mc = MyCobot280("/dev/ttyUSB0", 115200)
#           windows:
#              mc = MyCobot280("COM3", 115200)

# Initiate MyCobot280
# Create object code here for windows version
mc = MyCobot280("COM3", 115200)

i = 7
#loop 7 times
while i > 0:
    mc.set_color(0,0,255) #blue light on
    time.sleep(2)    #wait for 2 seconds
    mc.set_color(255,0,0) #red light on
    time.sleep(2)    #wait for 2 seconds
    mc.set_color(0,255,0) #green light on
    time.sleep(2)    #wait for 2 seconds
    i -= 1
```

If the following error message appears when executing the code, please check carefully whether the serial port number in the program is correct. You can solve this error message by checking the serial port number of your computer and changing it to the serial port number you found in the program. If the program runs normally but the robot arm does not respond, please check whether the baud rate is entered correctly.

```
Traceback (most recent call last):
  File "D:/python/Tms-GCN-edit/Tms-GCN-PyTorch/JointControl.py", line 24, in <module>
    mc = MyCobot("COM7", 115200)
  File "C:\Users\Lenovo\AppData\Roaming\Python\Python38\site-packages\pymycobot\mycobot.py", line 69, in __init__
    self._serial_port.open()
  File "C:\Users\Lenovo\AppData\Roaming\Python\Python38\site-packages\serial\serialwin32.py", line 64, in open
    raise SerialException("could not open port {!r}: {!r}".format(self.portstr, ctypes.WinError()))
serial.serialutil.SerialException: could not open port 'COM7': FileNotFoundError(2, 'The system cannot find the file speci
```

MyCobot 280

[toc]

Python API usage instaructions

API (Application Programming Interface), also known as Application Programming Interface functions, are predefined functions. When using the following function interfaces, please import our API library at the beginning by entering the following code, otherwise it will not run successfully:

```
# Example
from pymycobot import MyCobot280


mc = MyCobot280('COM3')


# Gets the current angle of all joints
angles = mc.get_angles()
print(angles)


# Set 1 joint to move to 40 and speed to 20
mc.send_angle(1, 40, 20)
```

> **Note:** Some function interfaces have return values, but if you enter the code directly, the result returned is no return value. You need to use the print function to print out the result. For example, if you want to get the current angle value of the robot arm, you can use get_angles(), but directly entering this function will not give you any result. The correct way to write it is: print(get_angles()) to print out the speed value. If the API description below indicates that there is no return value, you do not need to use the print function. Otherwise, you need to use the print function to print the result.

1. System Status

1.1 `get_system_version()`

- **function：** get system version
- **Return value：** system version

1.2 `get_basic_version()`

- **function：** Get basic firmware version for M5 version
- **Return value：** `float` firmware version

1.3 `get_error_information()`

- **function：** Obtaining robot error information
- **Return value：**
  - 0: No error message.
  - 1 ~ 6: The corresponding joint exceeds the limit position.
  - 16 ~ 19: Collision protection.

- 32: Kinematics inverse solution has no solution.
- 33 ~ 34: Linear motion has no adjacent solution.

1.4 `clear_error_information()`

- **function:** Clear robot error message

2. Overall Status

2.1 `power_on()`

- **function:** atom open communication (default open)
- **Return value:**
  - `1` - Power on completed.

2.2 `power_off()`

- **function:** Power off of the robotic arm
- **Return value:**
  - `1` - Power on completed.

2.3 `is_power_on()`

- **function:** judge whether robot arms is powered on or not
- **Return value:**
  - `1` : power on
  - `0` : power off
  - `-1` : error

2.4 `release_all_servos()`

- **function:** release all robot arms
  - Attentions：After the joint is disabled, it needs to be enabled to control within 1 second
- **Parameters：** `data` （optional）：The way to relax the joints. The default is damping mode, and if the 'data' parameter is provided, it can be specified as non damping mode (1- Undamping).
- **Return value:**
  - `1` - release completed.

2.5 `focus_servo(servo_id)`

- **function:** Power on designated servo
- **Parameters:**
  - `servo_id:` int, 1-6
- **Return value:**
  - `1` : complete

2.6 `is_controller_connected()`

- **function:** Wether connected with Atom
- **Return value:**
  - `1` : succeed
  - `0` : failed
  - `-1` : error data

2.7 `read_next_error()`

- **function:** Robot Error Detection
- **Return value:** list len 6
  - `0` : No abnormality
  - `1` : Communication disconnected
  - `2` : Unstable communication
  - `3` : Servo abnormality

2.8 `get_fresh_mode()`

- **function:** Query sports mode
- **Return value:**
  - `0` : Interpolation mode
  - `1` : Refresh mode

2.9 `set_fresh_mode()`

- **function:** Set command refresh mode
- **Parameters:**
  - `1` : Always execute the latest command first.
  - `0` : Execute instructions sequentially in the form of a queue.
- **Return value:**
  - `1` : complete

2.10 `set_free_mode()`

- **function:** set to free mode
- **Parameters:**
  - `1` : open free mode
  - `0` : close free mode
- **Return value:**
  - `1` : complete

2.11 `is_free_mode()`

- **function:** Check if it is free mode

- **Return value:**
  - `1` : free mode
  - `0` : on-free mode

2.12 `focus_all servos()`

- **Function:** All servos are powered on
- **Return value:**
  - `1` : complete

2.13 `set_vision_mode()`

- **Function:** Set the vision tracking mode, limit the attitude flip of send_coords in refresh mode. (Applicable only to vision tracking function)
- **Parameter:**
  - `1` : open
  - `0` : close
- **Return value:**
  - `1` : complete

3.MDI Mode and Operation

3.1 `get_angles()`

- **function:** get the degree of all joints
- **Return value**: `list` a float list of all degree

3.2 `send_angle(id, degree, speed)`

- **function:** send one degree of joint to robot arm
- **Parameters:**
  - `id` : Joint id, range int 1-6
  - `degree` : degree value(`float`)

> **Note:** ⚠ This joint limit information function is only available on Atom firmware ≥ 7.3 and pymycobot library ≥ 4.0.2.

Joint Id	Range
1	-168 ~ 168
2	-140 ~ 140
3	-150 ~ 150
4	-150 ~ 150
5	-155 ~ 160
6	-180 ~ 180

- `speed`： the speed and range of the robotic arm's movement 1~100
- **Return value:**
  - `1` : complete

3.3 `send_angles(angles, speed)`

- **function：** Send all angles to all joints of the robotic arm
- **Parameters:**
  - `angles` : a list of degree value(`List[float]`), length 6
  - `speed` : (`int`) 1 ~ 100
- **Return value:**
  - `1` : complete

3.4 `get_coords()`

- **function:** Obtain robot arm coordinates from a base based coordinate system
- **Return value:** a float list of coord:[x, y, z, rx, ry, rz]

3.5 `send_coord(id, coord, speed)`

- **function:** send one coord to robot arm
- **Parameters:**
  - `id` :send one coord to robot arm, 1-6 corresponds to [x, y, z, rx, ry, rz]
  - `coord` : coord value(`float`)

Coord ID	Range
x	-281.45 ~ 281.45
y	-281.45 ~ 281.45
z	-70 ~ 412.67
rx	-180 ~ 180
ry	-180 ~ 180
rz	-180 ~ 180

- `speed` : (`int`) 1-100
  - **Return value:**
- `1` : complete

3.6 `send_coords(coords, speed, mode)`

- **function:**: Send overall coordinates and posture to move the head of the robotic arm from its original point to your specified point
- **Parameters:**
  - coords: ： a list of coords value `[x,y,z,rx,ry,rz]` ,length6
  - speed `(int)` : 1 ~ 100
  - mode: `(int)` 0 - angluar, 1 - linear
- **Return value:**
  - `1` : complete

3.7 `pause()`

- **function:** Control the instruction to pause the core and stop all movement instructions
- **Return value**:
  - `1` - stopped
  - `0` - not stop
  - `-1` - error

3.8 `sync_send_angles(angles, speed, timeout=15)`

- **function：** Send the angle in synchronous state and return when the target point is reached
- **Parameters:**
  - `angles` : a list of degree value(`List[float]`), length 6
  - `speed` : (`int`) 1 ~ 100
  - `timeout` : default 15 seconds
- **Return value:**
  - `1` : complete

3.9 `sync_send_coords(coords, speed, mode=0, timeout=15)`

- **function：** Send the coord in synchronous state and return when the target point is reached
- **Parameters:**
  - `coords` : a list of coord value(`List[float]`), length 6
  - `speed` : (`int`) 1 ~ 100
  - `mode` : (`int`) 0 - angular（default）, 1 - linear
  - `timeout` : default 15 seconds
- **Return value:**
  - `1` : complete

3.10 `get_angles_coords()`

- **function：** Get joint angles and coordinates
- **Return value:** A list with a length of 12. The first six digits are angle information, and the last six digits are coordinate information.

3.11 `is_paused()`

- **function:** Check if the program has paused the move command
- **Return value:**
  - `1` - paused
  - `0` - not paused
  - `-1` - error

3.12 `resume()`

- **function:** resume the robot movement and complete the previous command
- **Return value:**
  - `1` - complete

3.13 `stop()`

- **function:** stop all movements of robot
- **Return value**:
  - `1` - stopped
  - `0` - not stop
  - `-1` - error

3.14 `is_in_position(data, flag)`

- **function** : judge whether in the position.
- **Parameters:**
  - data: Provide a set of data that can be angles or coordinate values. If the input angle length range is 6, and if the input coordinate value length range is 6
  - flag data type (value range 0 or 1)
    - `0` : angle
    - `1` : coord
- **Return value**:
  - `1` - true
  - `0` - false
  - `-1` - error

3.15 `is_moving()`

- **function:** judge whether the robot is moving
- **Return value:**
  - `1` moving
  - `0` not moving
  - `-1` error

3.16 `angles_to_coords(angles)`

- **Function** : Convert angles to coordinates.
- **Parameters:**
  - `angles` : `list` List of floating points for all angles.
- **Return value**: `list` List of floating points for all coordinates.

3.17 `solve_inv_kinematics(target_coords, current_angles)`

- **Function** : Convert coordinates to angles.
- **Parameters:**
  - `target_coords` : `list` List of floating points for all coordinates.
  - `current_angles` : `list` List of floating points for all angles, current angles of the robot
- **Return value**: `list` List of floating points for all angles.

4. JOG Mode and Operation

4.1 `jog_angle(joint_id, direction, speed)`

- **function:** jog control angle
- **Parameters**:

  - `joint_id` : Represents the joints of the robotic arm, represented by joint IDs ranging from 1 to 6
  - `direction(int)` : To control the direction of movement of the robotic arm, input `0` as negative value movement and input `1` as positive value movement
  - `speed` : 1 ~ 100
- **Return value:**
  - `1` : complete

4.2 `jog_coord(coord_id, direction, speed)`

- **function:** jog control coord.
- **Parameters:**
  - `coord_id` : (`int`) Coordinate range of the robotic arm: 1~6
  - `direction` : (`int`) To control the direction of machine arm movement, `0` - negative value movement, `1` - positive value movement
  - `speed` : 1 ~ 100
- **Return value:**
  - `1` : complete

4.3 `jog_rpy(end_direction, direction, speed)`

- **function:** Rotate the end around a fixed axis in the base coordinate system
- **Parameters:**
  - `end_direction` : (`int`) Roll, Pitch, Yaw (1-3)
  - `direction` : (`int`) To control the direction of machine arm movement, `1` - forward rotation, `0` - reverse rotation
  - `speed` : (`int`) 1 ~ 100
- **Return value:**
  - `1` : complete

4.4 `jog_increment_angle(joint_id, increment, speed)`

- **Function**: Angle stepping, single joint angle increment control
- **Parameter**:
  - `joint_id` : 1-6
  - `increment` : Incremental movement based on the current position angle
  - `speed` : 1~100
- **Return value:**
  - `1` : Completed

4.5 `jog_increment_coord(id, increment, speed)`

- **Function**: Coordinate stepping, single coordinate increment control
- **Parameter**:
  - `id` : Coordinate axis 1-6
  - `increment` : Incremental movement based on the current position coordinate
  - `speed` : 1~100
- **Return value:**
  - `1` : Completed

4.6 `set_encoder(joint_id, encoder, speed)`

- **function**: Set a single joint rotation to the specified potential value
- **Parameters**
  - `joint_id` : (`int`) 1-6
  - `encoder` : 0 ~ 4096
  - `speed` : 1 ~ 100
- **Return value:**
  - `1` : complete

4.7 `get_encoder(joint_id)`

- **function**: Set a single joint rotation to the specified potential value
- **Parameters**
  - `joint_id` : (`int`) 1-6
- **Return value:** (`int`) Joint potential value

4.8 `set_encoders(encoders, speed)`

- **function**: Set the six joints of the manipulator to execute synchronously to the specified position.
- **Parameters**
  - `joint_id` : (`int`) 1-6
  - `encoder` : 0 ~ 4096
  - `speed` : 1 ~ 100
- **Return value:**
  - `1` : complete

4.9 `get_encoders()`

- **function**: Get the six joints of the manipulator.
- **Return value:** (`list`) the list of encoders

5. Running status and Settings

5.1 `get_joint_min_angle(joint_id)`

- **function:** Gets the minimum movement angle of the specified joint
- **Parameters:**
  - `joint_id` : Enter joint ID (range 1-6)
- **Return value**： `float` Angle value

5.2 `get_joint_max_angle(joint_id)`

- **function:** Gets the maximum movement angle of the specified joint
- **Parameters:**
  - `joint_id` : Enter joint ID (range 1-6)
- **Return value:** `float` Angle value

5.3 `set_joint_min(id, angle)`

- **function:** Set minimum joint angle limit
- **Parameters:**
  - `id` : Enter joint ID (range 1-6)
  - `angle` : Refer to the limit information of the corresponding joint in the send_angle() interface, which must not be less than the minimum value
- **Return value:**
  - `1` : complete

5.4 `set_joint_max(id, angle)`

- **function:** Set maximum joint angle limit
- **Parameters:**
  - `id` : Enter joint ID (range 1-6)
  - `angle` : Refer to the limit information of the corresponding joint in the send_angle() interface, which must not be greater than the maximum value
- **Return value:**
  - `1` : complete

6. Joint motor control

6.1 `is_servo_enable(servo_id)`

- **function:** Detecting joint connection status
- **Parameters:** `servo id` 1-6
- **Return value:**
  - `1` : Connection successful
  - `0` : not connected
  - `-1` : error

6.2 `is_all_servo_enable()`

- **function:** Detect the status of all joint connections
- **Return value:**
  - `1` : Connection successful
  - `0` : not connected
  - `-1` : error

6.3 `set_servo_calibration(servo_id)`

- **function:** The current position of the calibration joint actuator is the angle zero point
- **Parameters**:
  - `servo_id` : 1 - 6
- **Return value:**
  - `1` : complete

6.4 `release_servo(servo_id)`

- **function:** Set the specified joint torque output to turn off
- **Parameters**:

- `servo_id` : 1 ~ 6
- **Return value:**
  - `1` : release successful
  - `0` : release failed
  - `-1` : error

6.5 `focus_servo(servo_id)`

- **function**: Set the specified joint torque output to turn on
- **Parameters**: `servo_id` : 1 ~ 6
- **Return value:**
  - `1` : focus successful
  - `0` : focus failed
  - `-1` : error

6.6 `set_servo_data(servo_id, data_id, value, mode=None)`

- **function:** Set the data parameters of the specified address of the steering gear
- **Parameters**：
  - `servo_id` : (`int`) joint id 1 - 6
  - `data_id` : (`int`) Data address
  - `value` : (`int`) 0 - 4096
  - `mode` : 0 - indicates that value is one byte(default), 1 - 1 represents a value of two bytes.
- **Return value:**
  - `1` : complete

6.7 `get_servo_data(servo_id, data_id, mode=None)`

- **function:** Read the data parameter of the specified address of the steering gear.
- **Parameters**：
  - `servo_id` : (`int`) joint id 1 - 6
  - `data_id` : (`int`) Data address
  - `mode` : 0 - indicates that value is one byte(default), 1 - 1 represents a value of two bytes.
- **Return value:** 0 ~ 4096

6.8 `joint_brake(joint_id)`

- **function:** Make it stop when the joint is in motion, and the buffer distance is positively related to the existing speed
- **Parameters**：
  - `joint_id` : (`int`) joint id 1 - 6
- **Return value:**
  - `1` : complete

7. 9g Servo

7.1 `move_round()`

- **function**：Drive the 9g steering gear clockwise for one revolution
- **Return value**：

- `1` : complete

7.2 `set_four_pieces_zero()`

- **function**：Set the zero position of the four-piece motor
- **Return value**：
  - `1` : success
  - `0` : failed

8. Servo state value

8.1 `get_servo_speeds()`

- **function**：Get the movement speed of all joints
- **Return value**： A list unit step/s

8.2 `get_servo_voltages()`

- **function**：Get joint voltages
- **Return value**： A list volts < 24 V

8.3 `get_servo_status()`

- **function**：Get the movement status of all joints
- **Return value**： A list,[voltage, sensor, temperature, current, angle, overload], a value of `0` means no error, a value of `1` indicates an error

8.4 `get_servo_temps()`

- **function**：Get joint temperature
- **Return value**： A list unit ℃

9. Robotic arm end IO control

9.1 `set_color(r, g, b)`

- **function**: Set the color of the end light of the robotic arm
- **Parameters**:
  - `r (int)` : 0 ~ 255
  - `g (int)` : 0 ~ 255
  - `b (int)` : 0 ~ 255
- **Return value**：
  - `1` : complete

9.2 `set_digital_output(pin_no, pin_signal)`

- **function:** set IO statue
- **Parameters**
  - `pin_no` (int): Pin number

- `pin_signal` (int): 0 / 1
- **Return value**:
  - `1` : complete

9.3 `get_digital_input(pin_no)`

- **function:** read IO statue
- **Parameters**: `pin_no` (int)
- **Return value**: signal

9.4 `set_pin_mode(pin_no, pin_mode)`

- **function:** Set the state mode of the specified pin in atom.
- **Parameters**
  - `pin_no` (int): Pin number
  - `pin_mode` (int): 0 - input, 1 - output, 2 - input_pullup
- **Return value**:
  - `1` : complete

10. Robotic arm end gripper control

10.1 `set_gripper_state(flag, speed, _type_1=None, is_torque=None)`

- **function**: Adaptive gripper enable
- **Parameters**:
  - `flag (int)` : 0 - open 1 - close, 254 - release
  - `speed (int)` : 0 ~ 100
  - `_type_1 (int)` :
    - `1` : Adaptive gripper (default state is 1)
    - `2` : A nimble hand with 5 fingers
    - `3` : Parallel gripper
    - `4` : Flexible gripper
  - `is_torque (int)` : Whether the gripper is force-controlled. This parameter can be omitted if no type parameter is specified. (**Note: This parameter is only supported when the end-end Atom firmware version is ≥ 6.5**)
    - `0` : Non-force-controlled gripper
    - `1` : Force-controlled gripper
- **Return value**:
  - `1` : complete

10.2 `set_gripper_value(gripper_value, speed, gripper_type=None, is_torque=None)`

- **function**: Set the gripper value
- **Parameters**:

- `gripper_value (int)` : 0 ~ 100
- `speed (int)` : 0 ~ 100
- `gripper_type (int)` :
  - `1` : Adaptive gripper (default state is 1)
  - `3` : Parallel gripper
  - `4` : Flexible gripper
- `is_torque (int)` : Whether the gripper is force-controlled. This parameter can be omitted if no type parameter is specified. (**Note: This parameter is only supported when the end-end Atom firmware version is ≥ 6.5**)
  - `0` : Non-force-controlled gripper
  - `1` : Force-controlled gripper

- **Return value**:
  - `1` : complete

10.3 `set_gripper_calibration()`

- **function**: Set the current position of the gripper to zero
- **Return value**:
  - `1` : complete

10.4 `is_gripper_moving()`

- **function**: Judge whether the gripper is moving or not
- **Return value**:
  - `0` : not moving
  - `1` : is moving
  - `-1` : error data

10.5 `get_gripper_value()`

- **function**: Get the value of gripper
- **Parameters**:
  - `gripper_type` : (int) default 1
    - 1: Adaptive gripper
    - 3: Parallel gripper
    - 4: Flexible gripper
- **Return value**: gripper value (int)

10.6 `set_pwm_output(channel, frequency, pin_val)`

- **function**: PWM control
- **Parameters**:
  - `channel` : (int): IO number.
  - `frequency` : (int): clock frequency
  - `pin_val` : (int) Duty cycle 0 ~ 256; 128 means 50%
- **Return value**:
  - `1` : complete

10.7 `set_HTS_gripper_torque(torque)`

- **function**: Set new adaptive gripper torque
- **Parameters**:
  - `torque` : (int): 150 ~ 980
- **Return value**:
  - `0` : Set failed
  - `1` : Set successful

10.8 `get_HTS_gripper_torque()`

- **function**: Get gripper torque
- **Return value**: (int) 150 ~ 980

10.9 `get_gripper_protect_current()`

- **function**: Get the gripper protection current
- **Return value**: (int) 1 ~ 500

10.10 `set_gripper_protect_current(current)`

- **function**: Set the gripper protection current
- **Parameters**:
  - `current` : (int): 1 ~ 500
- **Return value**:
  - `1` : complete

10.11 `init_gripper()`

- **function**: Initialize gripper
- **Return value**:
  - `1` : complete

10.12 `gripper_stop()`

> **Note:** Atom firmware version 7.3 or higher is required.

- **Function**: Stop gripper movement
- **Return value**:
  - `1` : Completed

10.13 `is_torque_gripper()`

- **Function**: Determines if the gripper is a force-controlled gripper type
- **Return Value**:
  - `40` : Force-controlled gripper
  - `9` : Non-force-controlled gripper

11. Set bottom IO input/output status

11.1 `set_basic_output(pin_no, pin_signal)`

- **function**：Set Base IO Output
- **Parameters**：
  - `pin_no` (`int`) Pin port number
  - `pin_signal` (`int`): 0 - low. 1 - high

11.2 `get_basic_input(pin_no)`

- **function:** Read base IO input
- **Parameters:**
  - `pin_no` (`int`) pin number
- **Return value:** 0 - low. 1 - high

12. WLAN Setting

12.1 `set_ssid_pwd(account, password)`

- **function:** Change connected wifi. (Apply to m5)
- **Parameters:**
  - `account` (`str`) new wifi account
  - `password` (`str`) new wifi password
- **Return value:**
  - `1` : complete

12.2 `get_ssid_pwd()`

- **function:** Get connected wifi account and password. (Apply to m5)
- **Return value:** (account, password)

12.3 `set_server_port(port)`

- **function:** Change the connection port of the server
- **Parameters:**
  - `port` (`int`) The new connection port of the server.
- **Return value:**
  - `1` : complete

13. TOF

13.1 `get_tof_distance()`

- **function:** Get the detected distance (Requires external distance detector)
- **Return value:** (int) The unit is mm.

14. Communication mode

14.1 `set_transponder_mode(mode)`

- **function:** Set basic communication mode
- **Parameters:**
  - `mode` : 0 - Turn off transparent transmission，1 - Open transparent transmission
- **Return value:**
  - `1` : complete

14.2 `get_transponder_mode()`

- **function:** Get basic communication mode
- **Parameters:**
- **Return value:**
  - `1` : Open transparent
  - `0` : Turn off transparent transmission

15. Cartesian space coordinate parameter setting

15.1 `set_tool_reference(coords)`

- **function:** Set tool coordinate system.
- **Parameters：**
  - `coords` : (`list`) [x, y, z, rx, ry, rz].
- **Return value:**
  - `1` : complete

15.2 `get_tool_reference(coords)`

- **function:** Get tool coordinate system.
- **Return value:** (`list`) [x, y, z, rx, ry, rz]

15.3 `set_world_reference(coords)`

- **function:** Set world coordinate system.
- **Parameters：**
  - `coords` : (`list`) [x, y, z, rx, ry, rz].
- **Return value:**
  - `1` : complete

15.4 `get_world_reference()`

- **function:** Get world coordinate system.
- **Return value:** `list` [x, y, z, rx, ry, rz].

15.5 `set_reference_frame(rftype)`

- **function:** Set base coordinate system.
- **Parameters：** `rftype` : 0 - base 1 - tool.
- **Return value:**

- `1` : complete

15.6 `get_reference_frame()`

- **function:** Get base coordinate system.
- **Return value:** (`list`) [x, y, z, rx, ry, rz].

15.7 `set_movement_type(move_type)`

- **function:** Set movement type.
- **Parameters**:
  - `move_type` : 1 - movel, 0 - moveJ.
- **Return value:**
  - `1` : complete

15.8 `get_movement_type()`

- **function:** Get movement type.
- **Return value:**
  - `1` - movel
  - `0` - moveJ

15.9 `set_end_type(end)`

- **function:** Set end coordinate system
- **Parameters:**
  - `end (int)` : `0` - flange, `1` - tool
- **Return value:**
  - `1` : complete

15.10 `get_end_type()`

- **function:** Obtain the end coordinate system
- **Return value:**
  - `0` - flange
  - `1` - tool

16. utils (module)

This module supports some helper methods. Use the code entered at the beginning of the file to import the module:

```
from pymycobot import utils
```

16.1 `utils.get_port_list()`

- **Function**: Get a list of all current serial port numbers
- **Return value:** Serial port list (`list`)

16.2 `utils.detect_port_of_basic()`

- **Function**: Return the first detected serial port number of M5 Basic. (Only one serial port number will be returned)
- **Return value:** Return the detected port number. If no serial port number is detected, it will return: None

MyCobot 280 Socket

> Note: The robotic arm that uses this class of premise has a server and has been turned on.

Use TCP/IP to control the robotic arm

1. Client

```
# demo
from pymycobot import MyCobot280Socket
# Port 9000 is used by default
mc = MyCobot280Socket("192.168.10.10",9000)

res = mc.get_angles()
print(res)

mc.send_angles([0,0,0,0,0,0],20)
...
```

2. Server

For details, please refer to the TCP/IP section.

Joint Control

For serial multi-joint robots, the control of joint space is to control the variables of each joint of the robot, and the goal is to make each joint of the robot reach the target position at a certain speed.

> **Note:** When setting the angle, the limit of different series of robot arms is different. For details, please refer to the parameter introduction of the corresponding model.

Single joint control

send_angle(id, degree, speed)

- **Function:** Send the specified single joint movement to the specified angle
- **Parameter description:**
  - `id` : Represents the joint of the robot arm. Use numbers 1-6 to represent it.
  - `degree` : Represents the angle of the joint
  - `speed` : Represents the speed of the robot arm movement, ranging from 1 to 100
- **Return value:** 1

set_encoder(joint_id, encoder, sp)

- **Function:** Send the specified single joint movement to the specified potential value
- **Parameter description:**
  - `joint_id` : Represents the joint of the robot arm. Use numbers 1-6 to represent it.
  - `encoder` : represents the potential value of the robot arm, the value range is 0 ~ 4096
  - `sp` : Indicates the speed of the robot arm movement, ranging from 1 to 100
- **Return value:** 1

Multi-joint control

get_angles()

- **Function:** Get all joint angles
- **Return value:** `list` A list of floating point values, representing the angles of all joints

send_angles(degrees, speed)

- **Function:** Send all angles to all joints of the robot arm
- **Parameter description:**
  - `degrees` : `(List[float])` contains the angles of all joints. the representation is: `[20,20,20,20,20,20]`
  - `speed` : Indicates the speed of the robot arm, the value range is 1-100
- **Return value:** 1

set_encoders(encoders, sp)

- **Function:** Send potential values to all joints of the robot arm
- **Parameter description:**
  - `encoder` : Indicates the potential value of the robot arm, the value range is 0 ~ 4096, the length is 6, representation method is: `[2048,2048,2048,2048,2048,2048]`
  - `sp` : Indicates the speed of the robot arm, the value range is 1-100
- **Return value:** 1

sync_send_angles(degrees, speed, timeout=15)

- **Function:** Synchronously send angles and return when reaching the target point
- **Parameter description:**
  - `degrees` : List of angle values of each joint `List[float]`
  - `speed` : (`int`) The speed of the robot arm, the value range is 1-100
  - `timeout` : The default time is 15s
- **Return value:** 1

get_radians()

- **Function:** Get the radians of all joints
- **Return value:** `list` contains a list of all joint radian values

send_radians(radians, speed)

- **Function:** Send radian values to all joints of the robot arm
- **Parameter description:**
  - `radians` : `list` Indicates the radian value of the robot arm, the value range is -5~5
- **Return value:** 1

Example use

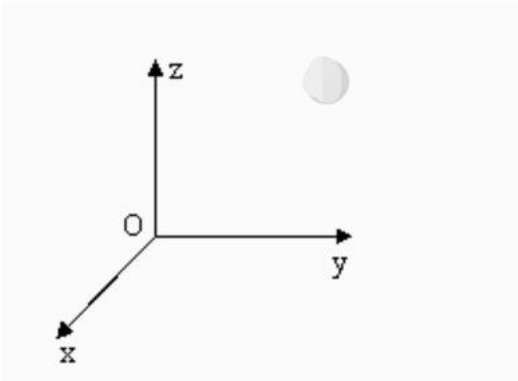
```
from pymycobot.mycobot280 import MyCobot280
import time


# MyCobot280 Class initialization requires two parameters:
# The first is the serial port string, such as:
    # linux: "/dev/ttyUSB0"
    # windows: "COM3"
    # The second is the baud rate:
    # M5 version: 115200
    # For example:
        # mycobot-M5:
            # linux:
            # mc = MyCobot280("/dev/ttyUSB0", 115200)
            # windows:
            # mc = MyCobot280("COM3", 115200)

# Initialize a MyCobot280 object
# Here is the object code for the windows version
mc = MyCobot280("COM3", 115200)
# By passing the angle parameter, each joint of the robot arm moves to the corresponding position [0, 0, 0, 0, 0, 0]
mc.send_angles([0, 0, 0, 0, 0, 0], 50)

# Set the waiting time to ensure that the robot has reached the specified position
time.sleep(2.5)

# Move joint 1 to the position of 90
mc.send_angle(1, 90, 50)

# Set the waiting time to ensure that the robot has reached the specified position
time.sleep(2)

# The following code can make the robot swing left and right
# Set the number of loops
num=5
while num > 0:
    # Move joint 2 to the position of 50
    mc.send_angle(2, 50, 50)

    # Set the waiting time to ensure that the robot has reached the specified position
    time.sleep(1.5)

    # Move joint 2 to the position of -50
    mc.send_angle(2, -50, 50)

    # Set the waiting time to ensure that the robot has reached the specified position
    time.sleep(1.5)

    num -= 1
```

```
# Retract the robot arm. You can swing the robot arm manually, and then use the get_angles() function to get the coordinat
# Use this function to make the robot arm reach the position you want.
mc.send_angles([88.68, -138.51, 155.65, -128.05, -9.93, -15.29], 50)

# Set the waiting time to ensure that the robot arm has reached the specified position
time.sleep(2.5)

# Relax the robot arm and swing it manually
mc.release_all_servos()
```

Coordinate control

It is mainly used to realize intelligent route planning to let the robot arm move from one position to another specified position. It is divided into `[x, y, z, rx, ry, rz]`, where `[x, y, z]` represents the position of the robot head in space (the coordinate system is the rectangular coordinate system), and `[rx, ry, rz]` represents the posture of the robot head at this point (the coordinate system is the Euler coordinate system). The implementation of the algorithm and the representation of Euler coordinates require certain academic knowledge. We will not explain it too much here. As long as we understand the rectangular coordinate system, we can use this function well.

> **Note:** When setting coordinates, different series of robot arm joint structures are different. For the same set of coordinates, different series of robot arms will show different postures.



Single parameter coordinate

send_coord(id,coord,speed)

- **Function:** Send a single coordinate value to the robot for movement
- **Parameter description:**
  - `id` : Represents the coordinate of the robot. Represented by numbers 1-6,for example, the X axis can be filled in 1, the Y can be filled in 2, and so on
  - `coord` : Enter the coordinate value you want to reach
  - `speed` : Indicates the speed of the robot movement, the range is 1-100
- **Return value:** 1

Multi-parameter coordinates

get_coords()

- **Function:** Get current coordinates and posture
- **Return value:** `list` contains a list of coordinates and postures, length is 6, in order `[x, y, z, rx, ry, rz]`

send_coords(coords, speed, mode)

- **Function:** Send the overall coordinates and posture, and let the robot head move from the original point to the point you specify.
- **Parameter description:**
  - `coords` : [x,y,z,rx,ry,rz] coordinate value, length is 6
  - `speed` : Indicates the speed of the robot movement, the range is 1-100

- `mode` : (`int`): The value is limited to 0 and 1.
  - 0 means that the path of the robot head is nonlinear, that is, the route is randomly planned, as long as the robot head moves to the specified point while maintaining the specified posture.
  - 1 means that the path of the robot head is linear, that is, the intelligent planning route allows the robot head to move to the specified point in a straight line.
- **Return value:** 1

set_tool_reference(coords)

- **Function:** Set the tool coordinate system.
- **Parameter description:**
  - `coords` :
    - Six axes: [x,y,z,rx,ry,rz] coordinate values, length 6, x,y,z range -280 ~ 280, rx,ry,yz range -314 ~ 314
- **Return value:** 1

get_tool_reference()

- **Function:** Get the tool coordinate system.
- **Return value:** Return a coordinate list with a length of 6

get_world_reference()

- **Function:** Get the world coordinate system.
- **Return value:** Return a coordinate list with a length of 6

set_world_reference(coords)

- **Function:** Set the world coordinate system.
- **Parameter description:**
  - `coords` :
    - Six axes: [x,y,z,rx,ry,rz] coordinate values, length is 6, x,y,z range is -280 ~ 280, rx,ry,yz range is -314 ~ 314
- **Return value:** 1

set_reference_frame(rftype)

- **Function:** Set the base coordinate system.
- **Parameter description:**
  - `rftype` : 0 - base coordinate system (default), 1 - world coordinate system
- **Return value:** 1

get_reference_frame()

- **Function:** Get the base coordinate system.
- **Return value:** 0 - base coordinate system, 1 - world coordinate system, -1 - communication failed

set_end_type(end)

- **Function:** Set the end coordinate system.
- **Parameter description:**
  - `end` : 0 - flange (default), 1 - tool
- **Return value:** 1

get_end_type()

- **Function:** Get the end coordinate system.
- **Return value:** 0 - flange (default), 1 - tool, -1 - communication failed

Example use

```
from pymycobot.mycobot280 import MyCobot280
import time


# MyCobot280 class initialization requires two parameters:
# The first is the serial port string, such as:
    # linux: "/dev/ttyUSB0"
    # windows: "COM3"
    # The second is the baud rate:
    # M5 version: 115200
    # For example:
        # mycobot-M5:
            # linux:
            # mc = MyCobot280("/dev/ttyUSB0", 115200)
            # windows:
            # mc = MyCobot280("COM3", 115200)

# Initialize a MyCobot280 object
# The following is the object code for the Windows version
mc = MyCobot280("COM3", 115200)

if mc.get_fresh_mode() != 1:
  mc.set_fresh_mode(1)

# Get the current head coordinates and posture
coords = mc.get_coords()
print(coords)
# # Intelligently plan the route, so that the head reaches the coordinates [57.0, -107.4, 316.3] in a linear manner, and m
mc.send_coords([57.0, -107.4, 316.3, -93.81, -12.71, -163.49], 80, 1)

# Set the waiting time to 1.5 seconds
time.sleep(1.5)

# Intelligently plan the route, let the head reach the coordinates [-13.7, -107.5, 223.9] in a linear manner, and maintain
mc.send_coords([-13.7, -107.5, 223.9, 165.52, -75.41, -73.52], 80, 1)

# Set the waiting time to 1.5 seconds
time.sleep(1.5)

# Only change the x coordinate of the head, set the x coordinate of the head to -40. Let it intelligently plan the route a
mc.send_coord(1, -40, 70)
```

IO control

IO is the input and output of data. There are multiple pins on the Basic and Atom of our robot arm. The input and output modes can be set through the following function interface.

- **myCobot：**

Basic IO

get_basic_input(pin_no)

- **Function:** Get the working status of the bottom pin number
- **Parameter description:** `pin_no` : Indicates the specific pin number at the bottom of the robot
- **Return value:** `pin_signal` (`int`) When the returned value is 0, it means it is running in the working state, and 1 means it is stopped

set_basic_output(pin_no, pin_signal)

- **Function:** Set the working status of the bottom pin number
- **Parameter description:**
  - `pin_no` (`int`) The number marked on the bottom of the device only takes the digital part
  - `pin_signal` (`int`): Input 0 means set to running state, input 1 means stop state
- **Return value:** 1

get_tof_distance()

- **Function:** Get the detected distance (external distance detector is required)
- **Return value:** Detected distance value, unit is mm

Atom IO

set_pin_mode(pin_no, pin_mode)

- **Function:** Set the state mode of the specified pin in atom
- **Parameter description:**
  - `pin_no` (int): The specific pin number on the top of the robot
  - `pin_mode` (int): Limited to 0~2
    - 0 is set to running state

    - 1 is set to stop state
    - 2 is set to pull-up mode
- **Return value:** 1

set_digital_output(pin_no, pin_signa)

- **Function:** Set the working state of the end pin number
- **Parameter description:**
    - `pin_no` (`int`) The number marked at the end of the device only takes the digital part
    - `pin_signal` (`int`): Enter 0 to set it to running state, enter 1 to stop state
- **Return value:** 1

get_digital_input(self, pin_no)

- **Function:** Get the working state of the end pin number
- **Parameter description:** `pin_no` : Indicates the specific pin number at the end of the robot
- **Return value:** `pin_signal` (`int`) When the returned value is 0, it means running in working state, and 1 means stop state

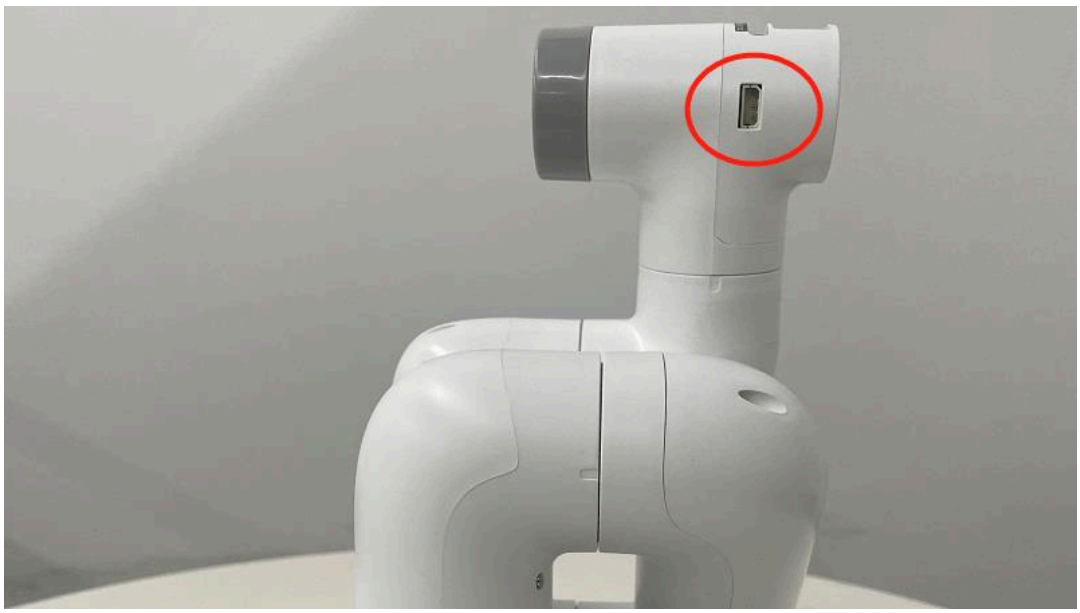
Case use

- **MyCobot 280-M5 version:**

```
from pymycobot.mycobot280 import MyCobot280
import time
#Enter the above code to import the required packages for the project

# MyCobot280 class initialization requires two parameters:
    # The first is the serial port string, such as:
        # linux: "/dev/ttyUSB0"
        # windows: "COM3"
        # The second is the baud rate:
        # M5 version: 115200

    # For example:
        # mycobot-M5:
            # linux:
            # mc = MyCobot280("/dev/ttyUSB0", 1000000)
            # windows:
            # mc = MyCobot280("COM3", 115200)

# Initialize a MyCobo280 object
# The following is the object creation code for the windows version
mc = MyCobot280("COM3", 115200)

for count in range(5):
# Set a loop
mc.set_basic_output(2,0)
# Put basic2 into working state
mc.set_basic_output(5,0)
# Put basic position 5 into working state
time.sleep(2)
# Wait for two seconds
mc.set_basic_output(2,1)
# Stop basic position 2 from working
mc.set_basic_output(5,1)
# Stop basic position 2 from working
```

Gripper control

Before using Python to control the gripper, you need to install and connect the gripper on the robot arm. Different grippers are compatible with different robots (for specific adaptation information, please refer to **Product accessories**.)

> **Note:**
>
> MyCobot 280 adaptive gripper inserts the gripper into the pins on the Atom, see the following figure:
>
> 

Gripper control

`is_gripper_moving()`

- **Function:** Determine whether the gripper is running
- **Return value:**
  - `0` : Indicates that the gripper of the robot arm is not running
  - `1` : Indicates that the gripper of the robot arm is running
  - `-1` : Indicates an error

`set_gripper_state(flag, speed, _type_1=None, is_torque=None)`

- **function**: Adaptive gripper enable
- **Parameters**:
  - `flag (int)` : 0 - open 1 - close, 254 - release
  - `speed (int)` : 0 ~ 100
  - `_type_1 (int)` :
    - `1` : Adaptive gripper (default state is 1)
    - `2` : A nimble hand with 5 fingers
    - `3` : Parallel gripper
    - `4` : Flexible gripper

  - `is_torque (int)` : Whether the gripper is force-controlled. This parameter can be omitted if no type parameter is specified. (**Note: This parameter is only supported when the end-end Atom firmware version is ≥ 6.5**)
    - `0` : Non-force-controlled gripper
    - `1` : Force-controlled gripper
- **Return value**:
  - `1` : complete

`set_gripper_value(gripper_value, speed, gripper_type=None, is_torque=None)`

- **function**: Set the gripper value
- **Parameters**:
  - `gripper_value (int)` : 0 ~ 100
  - `speed (int)` : 0 ~ 100
  - `gripper_type (int)` :
    - `1` : Adaptive gripper (default state is 1)
    - `3` : Parallel gripper
    - `4` : Flexible gripper
  - `is_torque (int)` : Whether the gripper is force-controlled. This parameter can be omitted if no type parameter is specified. (**Note: This parameter is only supported when the end-end Atom firmware version is ≥ 6.5**)
    - `0` : Non-force-controlled gripper
    - `1` : Force-controlled gripper
- **Return value**:
  - `1` : complete

`get_gripper_value(gripper_type=None)`

- **Function:** Get the current position data information of the gripper
- **Parameter description:**
  - `gripper_type` : gripper type, the default is adaptive gripper
    - `1` : adaptive gripper
    - `3` : parallel gripper
    - `4` : flexible gripper
- **Return value:** Gripper data information

`set_HTS_gripper_torque(torque)`

- **Function:** Set adaptive gripper torque
- **Parameter description:**
  - `torque` : 150 ~ 900
- **Return value:** 0 - Setting failed; 1 - Setting successful

`get_HTS_gripper_torque()`

- **Function:** Get adaptive gripper torque

- **Return value:** 150 ~ 900

`get_gripper_protect_current()`

- **Function:** Get the gripper protection current
- **Return value:** 1 ~ 500

`init_gripper()`

- **Function:** Initialize the gripper
- **Return value:** 0 - Initialization failed; 1 - Initialization successful

`set_gripper_protect_current(current)`

- **Function:** Set the gripper protection current
- **Parameter description:**
  - `current` : 1 ~ 500
- **Return value:** 0 - Initialization failed; 1 - Initialization successful

Example

```
from pymycobot.mycobot280 import MyCobot280
import time
#Enter the above code to import the packages required for the project

def gripper_test(mc):
print("Start check IO part of api\n")
# Check if the gripper is moving
flag = mc.is_gripper_moving()
print("Is gripper moving: {}".format(flag))
time.sleep(1)
# Set the current position to (2048).
# Use it when you are sure you need it.
# Gripper has been initialized for a long time. Generally, there
# is no need to change the method.
# mc.set_gripper_ini()
# Set joint point 1 and let it rotate to the position 2048
mc.set_encoder(1, 2048, 20)
time.sleep(2)
# Set six joint positions and let the robot arm rotate to this position at a speed of 20
mc.set_encoders([1024, 1024, 1024, 1024, 1024, 1024], 20)
time.sleep(3)

# Let the gripper reach the 100 state at a speed of 70
mc.set_gripper_value(100, 70)
time.sleep(3)
# Let the gripper reach the 0 state at a speed of 70
mc.set_gripper_value(0, 70)
time.sleep(3)

# Set the state of the gripper to open the claw quickly at a speed of 70
mc.set_gripper_state(0, 70)
time.sleep(3)

# Set the state of the gripper to close the claw quickly at a speed of 70
mc.set_gripper_state(1, 70)
time.sleep(3)

# Get the value of the gripper
print("")
print(mc.get_gripper_value())

if __name__ == "__main__":
# MyCobot280 class initialization requires two parameters:
    # The first is a serial string, such as:
        # linux: "/dev/ttyUSB0"
        # windows: "COM3"
        # The second is the baud rate:
        # M5 version: 115200
```

```
    # Example:
        # mycobot-M5:
            # linux:
            # mc = MyCobot280("/dev/ttyAMA0", 1000000)
            # windows:
            # mc = MyCobot280("COM3", 115200)

# Initialize a MyCobot280 object
# Below is the object code for M5 version
mc = MyCobot280('COM3', 115200)
# Move it to zero
mc.set_encoders([2048, 2048, 2048, 2048, 2048, 2048], 20)
time.sleep(3)
gripper_test(mc)
```

TCP/IP

TCP/IP transmission protocol, namely transmission control/network protocol, is also called network communication protocol. It is the most basic communication protocol in the use of the network, and stipulates the standards and methods for communication between various parts of the Internet. Users can connect to the robot arm through the IP address of the robot arm, so that the robot arm can be remotely operated without connecting to the USB port.

myCobot

Before using the robot arm, please make sure that the Basic firmware and Atom firmware have been burned.

1 Connection steps

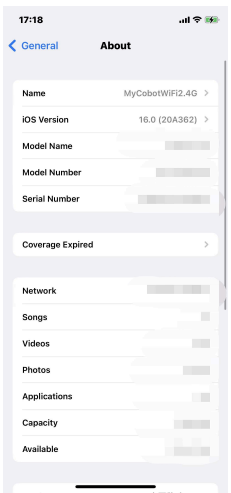
1.1 Create a default network

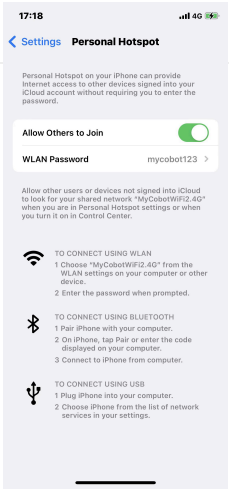
When the myCobot 280 m5 robot arm uses TCP/IP, it will use the default password "mycobot123" to connect to a network of "MyCobotWiFi2.4G".

At this time, we can use a mobile phone to create a hotspot, change the hotspot network name to "MyCobotWiFi2.4G", set the password to "mycobot123", and after turning on the hotspot, the robot arm will automatically connect to the mobile phone hotspot using the TCP/IP function. In the future, as long as they are in the same local area network, network communication can be carried out between devices.

The same is true for the router. Set the network name and password of the router, and the robot arm will connect to the router when the TCP/IP function is turned on.

One thing to note is that the myCobot 280 m5 robot arm only supports the 2.4 GHz network band. It does not support the 5 GHz network band. The following takes the mobile phone hotspot as an example.





1.2 TCP/IP function turned on

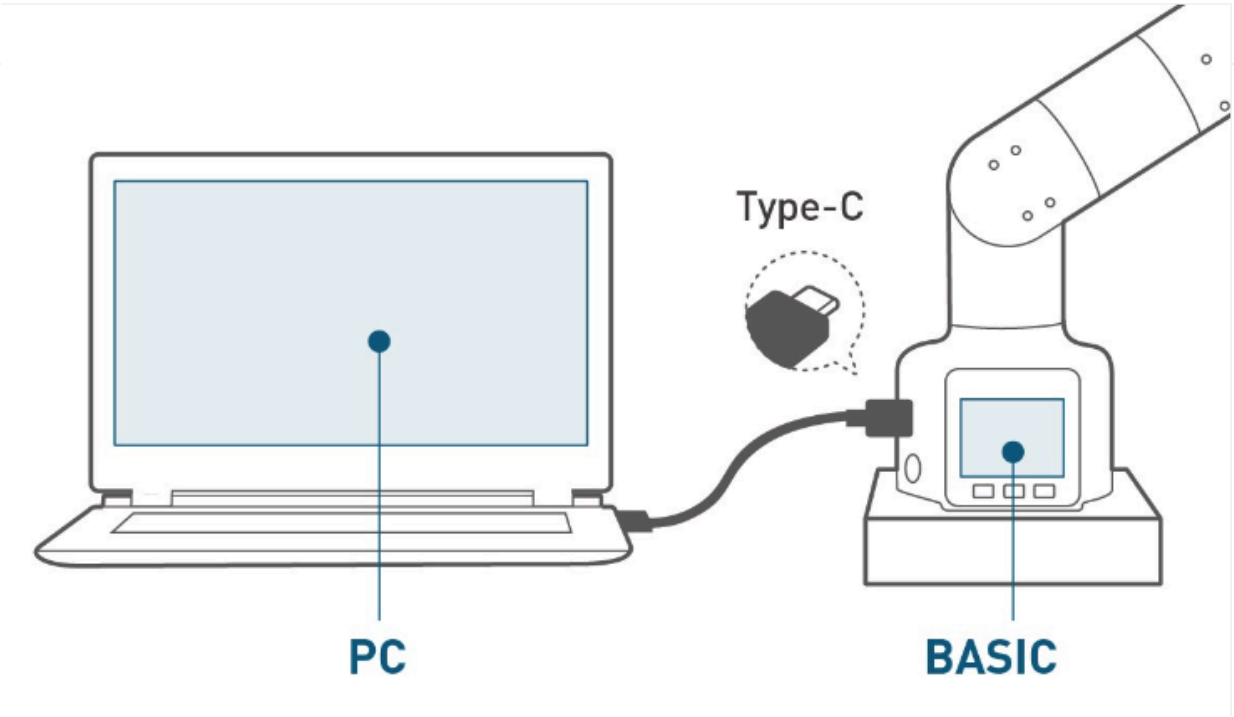
As shown in the figure, the robot arm clicks Transponder->WLAN Server through the button. If the connection is successful, the IP and port number will be displayed. If the connection fails, please check whether the network name and password are set correctly.

1.3 Connect to other networks

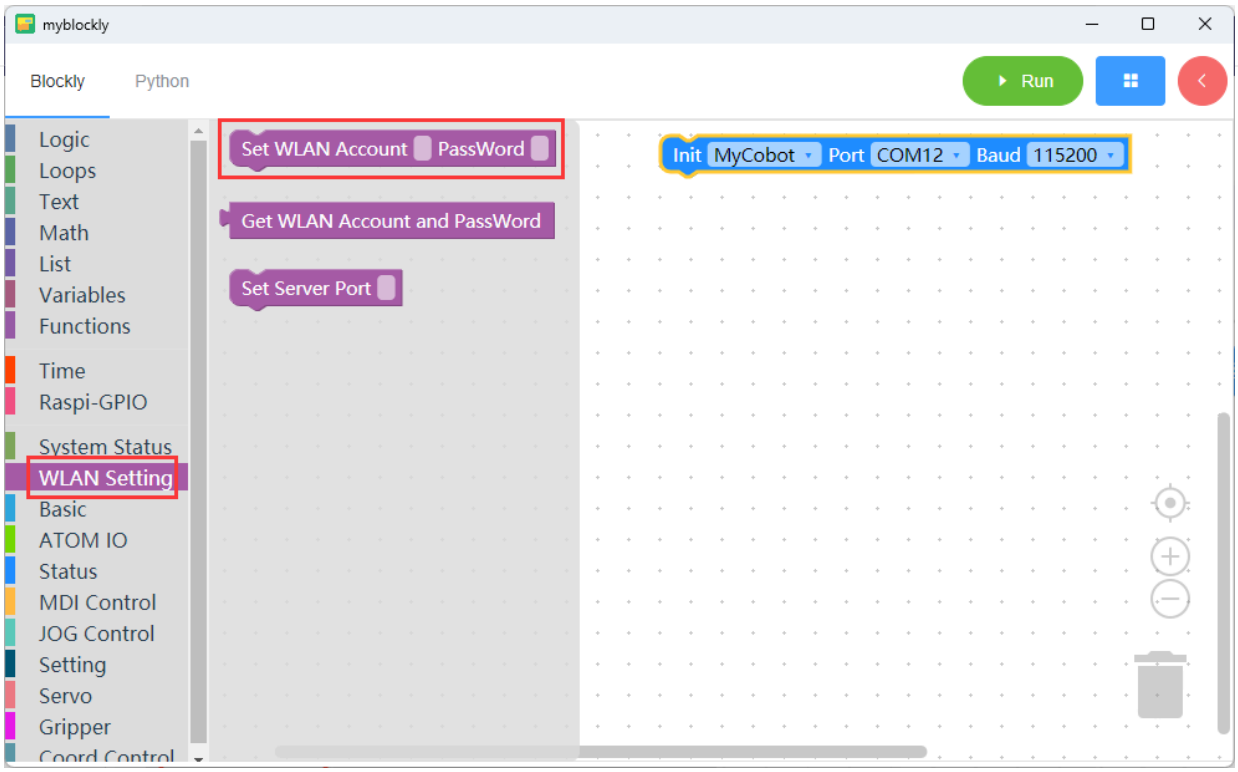
If you need to connect to other networks, you can download the myBlockly software provided by our company to connect to other networks.

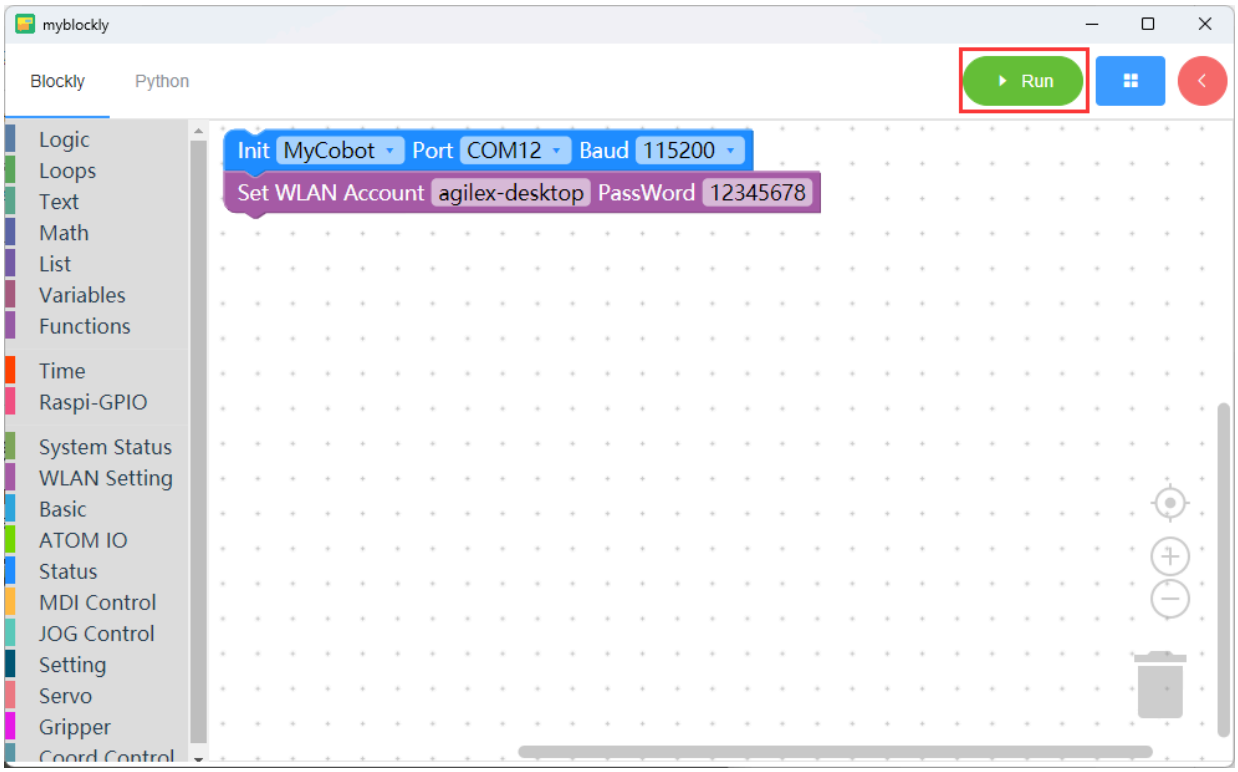
Note: The 280 m5 cannot save the connected WIFI account and password when it is powered off. After the 280 m5 is powered off and restarted, it will still connect to the default WIFI account "MyCobotWiFi2.4G" and password "mycobot123". To connect to other networks, you need to set the WIFI account and password again.

Step 1: Connect PC and myCobot 280 m5



Step 2: Open myBlockly, set the WIFI account and password for 280 m5 to connect, and then click Run.





Step 3: The operation steps are as follows: Transponder -> WLAN Server, and the robot arm will connect to the "agilex-desktop" network.

2 Case

Under the mobile phone hotspot, after the robot arm successfully starts the TCP/IP function, the robot arm will display the IP and port. You need to remember the IP and port.

Connect the PC to the same mobile phone hotspot as the robotic arm, call the python driver library, and you can connect to the robotic arm through the IP address of the robotic arm, so that you can remotely operate the robotic arm without connecting to the USB port.

```
from pymycobot import MyCobot280Socket
# Default port is 9000
#"172.20.10.14" is the IP address of the robot arm. Please enter your own IP address of the robot arm
mc = MyCobot280Socket("172.20.10.14",9000)

#If the connection is normal, you can control the robot arm
mc.send_angles([0,0,0,0,0,0],20)
res = mc.get_angles()
print(res)

...
```

Handle control

You can use the game controller to control the movement of the machine and use the gripper or suction pump to grab objects.

> Note: The handle needs to be purchased separately, please contact the official customer service for details

The corresponding functions of the handle buttons are as follows:

myCobot:

- **1**: RX coordinate value increases
- **2**: RX coordinate value decreases
- **3**: RY coordinate value increases
- **4**: RY coordinate value decreases
- **5**: X coordinate value increases
- **6**: X coordinate value decreases

- **7**: Y coordinate value decreases
- **8**: Y coordinate value increases
- **9**: Z coordinate value decreases
- **10**: Z coordinate value increases
- **11**: RZ coordinate value decreases
- **12**: RZ Coordinate value increases
- **13**: Wake up the handle. If the handle is not used for a long time after connection, it will enter sleep mode. You need to press this button to continue using it.
- **X**: Click the button to open the jaws
- **Y**: Click the button to close the jaws
- **A**: Click the button to turn on the suction pump
- **B**: Click the button to turn off the suction pump
- **Left 1**: Press and hold for 2s to initialize the robot to the joint zero position state.
- **Left 2**: Press and hold for 2s, the robot stops torque output and relaxes all joints.
- **Right 1**: Press and hold for 2s to initialize the robot to the initial point of movement.
- **Right 2**: Press and hold for 2s, the robot turns on torque output and all joints are locked.

Instructions for use

Connect the device

Connect MyCobot280 and the handle to the computer.

Install the required packages

Download code: https://github.com/elephantrobotics/pymycobot

Open the terminal, switch the path to the `pymycobot/demo/handle_control` folder, and run the following command:

```
pip3 install -r requirements.txt
```

Change the port number

myCobot

Edit the myCobot280_handle_control.py file

```
import pygame
import time
from pymycobot import MyCobot280
import threading
# Change com7 to the actual port number detected by your computer

mc = MyCobot280("com7", 115200)
...
```

Run the program.

```
python3 myCobot280_handle_control.py
```

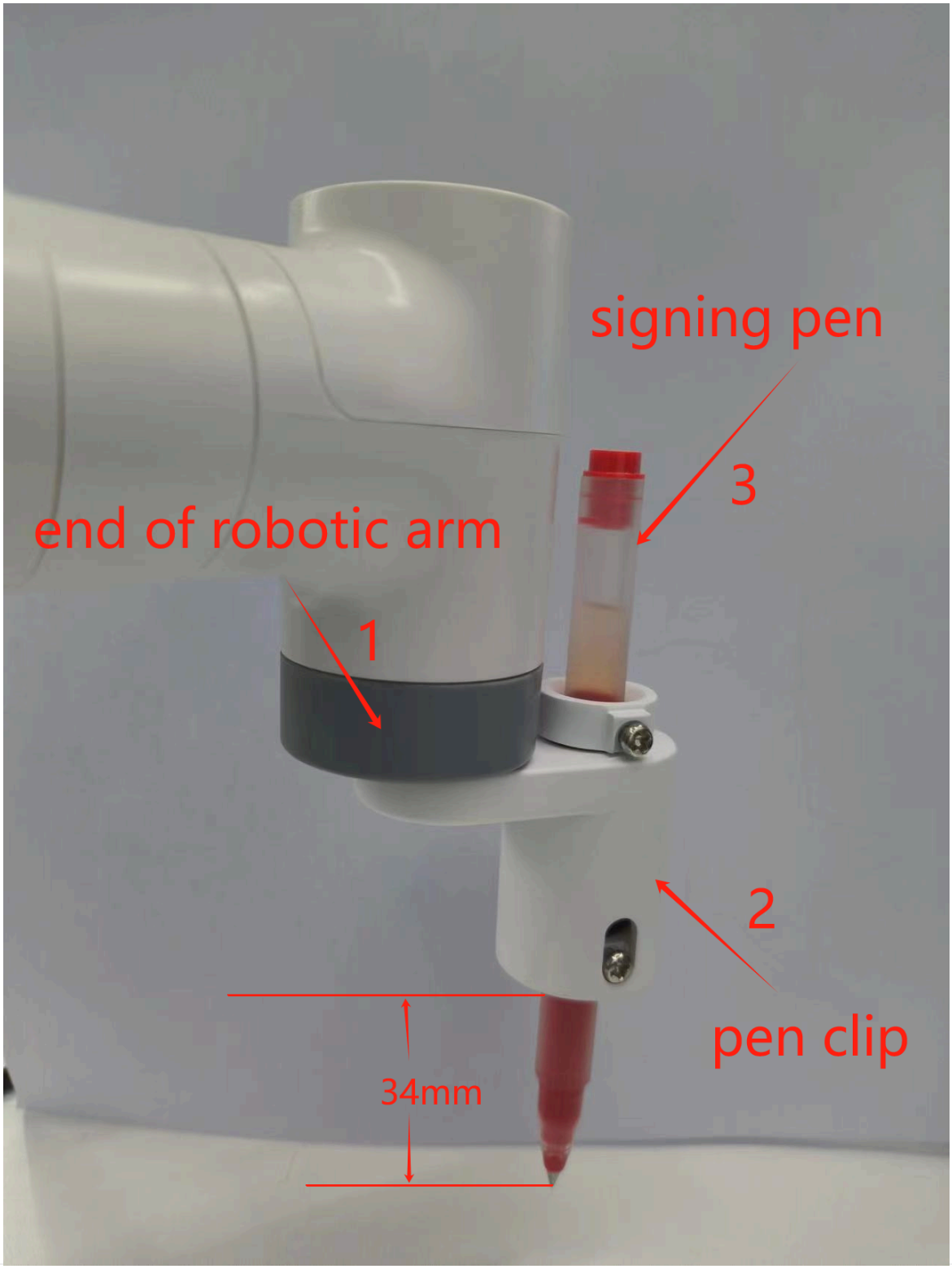
> Note: After running the program, first click the **Right 1** button. After the machine reaches the initial point, other operations can be performed.

Draw a pattern

You can control the movement of the robot arm and realize the drawing operation by parsing the instructions in a gcode file.

Installation diagram

> Note: The end of the robot arm and the pen clip are connected using Lego technology.



Instructions

1. Connect the device

Connect MyCobot280 to the computer, install the pen clip to the end of the robot arm, put the signature pen in the pen clip and tighten the screws to fix it.

> Note: Use the G-type base 2.0 to fix the robot arm on the desktop, and place the A4 white paper on the desktop for drawing patterns.

2. Install the required packages

Download code: https://github.com/elephantrobotics/pymycobot

Open the terminal, switch the path to the `pymycobot/demo/myCobot_280_demo` folder, and run the following command:

```
pip install pyserial pymycobot
```

3. Change the port number

Edit the 280_draw_gcode.py file

```
# Change COM14 to the actual port number detected by your computer
import time
from pymycobot import MyCobot280 # import mycobot library,if don't have, first 'pip install pymycobot'


# use PC and M5 control
mc = MyCobot280('COM14', 115200) # WINDOWS use, need check port number when you PC
# mc = MyCobot280('/dev/ttyUSB0',115200) # VM linux use
time.sleep(0.5)
...
```

Just run the program.

```
python 280_draw_gcode.py
```

Then, according to the terminal prompt, enter different numbers to select different patterns:

```
1-square
2-triangle
3-five point star
4-quit
```

> Note: The initial point of the robot arm can be changed by yourself, but the posture of the J6 joint must be vertically downward, and the speed can also be changed by yourself, the default is 100 mm per second.

```
# Send the initial point angle of the robot arm, the speed is 50,
# it can be customized and modified, as long as the end is facing down
mc.send_angles([0, -40, -130, 80, 0, 50], 50)
# Wait 3 seconds for the robot arm to move to the specified angle
time.sleep(3)
# Get the current coordinates of the robot arm
get_coords = mc.get_coords()
time.sleep(1.5)
# Save the parsed coordinates
data_coords = []
# Set the drawing speed to 100, and the speed range is 0~100
draw_speed = 100


...
```

Demonstration code

The following are various use cases and operation result videos. You can copy the code for use or modification (the robot arm model used in the following cases is MyCobot280 280. The parameters of different series of robot arms are different. Please pay attention to the modification).

Note: The corresponding baud rates of various devices are different. Please refer to the information to understand their baud rates when using them. The serial port number can be viewed through Calculator Device Manager or the serial port assistant.

1 Control RGB light board

```
from pymycobot import MyCobot280
import time
#The above needs to be written at the beginning of the code, which means importing the project package

# MyCobot280 class initialization requires two parameters: serial port and baud rate
    # The first is the serial port string, such as:
        # linux: "/dev/ttyUSB0"
        # windows: "COM3"
        # The second is the baud rate:
        # M5 version: 115200
    # The following is such as:
        # mycobot-M5:
            # linux:
            # mc = MyCobot280("/dev/ttyUSB0", 115200)
            # windows:
            # mc = MyCobot280("COM3", 115200)

# Initialize a MyCobot280 object
# The following is the object code for the Windows version
mc = MyCobot280("COM3", 115200)

i = 7
# Loop 7 times
while i > 0:
mc.set_color(0,0,255) #Blue light on
time.sleep(2) #Wait 2 seconds
mc.set_color(255,0,0) #Red light on
time.sleep(2) #Wait 2 seconds
mc.set_color(0,255,0) #Green light on
time.sleep(2) #Wait 2 seconds
i -= 1
```

2 Control the machine to return to the origin

```
from pymycobot import MyCobot280
# MyCobot280 class initialization requires two parameters:
# The first is the serial port string, such as:
        # linux: "/dev/ttyUSB0"
        # windows: "COM3"
        # The second is the baud rate:
        # M5 version: 115200
    # The following is such as:
        # mycobot-M5:
            # linux:
            # mc = MyCobot280("/dev/ttyUSB0", 115200)
            # windows:
            # mc = MyCobot280("COM3", 115200)



# Initialize a MyCobot280 object
# The following is the object code for M5 version
mc = MyCobot280("COM3", 115200)

# Check if the robot can be programmed

if mc.is_controller_connected() != 1:

print("Please connect the robot correctly to write the program")

exit(0)

# Fine-tune the robot to ensure that all the ports are aligned

# The alignment of the robot port is the standard. This is just an example

mc.send_angles([0, 0, 0, 0, 0, 0], 30)

# Calibrate the position at this time. The calibrated angle position is [0,0,0,0,0,0] and the potential value is [2048,204

# This for loop is equivalent to the set_gripper_ini() method

#for i in range(1, 7):

#mc.set_servo_calibration(i)
```

3 Single joint movement

```python
from pymycobot import MyCobot280
import time

# The MyCobot280 class requires two parameters to be initialized:
# The first is the serial port string, such as:
        # linux: "/dev/ttyUSB0"
        # windows: "COM3"
        # The second is the baud rate:
        # M5 version: 115200
    # The following is such as:
        # mycobot-M5:
            # linux:
            # mc = MyCobot280("/dev/ttyUSB0", 115200)
            # windows:
            # mc = MyCobot280("COM3", 115200)

# Create object code for M5 version
mc=MyCobot280('COM3',115200)

# Robot arm recovery
mc.send_angles([0, 0, 0, 0, 0, 0], 40)
time.sleep(3)

# Control joint 3 to move 70°
mc.send_angle(Angle.J3.value,70,40)
time.sleep(3)

# Control joint 4 to move -70°
mc.send_angle(Angle.J4.value,-70,40)
time.sleep(3)

# Control joint 1 to move 90°
mc.send_angle(Angle.J1.value,90,40)
time.sleep(3)

# Control joint 5 to move -90°
mc.send_angle(Angle.J5.value,-90,40)
time.sleep(3)

# Control joint 5 to move 90°
mc.send_angle(Angle.J5.value,90,40)
time.sleep(3)
```

4 Multi-joint exercise

```
import time
from pymycobot import MyCobot280
# The MyCobot280 class requires two parameters to be initialized:
#   The first is the serial port string, such as:
#       linux: "/dev/ttyUSB0"
#       windows: "COM3"
#   The second is the baud rate:
#       M5 version: 115200
#
#   Example:
#       mycobot-M5:
#           linux:
#                mc = MyCobot280("/dev/ttyUSB0", 115200)
#           windows:
#              mc = MyCobot280("COM3", 115200)

# Initialize a MyCobot280 object
# 280-M5 version object code
mc=MyCobot280('COM3',115200)
# Robot arm reset to zero
mc.send_angles([0,0,0,0,0,0],50)
time.sleep(2.5)
# Control the different angles of rotation of multiple joints
mc.send_angles([90,45,-90,90,-90,90],50)
time.sleep(2.5)
# Robot arm reset to zero
mc.send_angles([0,0,0,0,0,0],50)
time.sleep(2.5)
# Control the different angles of rotation of multiple joints
mc.send_angles([-90,-45,90,-90,90,-90],50)
time.sleep(2.5)
```

5 Control the robot arm to swing left and right

```
from pymycobot import MyCobot280
import time

# M5 version
mc = MyCobot280("COM3", 115200)
# Get the coordinates of the current position
angle_datas = mc.get_angles()
print(angle_datas)

# Use a sequence to pass coordinate parameters to move the robot to the specified position
mc.send_angles([0, 0, 0, 0, 0, 0], 50)
print(mc.is_paused())
# Set the waiting time to ensure that the robot has reached the specified position
# while not mc.is_paused():
time.sleep(2.5)

# Move joint 1 to position 90
mc.send_angle(Angle.J1.value, 90, 50)

# Set the waiting time to ensure that the robot has reached the specified position
time.sleep(2)

# Set the number of loops
num = 5

# Let the robot swing left and right
while num > 0:
    # Move joint 2 to position 50
    mc.send_angle(2, 50, 50)
    # Set the waiting time to ensure that the robot has reached the specified position
    time.sleep(1.5)
    # Move joint 2 to position -50
    mc.send_angle(2, -50, 50)
    # Set the waiting time to ensure that the robot has reached the specified position
    time.sleep(1.5)
    num -= 1
# Retract the robot arm. You can swing the robot arm manually, and then use the get_angles() function to get the coordinat
# Use this function to make the robot arm reach the position you want.
mc.send_angles([88.68, -138.51, 155.65, -128.05, -9.93, -15.29], 50)

# Set the waiting time to ensure that the robot arm has reached the specified position
time.sleep(2.5)
# Relax the robot arm and swing it manually
mc.release_all_servos()
```

6 Controlling the robotic arm to dances

```
from pymycobot import MyCobot280
import time


if __name__ == '__main__':
# MyCobot280 class initialization requires two parameters:
# The first is the serial port string, such as:
        # linux: "/dev/ttyUSB0"
        # windows: "COM3"
        # The second is the baud rate:
        # M5 version: 115200
    # The following is such as:
        # mycobot-M5:
            # linux:
            # mc = MyCobot280("/dev/ttyUSB0", 115200)
            # windows:
            # mc = MyCobot280("COM3", 115200)


# Initialize a MyCobot280 object
# M5 version
 mc = MyCobot280("COM3",115200)
# Set the start time
start = time.time()
# Let the robot reach the specified position
mc.send_angles([-1.49, 115, -153.45, 30, -33.42, 137.9], 80)
# Determine whether it has reached the specified position
while not mc.is_in_position([-1.49, 115, -153.45, 30, -33.42, 137.9], 0):
    # Let the robot resume movement
    mc.resume()
    # Let the robot move for 0.5s
    time.sleep(0.5)
    # Pause the movement of the robot
    mc.pause()
    # Determine whether the movement has timed out
    if time.time() - start > 3:
        break
# Set the start time
start = time.time()
# Let the movement last for 30 seconds
while time.time() - start < 30:
    # Let the robot reach this position quickly
    mc.send_angles([-1.49, 115, -153.45, 30, -33.42, 137.9], 80)
    # Set the color of the light to [0,0,50]
    mc.set_color(0, 0, 50)
    time.sleep(0.7)
    # Let the robot reach this position quickly
    mc.send_angles([-1.49, 55, -153.45, 80, 33.42, 137.9], 80)
    # Set the color of the light to [0,50,0]
```

```
    mc.set_color(0, 50, 0)
    time.sleep(0.7)
```

7 Gripper control

```python
from pymycobot import MyCobot280
import time
def gripper_test(mc):
    print("Start check IO part of api\n")
    # Check if the gripper is moving
    flag = mc.is_gripper_moving()
    print("Is gripper moving: {}".format(flag))
    time.sleep(1)

    # Set the current position to (2048).
    # Use it when you are sure you need it.
    # Gripper has been initialized for a long time. Generally, there
    # is no need to change the method.
    # mc.set_gripper_ini()
    # Set joint point 1 to rotate to position 2048
    mc.set_encoder(1, 2048, 20)
    time.sleep(2)
    # Set six joint positions and let the robot arm rotate to the position at a speed of 20

    mc.set_encoders([1024, 1024, 1024, 1024, 1024, 1024], 20)
    # mc.set_encoders([2048, 2900, 2048, 2048, 2048, 2048], 20)
    # mc.set_encoders([2048, 3000,3000, 3000, 2048, 2048], 50)
    time.sleep(3)
    # Get the position information of joint point 1
    print(mc.get_encoder(1))
    # Set the gripper to rotate to the position of 2048
    mc.set_encoder(7, 2048, 20)
    time.sleep(3)
    # Set the gripper to rotate to the position of 1300
    mc.set_encoder(7, 1300, 20)
    time.sleep(3)

    # Let the gripper reach the state of 100 at a speed of 70
    mc.set_gripper_value(100, 70)
    time.sleep(3)
    # Let the gripper reach the state of 0 at a speed of 70
    mc.set_gripper_value(0, 70)
    time.sleep(3)

    num=5
    while num>0:
        # Set the state of the gripper to open the claws quickly at a speed of 70
        mc.set_gripper_state(0, 70)
        time.sleep(3)
        # Set the state of the gripper to close the claws quickly at a speed of 70
        mc.set_gripper_state(1, 70)
        time.sleep(3)
```

```
        num-=1


    # Get the value of the gripper
    print("")
    print(mc.get_gripper_value())
    # mc.release_all_servos()

if __name__ == "__main__":
# MyCobot280 class initialization requires two parameters:
#   The first is the serial port string, such as:
#       linux: "/dev/ttyUSB0"
#windows: "COM3"
#   The second is the baud rate:
#       M5 version is: 115200
#
#   Example:
#       mycobot-M5:
#           linux:
#              mc = MyCobot280("/dev/ttyUSB0", 115200)
#           windows:
#              mc = MyCobot280("COM3", 115200)

# Initialize a MyCobot280 object
# M5 version
mc = MyCobot280('COM3', 115200)
# Move it to zero position

mc.set_encoders([2048, 2048, 2048, 2048, 2048, 2048], 20)
time.sleep(3)
gripper_test(mc)
```

8 Suction pump control

280-M5

```
from pymycobot import MyCobot280
import time


# The MyCobot280 class requires two parameters to initialize:
#   The first is the serial port string, such as:
#       linux: "/dev/ttyUSB0"
#       windows: "COM3"
#   The second is the baud rate:
#       M5 version: 115200
#
#   Example:
#       mycobot-M5:
#           linux:
#               mc = MyCobot280("/dev/ttyUSB0", 115200)
#           windows:
#               mc = MyCobot280("COM3", 115200)

# Initialize a MyCobot280 object
# The following is the object code for the M5 version
mc = MyCobot280('COM3',115200)
# The position of the robot arm movement
angles = [
[92.9, -10.1, -60, 5.8, -2.02, -37.7],
[92.9, -53.7, -83.05, 50.09, -0.43, -38.75],
[92.9, -10.1, -87.27, 5.8, -2.02, -37.7]
]

# Turn on the suction pump
def pump_on():
    # Open the solenoid valve
    mc.set_basic_output(5, 0)
    time.sleep(0.05)

# Stop the suction pump
def pump_off():
    # Close the solenoid valve
    mc.set_basic_output(5, 1)
    time.sleep(0.05)
    # The exhaust valve starts working
    mc.set_basic_output(2, 0)
    time.sleep(1)
    mc.set_basic_output(2, 1)
    time.sleep(0.05)

# Robot arm recovery
mc.send_angles([0, 0, 0, 0, 0, 0], 30)
time.sleep(3)

# Turn on the suction pump
pump_on()
```

```
mc.send_angles(angles[2], 30)
time.sleep(2)

# Suction small objects
mc.send_angles(angles[1], 30)
time.sleep(2)
mc.send_angles(angles[0], 30)
time.sleep(2)
mc.send_angles(angles[1], 30)
time.sleep(2)
#Turn off the suction pump
pump_off()
mc.send_angles(angles[0], 40)
time.sleep(1.5)
```

Introduction to ROS

ROS is an open source meta-operating system for robots. It provides the services that an operating system should have, including hardware abstraction, low-level device control, implementation of common functions, messaging between processes, and package management. It also provides the tools and library functions needed to obtain, compile, write, and run code across computers.

The "graph" of the ROS runtime is a loosely coupled point-to-point process network based on the ROS communication infrastructure. ROS implements several different communication methods, including services based on synchronous RPC-style communication, topics based on asynchronous streaming data, and parameter servers for data storage.

ROS is not a real-time framework, but ROS can be embedded in real-time programs. Willow Garage's PR2 robot uses a system called pr2_etherCAT to send or receive ROS messages in real time. ROS can also be seamlessly integrated with the Orocos real-time toolkit.

Design goals and features of ROS

Many people ask "What is the difference between ROS and other robotics software platforms?" This is a difficult question to answer. Because ROS is not a framework that integrates most functions or features. In fact, the main goal of ROS is to support code reuse for robotics research and development. ROS is a framework of distributed processes (i.e. nodes) that are packaged in packages and function packages that are easy to share and distribute.

ROS also supports a federated system similar to a code repository, which also enables collaboration and distribution of projects. This design allows the development and implementation of a project to be completely independent of decisions (not limited by ROS) from the file system to the user interface. At the same time, all projects can be integrated with the basic tools of ROS.

In order to support the main goal of sharing and collaboration, the ROS framework has several other characteristics:

- Lean: ROS is designed to be as lean as possible so that code written for ROS can be used with other robotics software frameworks. A corollary to this is that ROS can be easily integrated with other robotics software platforms: ROS has been integrated with OpenRAVE, Orocos and Player.
- ROS-insensitive libraries: The preferred development model of ROS is written in clean library functions that do not depend on ROS.
- Language independence: The ROS framework can be easily implemented in any modern programming language. ROS has implemented Python version, C++ version and Lisp version. It also has Java and Lua version experimental libraries.
- Loose coupling: The function modules in ROS are encapsulated in independent function packages or meta-function packages for easy sharing. The modules in the function package run as nodes and use ROS standard IO as the interface. Developers do not need to pay attention to the internal implementation of the module. As long as they understand the interface rules, they can reuse it, realizing point-to-point loose coupling connection between modules
- Convenient testing: ROS has a built-in unit/integration test framework called rostest, which can easily install or uninstall test modules.
- Scalable: ROS can be applied to large runtime systems and large development processes.
- Free and open source: many developers and many function packages

Why use ROS

Through ROS, we can realize the simulation control of the robot arm in a virtual environment.

We will use the **rviz** platform to realize the visualization of the robot arm and use a variety of methods to operate our robot arm; through the **moveit** platform to plan and execute the robot arm's action path, we can achieve the effect of free control of the robot arm.

In the next chapter, we will learn how to control our products through the platform in ros.

ROS1 Tutorial Guide

Environment Building

ROS1 Basics

rviz Introduction and Use

moveit Introduction and Use

Gazebo Introduction and Use

ROS1 Environment Setup

This tutorial provides two methods for setting up an Ubuntu 20.04 + ROS1 development environment:

- **Method 1: Importing a Virtual Machine Image (Recommended)** → Quickest way to get started, with a complete built-in environment
- **Method 2: Customizing the Installation Environment** → Building from scratch, suitable for users who require flexible customization

Method 1: Importing A Virtual Machine Image

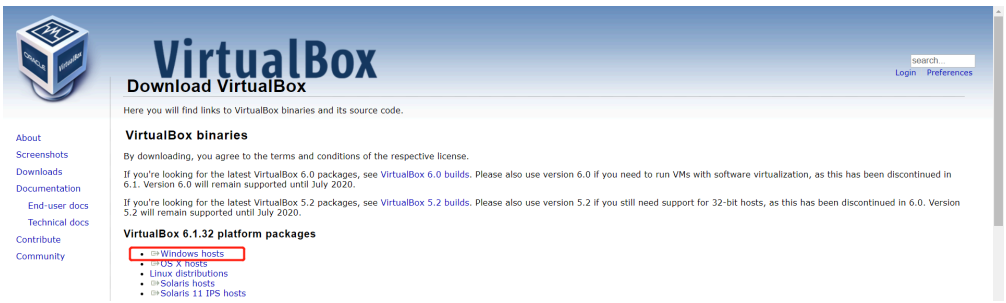
> **Recommended**: This is the quickest method and suitable for beginners. **Note:** To simplify environment setup, we will provide a Linux system image (Ubuntu 20.04), the Virtual Box installation package, and its extensions. The following instructions will show you how to install Virtual Box and import the Linux system image (the default user is `u202`, and the default password is `123`). **Built-in Environment:** ROS1 + Moveit + Git + pymycobot + mycobot_ros

1 Install Virtual Machine

- Go to the official website to download the virtual machine Virtual Box
- VirtualBox installation package: Windows hosts
- VirtualBox expansion package: VirtualBox 7.0.10 Oracle VM VirtualBox Extension Pack
- For instructions on installing VirtualBox extension packs, please refer to: Extension Pack Installation Tutorial

Of course, if you already have your virtual machine, you can skip this step.

We chose to download Virtual box because it is free.

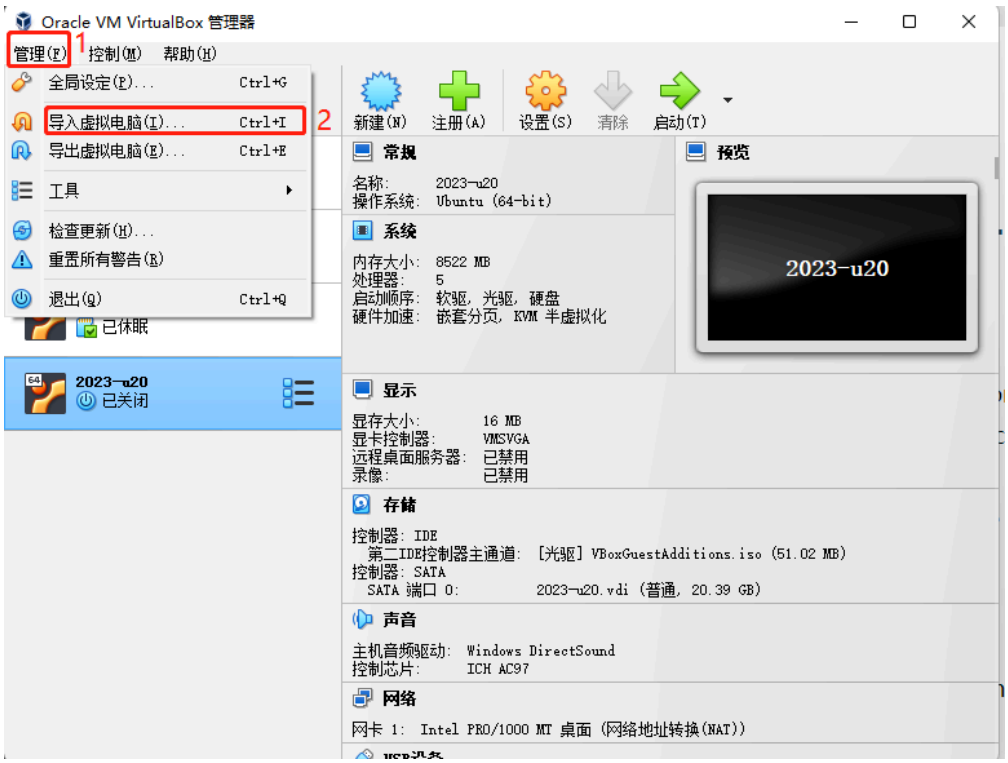


2 Download Linux system image

Click to download: Linux ubuntu20.04

3 Import Linux system image

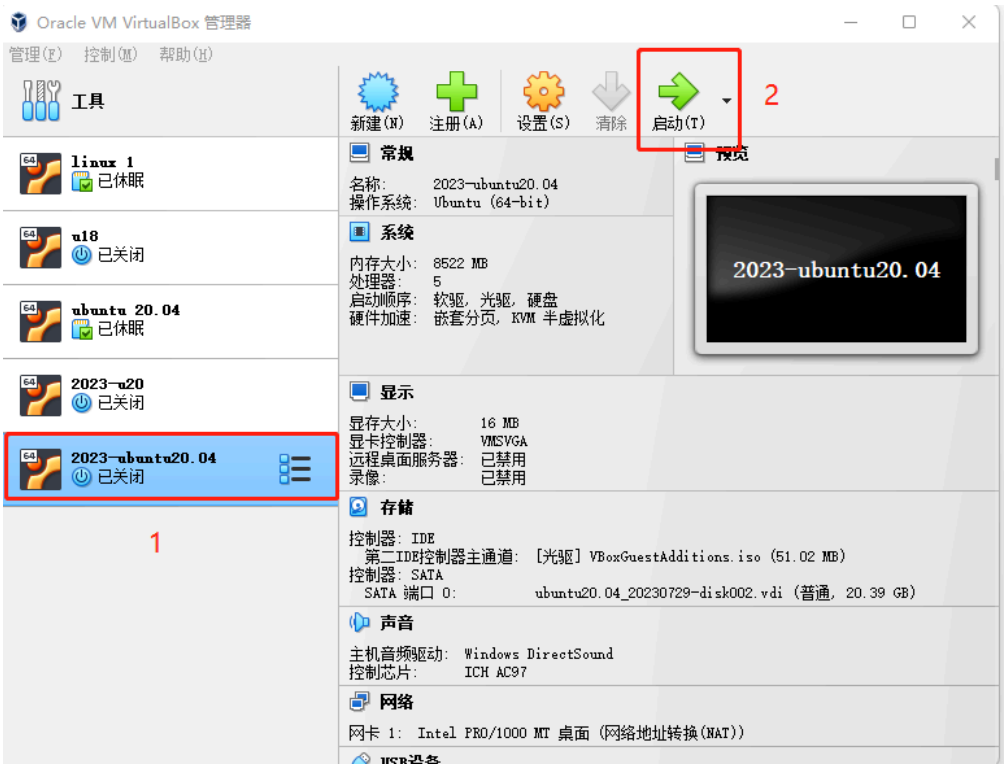
In the Virtual Box interface, click Management -> Import Virtual Computer -> Select Virtual Image -> Select the installation path and import it, and then install it as follows.




导入虚拟电脑
要导入的虚拟电脑
请选择导入源。可以选择一个本地的文件系统导入OVF包，也可以选择从云服务导入。
来源(S)：
本地文件系统
选择文件导入虚拟电脑。VirtualBox 当前支持导入以开放式虚拟化格式 (OVF) 保存的虚拟电脑。
若要继续，请在下面选择要导入的文件。
文件(F)：
帮助(H)
专家模式(E)
返回(B)
下一步(N)
取消(C)


导入虚拟电脑
要导入的虚拟电脑
请选择导入源。可以选择一个本地的文件系统导入OVF包，也可以选择从云服务导入。
来源(S)：
本地文件系统
选择文件导入虚拟电脑。VirtualBox 当前支持导入以开放式虚拟化格式 (OVF) 保存的虚拟电脑。
若要继续，请在下面选择要导入的文件。
文件(F)：
D:\ROS2\VirtualBox\ubuntu20.04_ROS1_V20230731.ova
帮助(H)
专家模式(E)
返回(B)
下一步(N)
取消(C)

Just wait for the image to be imported. The installation is successful as shown below.



Then start the system, the user name is **u202**, the default password is **123**

4 Update Pymycobot

To use the latest robotics driver library, open a terminal and execute the following command:

```
pip3 install pymycobot --upgrade
```

5 Update Mycobot_ros

To ensure users have the latest official packages, navigate to the /home/u202/catkin_ws/src folder through a file manager, open a console terminal (shortcut Ctrl+Alt+T), and enter the following command to update:

```
# Clone the code from GitHub
cd ~/catkin_ws/src
# Delete the original mycobot_ros package
sudo rm -rf mycobot_ros

git clone --depth 1 https://github.com/elephantrobotics/mycobot_ros.git
cd .. # Return to the workspace
catkin_make # Build the code in the workspace
source devel/setup.bash # Add environment variables
```

Method 2: Customize The Installation Environment

1 Virtual Machine Installation

- Go to the official website to download the virtual machine Virtual Box
- VirtualBox installation package: Windows hosts
- VirtualBox expansion package: VirtualBox 7.0.10 Oracle VM VirtualBox Extension Pack
- For instructions on installing VirtualBox extension packs, please refer to: Extension Pack Installation Tutorial

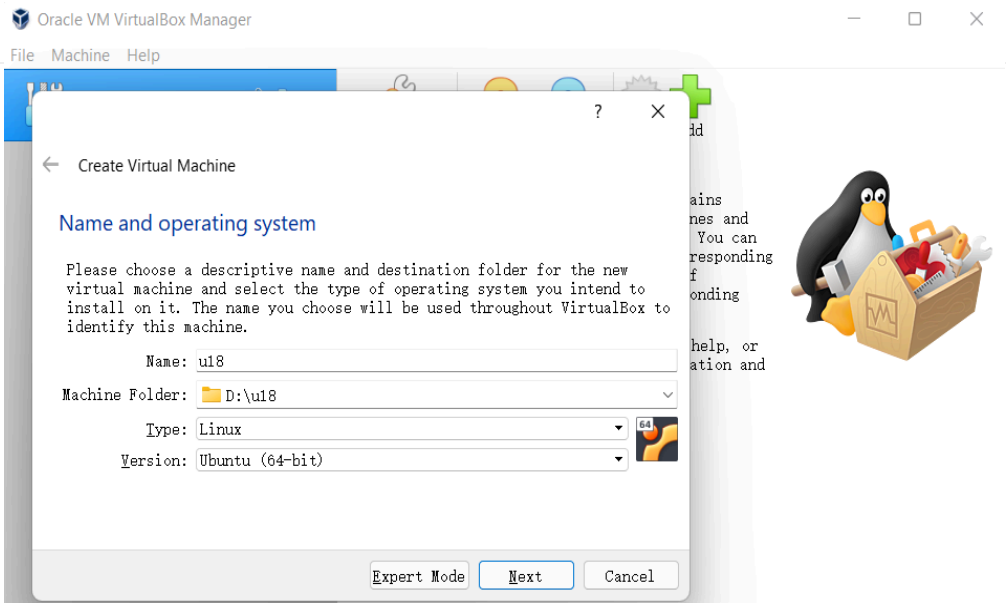
Of course, if you already have your virtual machine, you can skip this step.

We chose to download Virtual box because it is free.

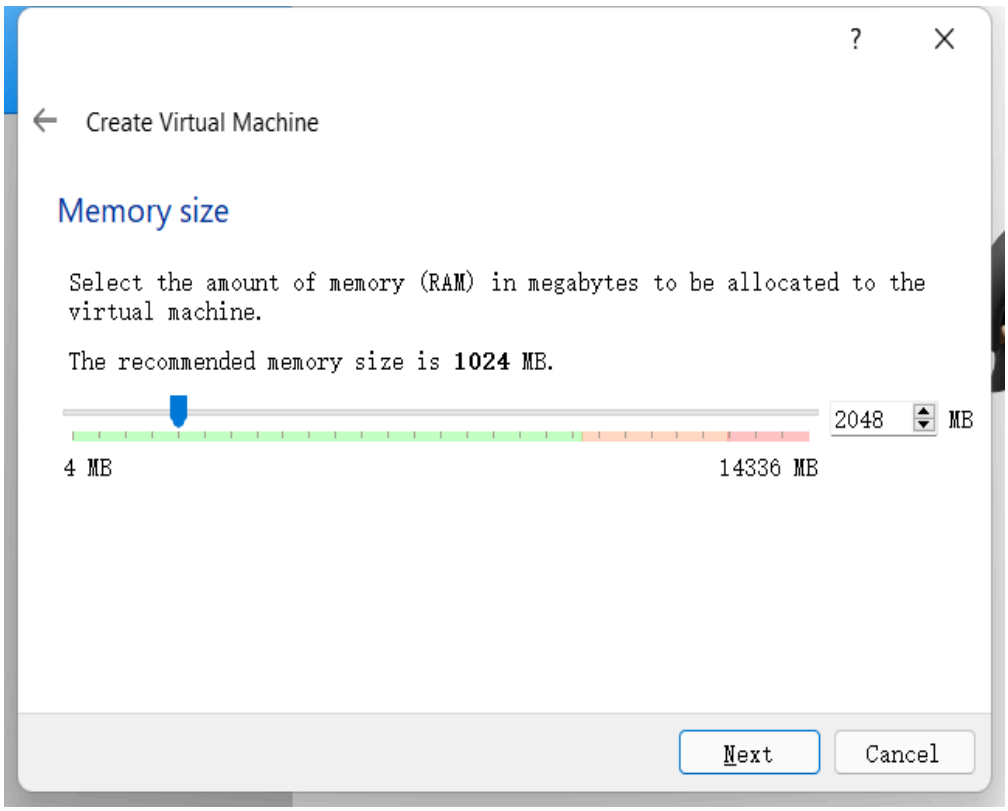
2 Create A Virtual Machine

- **Select New in the control**

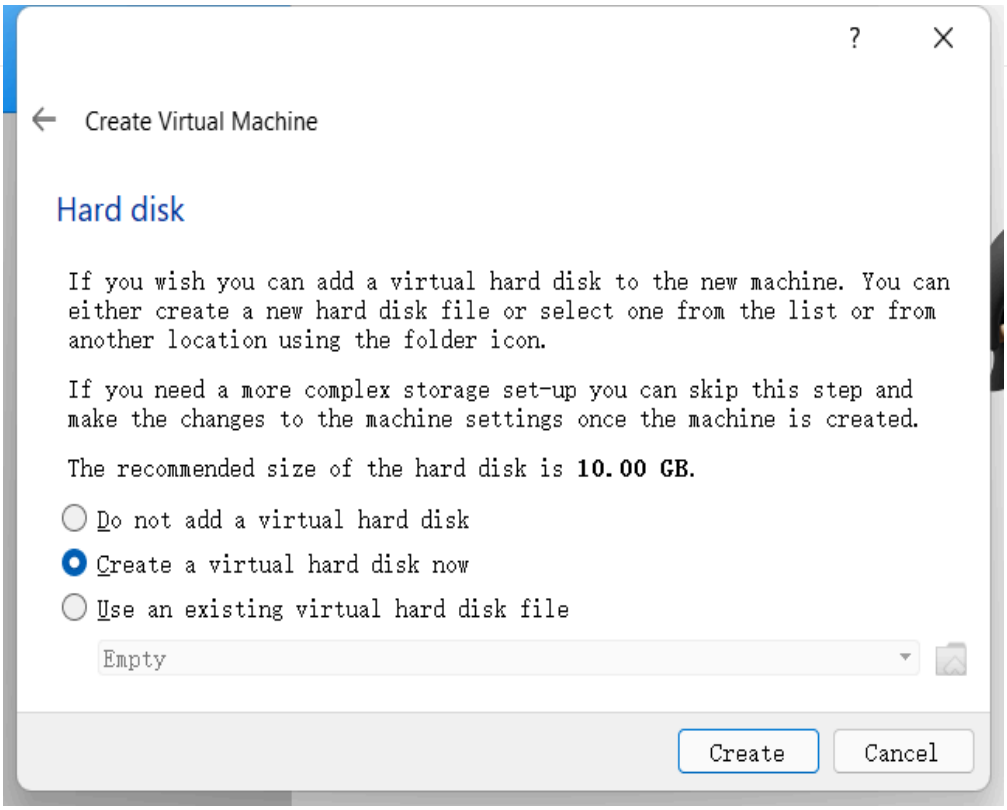
Enter the virtual machine name and the location where the virtual machine is stored, select the virtual machine type as **Linux**, select Ubuntu 64-bit version, and proceed to the next step.



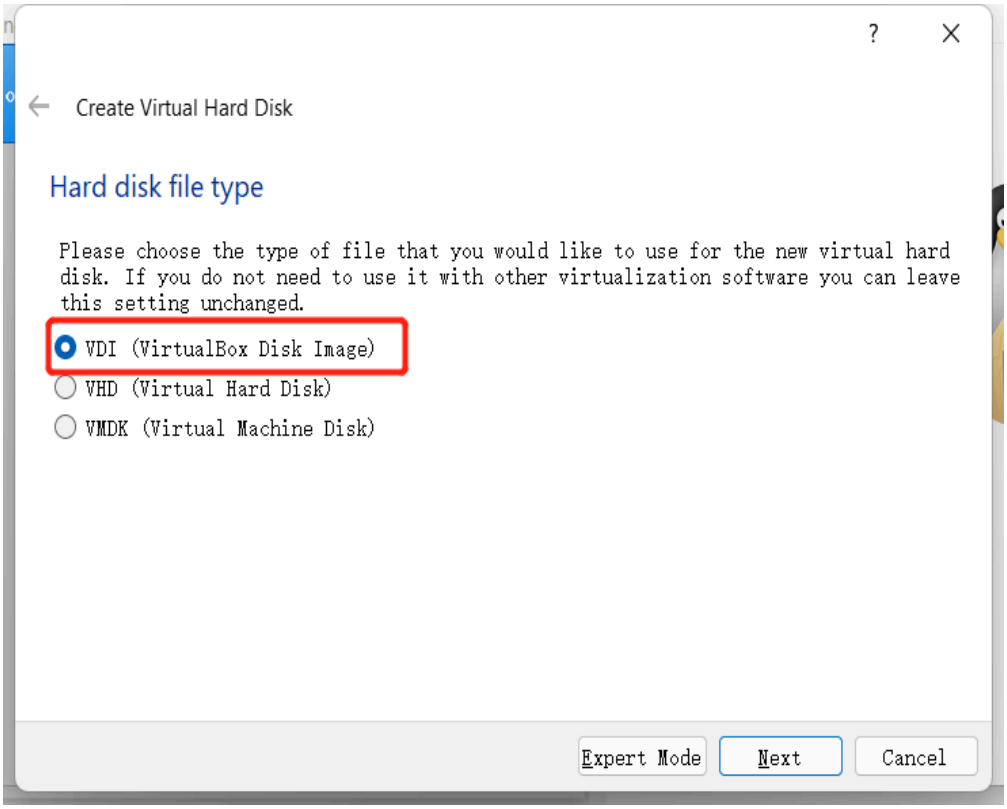
Configure the memory size according to your needs and proceed to the next step.



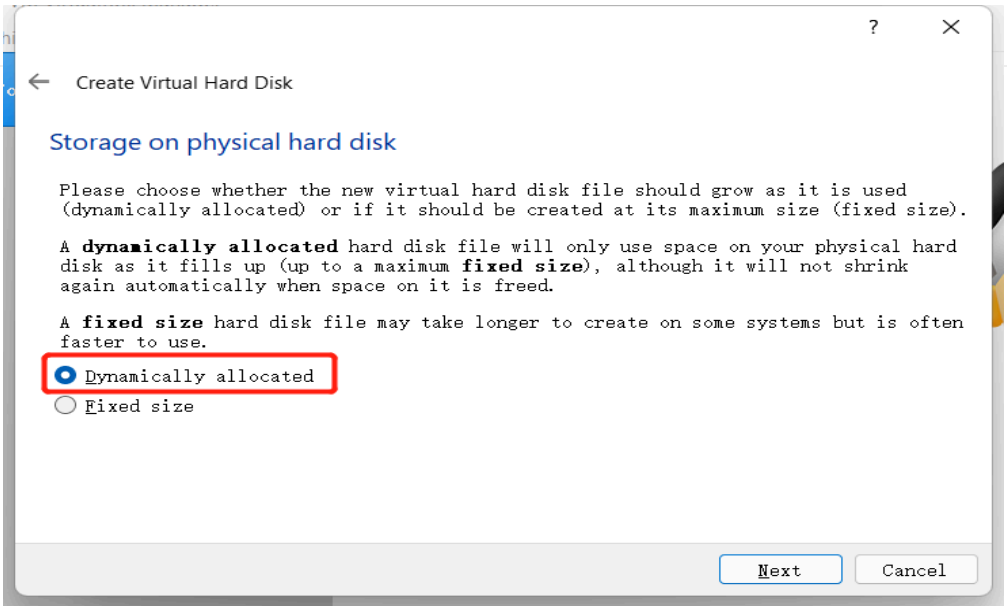
Select **Create a virtual hard disk now** and create it.

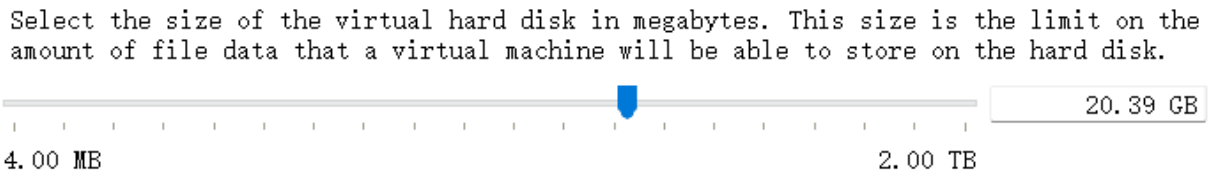


Select the **VDI** type for the virtual hard disk type and proceed to the next step.



Allocate the size of the virtual hard disk. Since you need to install the Ubuntu system and will also operate in the system, it is recommended that the size should not be less than 20G.



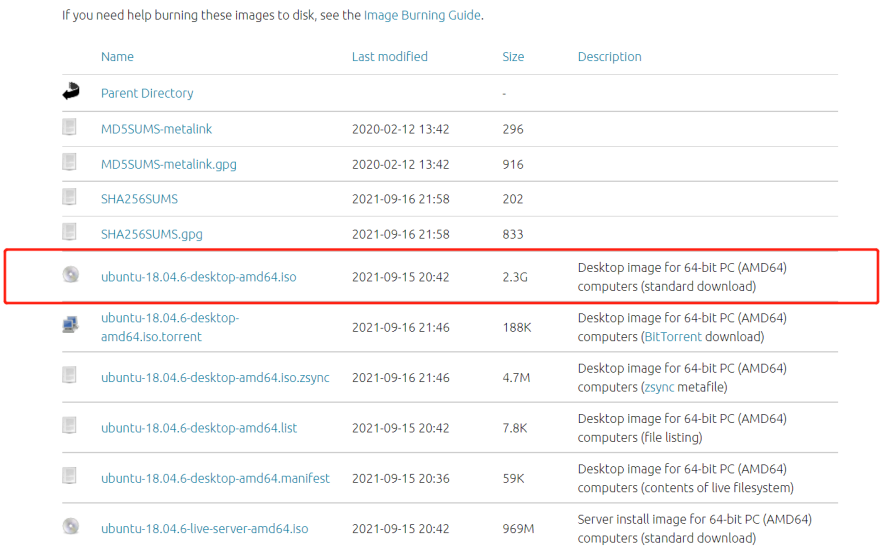


3 Download Ubuntu system

Please choose the Ubuntu version to install according to your needs, the default version is Ubuntu 20.04.

- 20.04 version

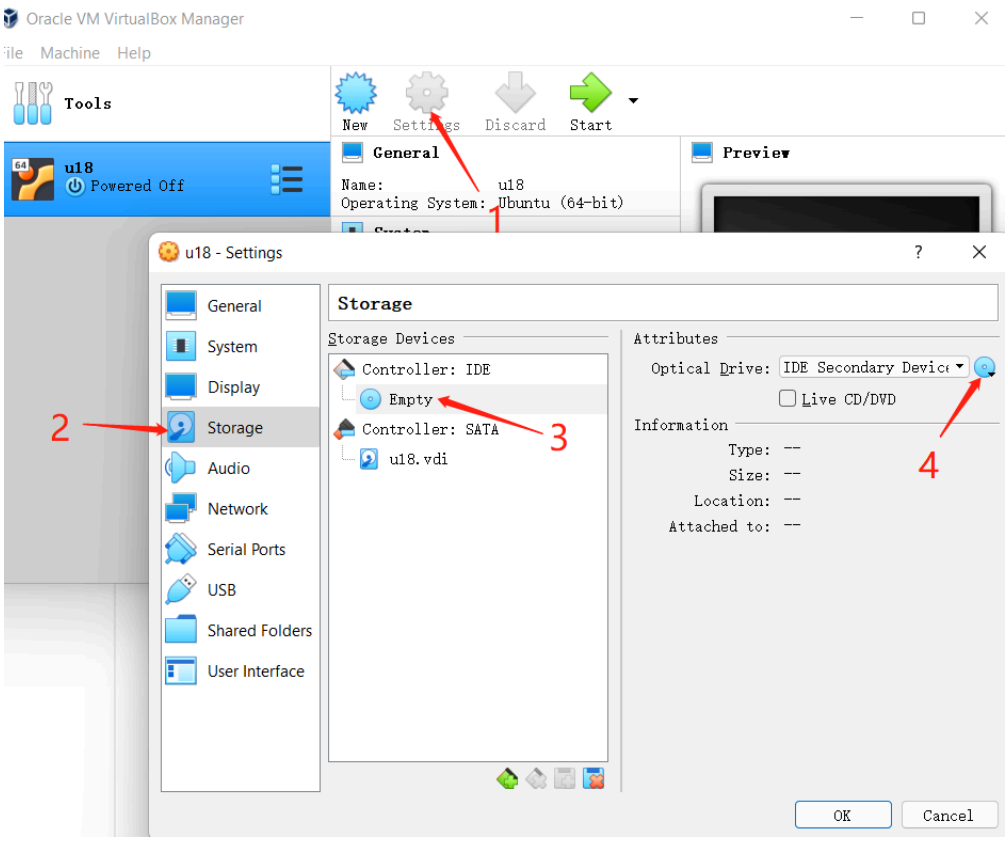
The installation method and process of each version are the same. Here we use the 18.04 version as an example.

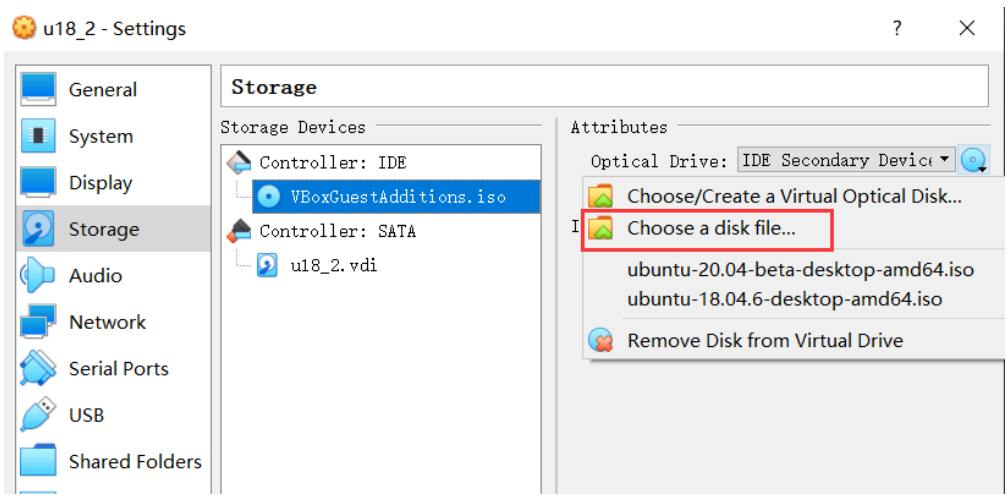


After downloading, there is a file as shown in the figure:

4 Import Ubuntu into the virtual machine

Find the previously installed virtual machine in Virtual Box, enter **Settings**, and assign the CD to the controller in **Storage**:



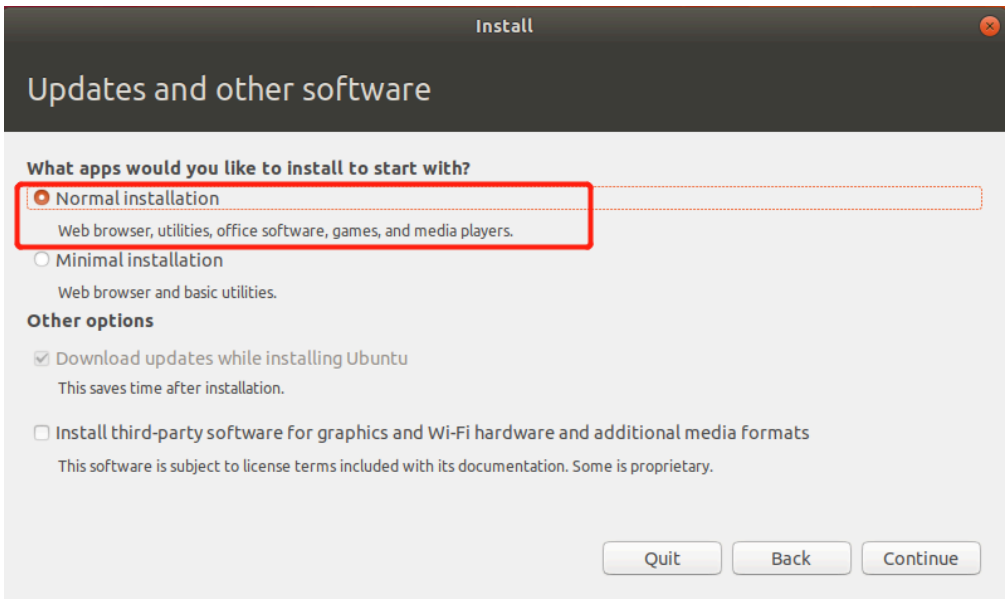


Then open the virtual machine to install Ubuntu and click Start.

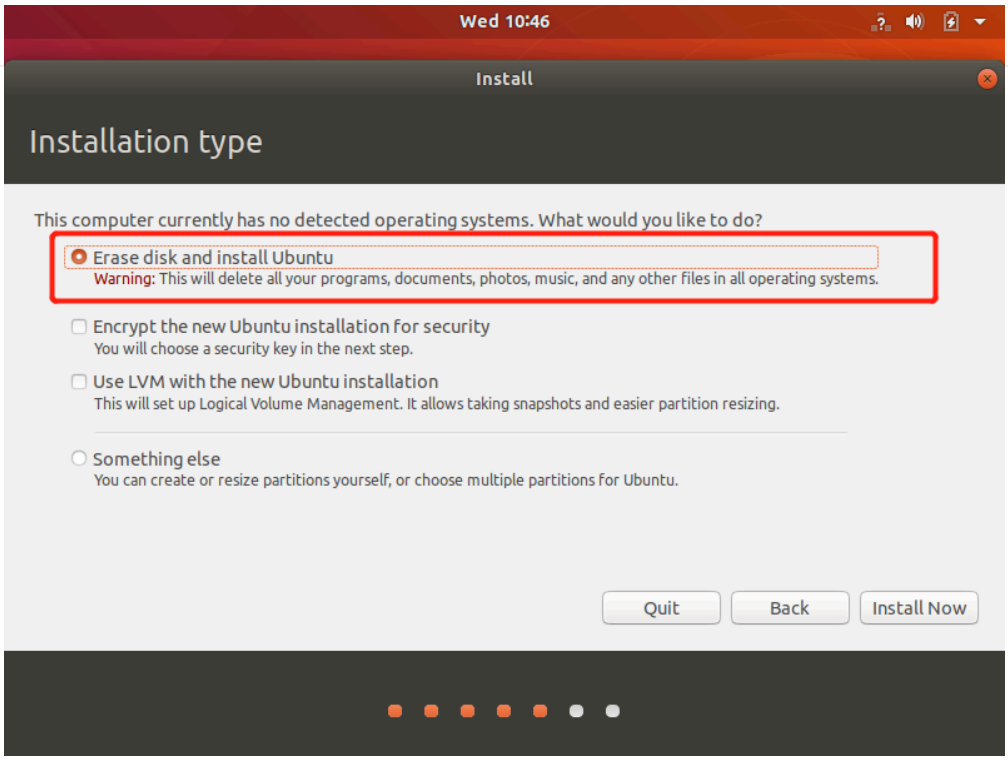
5 Ubuntu Installation

Wait for the system to start, enter the **Welcome** interface, select "English", and click the "Install Ubuntu" button;

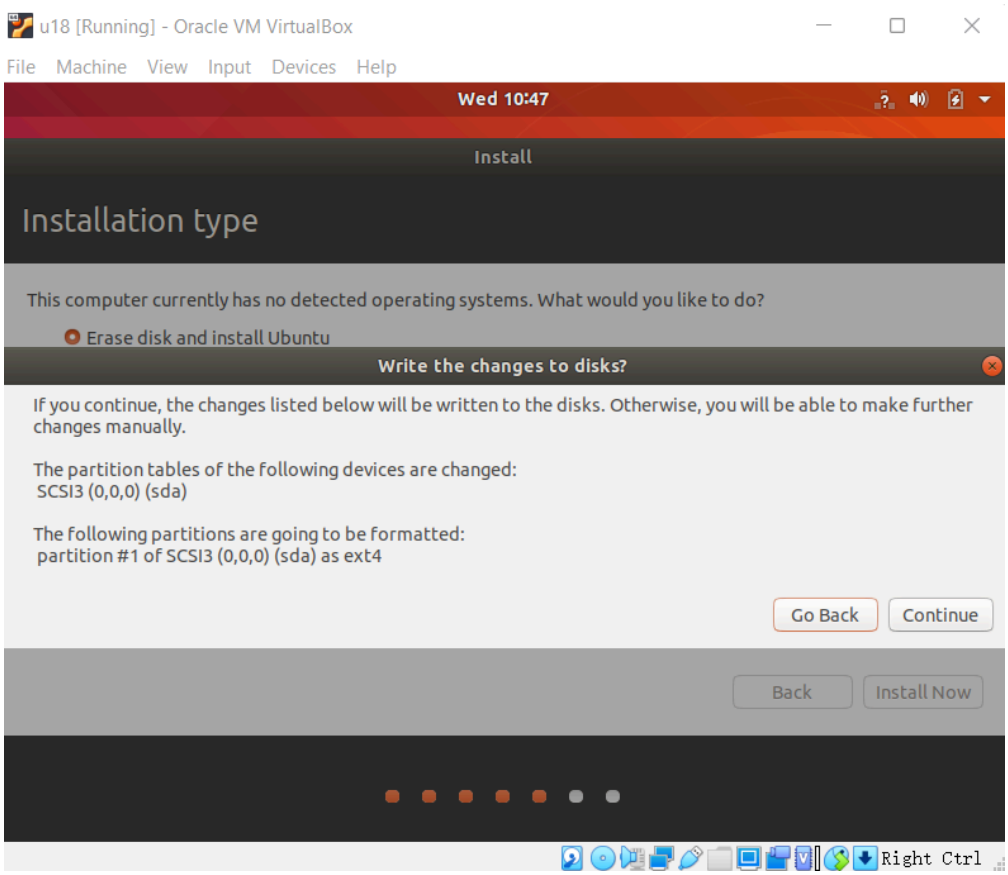
Click the "Continue" button;



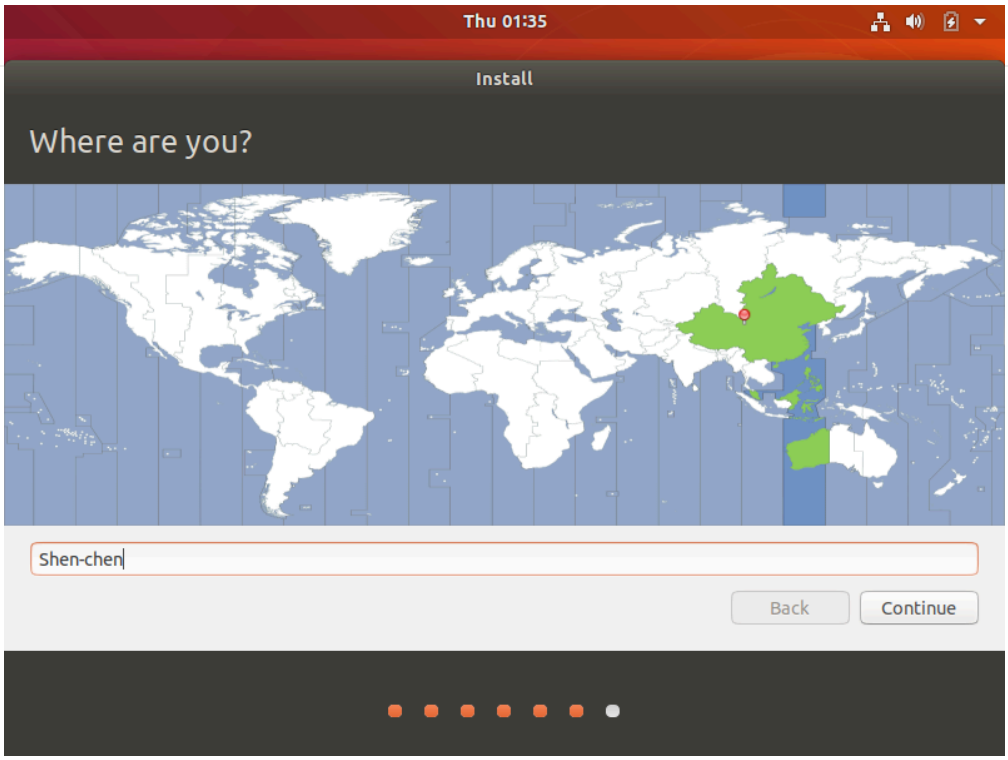
Select the "Erase the entire disk and install Ubuntu" option, and click the "Install Now" button;



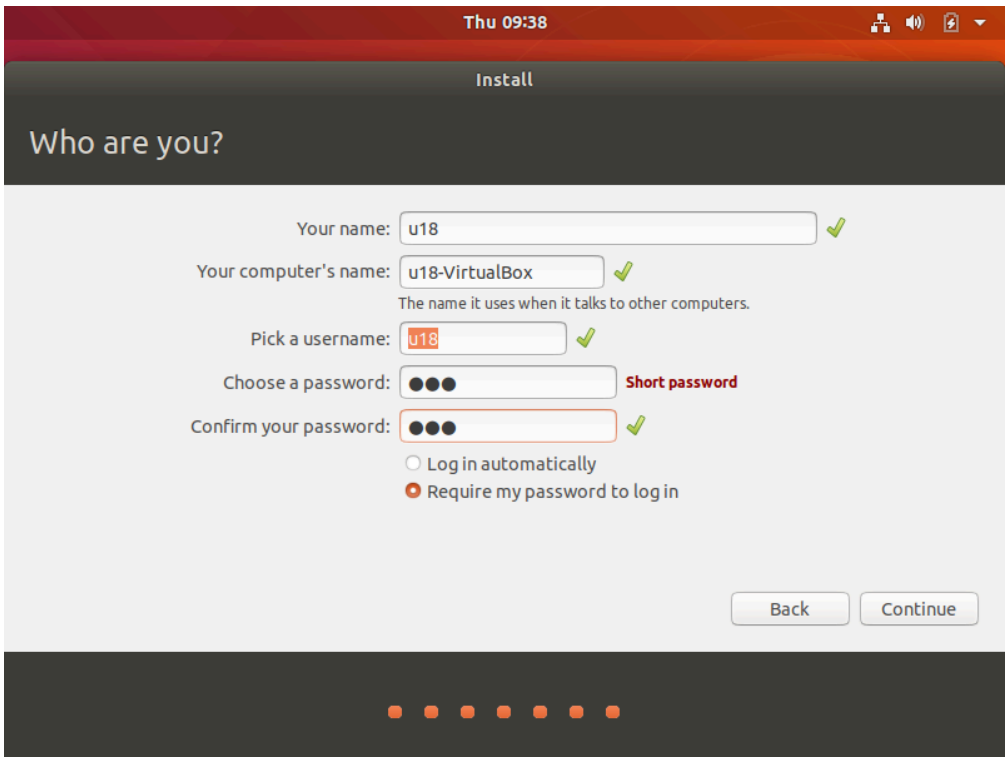
Click the "Continue" button in the pop-up dialog box;



Set the geographic location and click the "Continue" button;

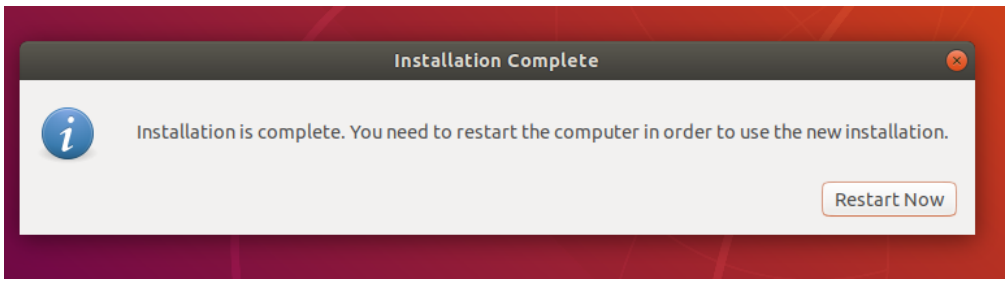


Set the user name and password and click the "Continue" button;



Enter the system installation interface, please wait patiently;

After the installation is complete, in the pop-up dialog box, click the "Restart Now" button to complete the installation.



6 ROS Installation

The basic development environment setup requires the installation of the robot operating system ROS, MoveIt, and git version manager. The following describes their installation methods and processes.

For **myCobot 280-M5** and **myCobot 320-M5** devices, please refer to the installation methods and processes described below.

Here we choose Ubuntu 20.04, and the corresponding ROS version is ROS Melodic

> NOTE: We currently do not provide any reference for installing ROS on Windows. If necessary, please refer to https://wiki.ros.org/Installation

6.1 Start Installation

1 Add source

There is no ROS software source in the software source list of Ubuntu itself, so you need to **configure the ROS software source to the software list warehouse** before you can download ROS. Open a console terminal (shortcut key `Ctrl+Alt+T`), enter the following command:

- Official source:

```
sudo sh -c 'echo "deb http://packages.ros.org/ros/ubuntu $(lsb_release -sc) main" > /etc/apt/sources.list.d/ros-latest.lis
```

- If the download speed is slow, it is recommended to select a mirror source nearby to replace the above command. For example, Tsinghua University is:

```
sudo sh -c '. /etc/lsb-release && echo "deb http://mirrors.tuna.tsinghua.edu.cn/ros/ubuntu/ `lsb_release -cs` main" > /etc
```

You will be asked to enter the user password here. Just enter the user password you set when installing Ubuntu.

2 Set up the secret key

Configure the public network secret key. This step is to let the system confirm that our path is safe, so that there is no problem downloading the file, otherwise it will be deleted immediately after downloading:

```
sudo apt-key adv --keyserver 'hkp://keyserver.ubuntu.com:80' --recv-key C1CF6E31E6BADE8868B172B4F42ED6FBAB17C654
```

The execution results are shown below:：

```
u18@u18-VirtualBox:~$ sudo apt-key adv --keyserver 'hkp://keyserver.ubuntu.com:
80' --recv-key C1CF6E31E6BADE8868B172B4F42ED6FBAB17C654
Executing: /tmp/apt-key-gpghome.ncwvc7DwDj/gpg.1.sh --keyserver hkp://keyserver
.ubuntu.com:80 --recv-key C1CF6E31E6BADE8868B172B4F42ED6FBAB17C654
gpg: key F42ED6FBAB17C654: public key "Open Robotics <info@osrfoundation.org>"
imported
gpg: Total number processed: 1
gpg:               imported: 1
u18@u18-VirtualBox:~$
```

3 Installation

After adding a new software source, you need to **update the software source list**, open a console terminal (shortcut key `Ctrl+Alt+T`), and enter the following command:

```
sudo apt-get update
```

Execute **Install ROS**, open a console terminal (shortcut key `Ctrl+Alt+T`), and enter the following command according to your Ubuntu version:

```
# Ubuntu 20.04
sudo apt install ros-noetic-desktop-full
```

It is recommended to install the complete ROS to prevent missing libraries and dependencies.

The installation process takes a long time, please be patient.

- If the following error message appears in the console terminal during the installation, you need to change the software source list in /etc/apt/sources.list.

```
Fetched 523 MB in 2min 34s (3,401 kB/s)
E: Failed to fetch http://us.archive.ubuntu.com/ubuntu/pool/universe/w/wxwidgets
3.0/libwxbase3.0-0v5_3.0.4+dfsg-3_amd64.deb  Undetermined Error [IP: 91.189.91.3
9 80]
```

- Open a console terminal (shortcut key `Ctrl+Alt+T`), and enter the following command:

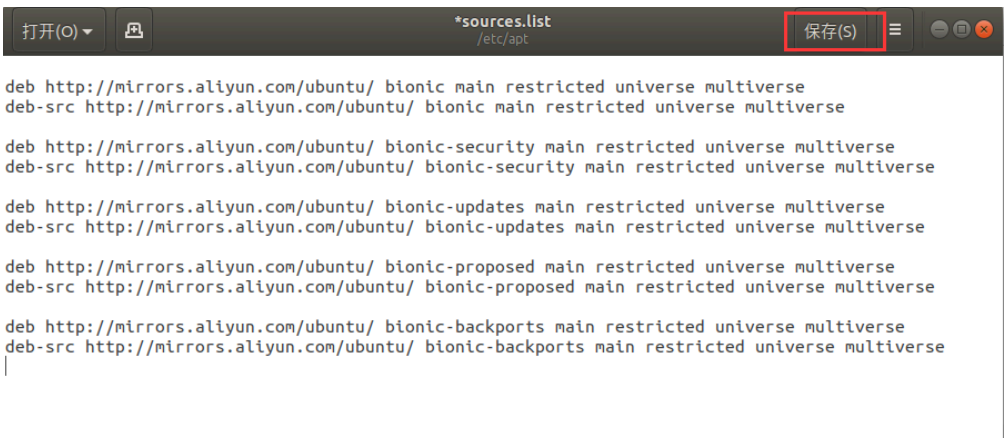
```
sudo gedit /etc/apt/sources.list
```

- Replace all official software sources in sources.list with the following Alibaba Cloud software sources:

Ubuntu 20.04：

```
deb http://mirrors.aliyun.com/ubuntu/ focal main restricted universe multiverse
deb-src http://mirrors.aliyun.com/ubuntu/ focal main restricted universe multiverse

deb http://mirrors.aliyun.com/ubuntu/ focal-security main restricted universe multiverse
deb-src http://mirrors.aliyun.com/ubuntu/ focal-security main restricted universe multiverse

deb http://mirrors.aliyun.com/ubuntu/ focal-updates main restricted universe multiverse
deb-src http://mirrors.aliyun.com/ubuntu/ focal-updates main restricted universe multiverse

deb http://mirrors.aliyun.com/ubuntu/ focal-proposed main restricted universe multiverse
deb-src http://mirrors.aliyun.com/ubuntu/ focal-proposed main restricted universe multiverse

deb http://mirrors.aliyun.com/ubuntu/ focal-backports main restricted universe multiverse
deb-src http://mirrors.aliyun.com/ubuntu/ focal-backports main restricted universe multiverse
```

- After the configuration is complete, the contents of the sources.list file are as follows. Click Save and Exit.



- Update the software source list and enter in the console terminal:

```
sudo apt-get update
```

- Enter the command to install ROS in the console terminal:

```
# Ubuntu 20.04
sudo apt install ros-noetic-desktop-full
```

The installation process takes a long time, please wait patiently.

4 Configure ROS environment to the system

rosdep allows you to easily install the source code you want to compile or the system dependencies required by some ROS core components. Execute the following commands in the terminal in sequence to open a console terminal (shortcut key `Ctrl+Alt+T`).

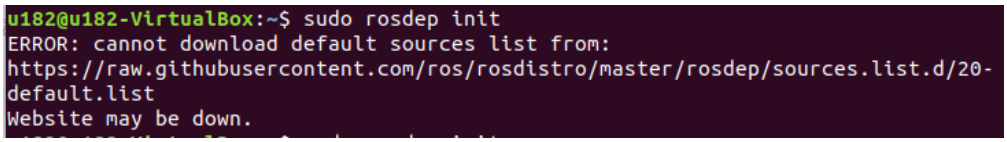
If rosdep is not installed on your system, please use the command `sudo apt install python-rosdep` to install it.

If your installed Ubuntu system is version 20.04, please use the command `sudo apt install python3-rosdep` to install it, and execute the rosdep initialization command after completion.

Initialize rosdep:

```
sudo rosdep init
```

If the error message shown below appears:



Solution: Modify the hosts file and enter the following command in the console terminal:

```
sudo gedit /etc/hosts
```

At the end of the file content, add the IP addresses of the following two websites to access:

```
199.232.28.133 raw.githubusercontent.com

151.101.228.133 raw.github.com
```

After the modification is completed, execute in the console terminal:

```
sudo rosdep init
```

```
rosdep update
```

After initialization is completed, in order to avoid the need to re-validate the ROS function path every time the terminal window is closed, we can **configure the path to the environment variable**, so that the ROS function path can be automatically validated every time a new terminal is opened. Execute the following commands in the terminal in sequence to open a console terminal (shortcut key `Ctrl+Alt+T`):

6.2 Set Up The Ros Environment

Execute the following command:

```
# Ubuntu 20.04
echo "source /opt/ros/noetic/setup.bash" >> ~/.bashrc
```

```
source ~/.bashrc
```

6.3 Install ROS Additional Dependencies

Enter the following command in the terminal to install ROS additional dependencies and open a console terminal (shortcut key `Ctrl+Alt+T`):

```
sudo apt-get install python-rosinstall python-rosinstall-generator python-wstool build-essential
```

If your Unbutu system is version 20.04, please execute the following command to install it:

```
sudo apt install python3-rosdep python3-rosinstall python3-rosinstall-generator python3-wstool build-essential
```

```
# Ubuntu 20.04
sudo apt install ros-noetic-joint-state-publisher-gui
```

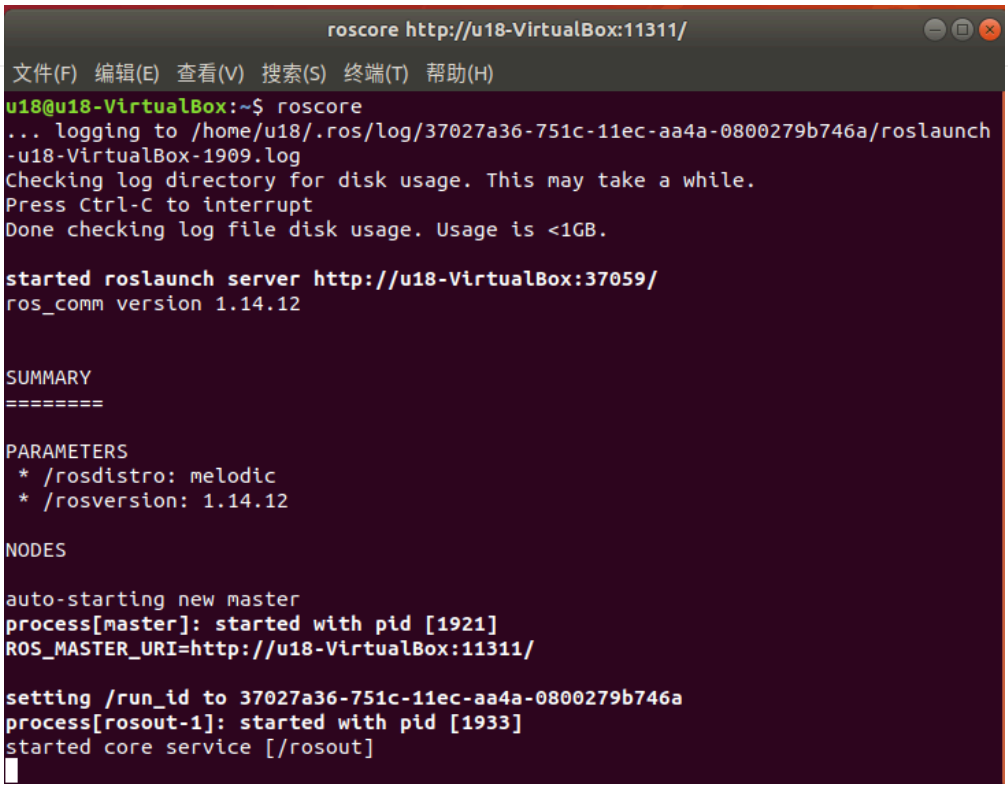
6.4 Verify The Installation

The startup of the ROS system requires a ROS Master, i.e., a node manager. We can start the ROS Master by entering the roscore command in the terminal.

To verify whether ROS is successfully installed, open a console terminal (shortcut key `Ctrl+Alt+T`), and execute the following command in the terminal:

```
roscore
```

When the following interface is displayed, it means that ROS is installed successfully



The roscore command starts a node manager, which is used for node management. In a ros system, there is only one node manager, which is the prerequisite for the operation of the ros node. Therefore, before starting the ros node, the first step is to execute roscore.

_For more detailed installation instructions, please refer to the official installation guide at:
http://wiki.ros.org/ROS/Installation

7 MoveIt Installation

MoveIt is a functional package of a series of mobile operations in ROS, mainly including motion planning, collision detection, kinematics, 3D perception, operation control and other functions.

7.1 Update The Software Source List

Open a console terminal (shortcut key `Ctrl+Alt+T`), and enter the following command in the terminal window to **update the software source list**:

```
sudo apt-get update
```

7.2 Install MoveIt

Open a console terminal (shortcut key `Ctrl+Alt+T`), enter the following command in the terminal window to execute **MoveIt installation**:

```
# Ubuntu20.04
sudo apt-get install ros-noetic-moveit
```

8 Git Installation

8.1 Add Software Source

Add the software source installed by git to the software source list of Ubuntu, open a console terminal (shortcut key `Ctrl+Alt+T`), and enter the following command in the terminal window:

```
sudo add-apt-repository ppa:git-core/ppa
```

8.2 Update The Software Source List

Open a console terminal (shortcut key `Ctrl+Alt+T`), and enter the following command in the terminal window to **update the software source list**:

```
sudo apt-get update
```

8.3 Install Git

Open a console terminal (shortcut key `Ctrl+Alt+T`), enter the following command in the terminal window, **execute git installation**:

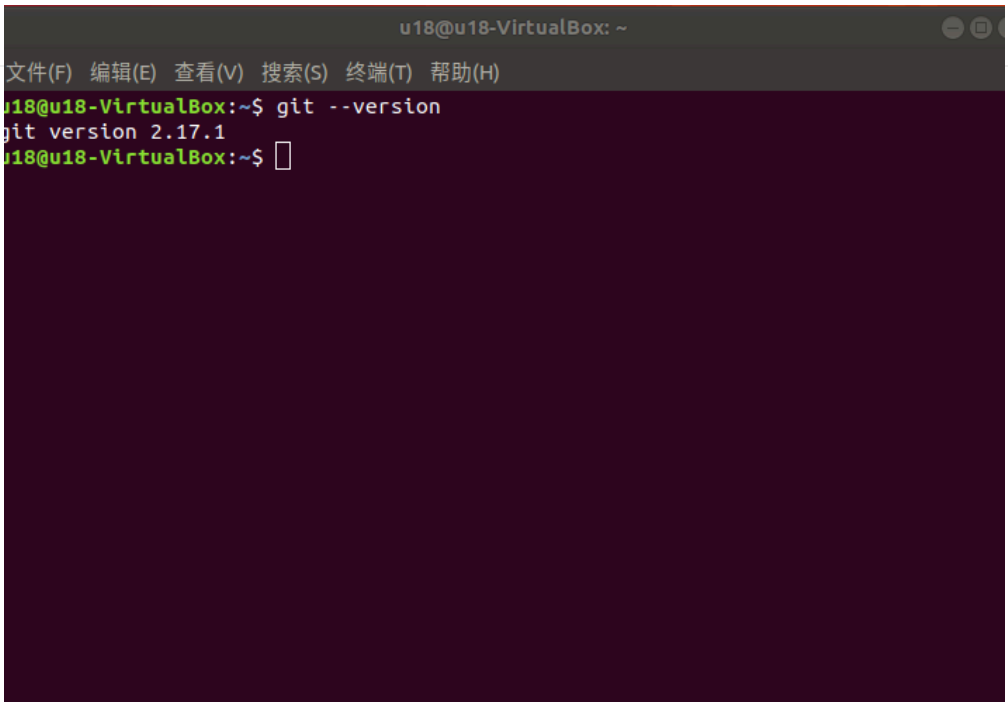
```
sudo apt-get install git
```

8.4 Verify Installation

Read the git version, open a console terminal (shortcut key `Ctrl+Alt+T`), and enter the following command in the terminal window:

```
git --version
```

The git version number can be displayed in the terminal, as shown below, indicating a successful installation



8.5 Usage

You will need to use git to download the ros package later. For details on how to use git, please refer to the following link:

- https://git-scm.com/book/zh/v2
- https://www.runoob.com/git/git-tutorial.html

9 mycobot_ros Installation

`mycobot_ros` is a ROS package launched by ElephantRobotics, which is compatible with its desktop six-axis robot arm mycobot series.

项目地址：http://github.com/elephantrobotics/mycobot_ros

9.1 Prerequisites

Before installing the package, please ensure that you have a ros workspace.

Here we give a sample command for creating a workspace, the default is `catkin_ws`, open a console terminal (shortcut key `Ctrl+Alt+T`), and enter the following command in the command line:

```
mkdir -p ~/catkin_ws/src # Create a folder
cd ~/catkin_ws/src # Enter the folder
catkin_init_workspace # Initialize the current directory as a ROS workspace
cd .. # Return to the parent directory
catkin_make # Build the code in the workspace.
```

Add workspace environment:

The official default ROS1 workspace is `catkin_ws`.

```
# Ubuntu 20.04
echo "source ~/catkin_ws/devel/setup.bash" >> ~/.bashrc
```

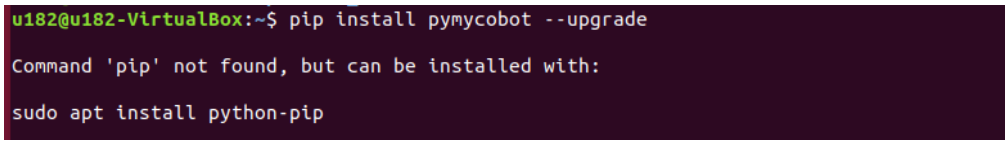
```
source ~/.bashrc
```

9.2 Installation

NOTE:

- This package depends on ROS and MoveIT. Please make sure that ROS and MoveIT are installed successfully before use.
- The interaction between this package and the real robot arm depends on PythonApi - `pymycobot`
- The Api project is: https://github.com/elephantrobotics/pymycobot
- Quick installation: `pip install pymycobot --upgrade`

When executing the pip install pymycobot --upgrade command, if the following error message appears:



Enter the following command to install pip according to the prompt

```
sudo apt install python-pip
```

- If your Ubuntu system is version 20.04, please execute the command `sudo apt install python3-pip` to install pip After pip is installed, execute it again in the terminal

```
pip install pymycobot --upgrade
```

- The installation method depends on Git, please make sure Git is installed on your computer.

The official default ROS1 workspace is `catkin_ws` .

```
cd ~/catkin_ws/src # Enter the src folder of the workspace
git clone https://github.com/elephantrobotics/mycobot_ros.git # Clone the code on github
cd .. # Return to the workspace
catkin_make # Build the code in the workspace
cd ..
source devel/setup.bash # Add environment variables
```

The ROS1 environment has been set up. For the use of ROS1, please refer to Rviz Introduction and Use.

Service and Topic

Service

> Note: myCobot Pro 600 and myCobot Pro 630 devices do not support Service usage.

Service is a request-response communication mechanism. One node can provide a service, and another node can request the service and wait for a response. Services are usually used to perform time-consuming operations or tasks that require interaction, such as performing calculations and obtaining data.

Related commands and instructions:

Command	Detailed description
rosservice list	Display active service information
rosservice info [service name]	Display information of a specified service
rosservice type [service name]	Display service type
rosservice find [service type]	Find services of a specified service type
rosservice uri [service name]	Display ROSRPC URI services
rosservice args [service name]	Display service parameters
rosservice call [service name] [parameters]	Request services with input parameters

Topic

Topic is a communication mechanism in publish-subscribe mode. Nodes can publish messages to a topic or subscribe to a topic to receive messages. Multiple nodes can publish and subscribe to the same topic at the same time to broadcast and receive information. Topic is mainly used for data transmission with low real-time requirements, such as sensor data, status information, etc.

Related commands and instructions:

Command	Detailed description
rostopic list	Display the active topic directory
rostopic echo [topic name]	Display the message content of the specified topic in real time
rostopic find [type name]	Display topics using the specified type of message
rostopic type [topic name]	Display the message type of the specified topic
rostopic bw [topic name]	Display the message bandwidth of the specified topic
rostopic hz [topic name]	Display the message data publishing cycle of the specified topic
rostopic info [topic name]	Display the information of the specified topic
rostopic pub [topic name] [message type] [parameters]	Publish a message with the specified topic name

Difference between service and topic:

	topic	service
Synchronicity	Asynchronous	Synchronous
Communication model	Publish/Subscribe	Request/Response
Underlying protocol	ROSTCP/ROSUDP	ROS service protocol RPC
Feedback mechanism	No	Yes
Buffer	Yes	No
Real-time	Weak	Strong
Node relationship	Many-to-many	One-to-many
Applicable scenarios	Data transmission	Logical processing

You can go to service and topic to learn more about the use of these two functions

Introduction to msg and srv

- msg: msg files are simple text files that describe the fields of ROS messages. They are used to generate source code for messages in different languages (c++ or python, etc.).
- srv: srv files are used to describe services. It consists of two parts: request and response. msg files are stored in the msg directory of the package, while srv files are stored in the srv directory.

rosmsg

rosmsg is a command-line tool for displaying information about ROS message types.

rosmsg demo:

```
rosmsg show # Display message description
rosmsg info # Display message information
rosmsg list # List all messages
rosmsg md5 # Display md5 encrypted messages
rosmsg package # Display all messages under a certain function package
rosmsg packages # List function packages containing messages
```

- rosmsg list Will list all msg in the current ROS
- rosmsg packages List all packages containing messages
- rosmsg package List all msg under a certain package

```
//rosmsg package # Package name
rosmsg package turtlesim
```

- rosmsg show Display message description

```
//rosmsg show # Message name
rosmsg show turtlesim/Pose
# Result:
float32 x
float32 y
float32 theta
float32 linear_velocity
float32 angular_velocity
```

- rosmsg info Same as rosmsg show
- rosmsg md5 A verification algorithm to ensure the consistency of data transmission

rossrv

rossrv is a command line tool used to display information about ROS service types, and its syntax is highly similar to rosmsg.

```
rossrv show # Display service message details
rossrv info # Display service message related information
rossrv list # List all service information
rossrv md5 # Display md5 encrypted service message
rossrv package # Display all service messages under a certain package
rossrv packages # Display all packages containing service messages
```

- rossrv list Will list all srv messages in the current ROS
- rossrv packages List all packages containing service messages
- rossrv package List all msg under a certain package

```
//rossrv package # Package name
rossrv package turtlesim
```

- rossrv show Display message description

```
//rossrv show # Message name
rossrv show turtlesim/Spawn
# Result:
float32 x
float32 y
float32 theta
string name
---
string name
```

- rossrv info The same function as rossrv show
- rossrv md5 Use md5 verification (encryption) for service data

Introduction to URDF

- Unified Robot Description Format, abbreviated as URDF. The urdf function package in ROS contains a C++ parser for URDF. The URDF file uses XML format to describe the robot model.
- URDF cannot be used alone and needs to be combined with Rviz or Gazebo. URDF is just a file that needs to be rendered into a graphical robot model in Rviz or Gazebo.

urdf file description

Code example:

Here only part of the code is intercepted for display:

```
<?xml version="1.0"?>
<robot  xmlns:xacro="http://www.ros.org/wiki/xacro" name="mycobot_ai_with" >

  <xacro:property name="width" value=".2" />

  <link name="env">
  <inertial>
    <origin xyz="0 0 0" rpy="0 0 0"/>
      <mass value="10"/>
      <inertia
        ixx="1.0" ixy="0.0" ixz="0.0"
        iyy="1.0" iyz="0.0"
        izz="1.0"/>
  </inertial>
    <visual>
      <geometry>
         <!--- 0.0 0 -0.04  1.5708 3.14159-->
       <mesh filename="package://mycobot_description/urdf/mycobot/suit_env.dae"/>
      </geometry>
      <origin xyz = "0 0 0.0" rpy = "1.5708 0 -1.5708"/>
    </visual>
  </link>

  <link name="joint1">
    <inertial>
    <origin xyz="0 0 0.1" rpy="0 0 0"/>
      <mass value="0.2"/>
      <inertia
        ixx="1.0" ixy="0.0" ixz="0.0"
        iyy="1.0" iyz="0.0"
        izz="1.0"/>
  </inertial>
    <visual>
      <geometry>
         <!--- 0.0 0 -0.04  1.5708 3.14159-->
       <mesh filename="package://mycobot_description/urdf/mycobot/joint1.dae"/>
      </geometry>
      <origin xyz = "0.0 0 0.02 " rpy = " 0 0 -1.5708"/>
    </visual>
    <collision>
      <geometry>
         <!--- 0.0 0 -0.04  1.5708 3.14159-->
       <mesh filename="package://mycobot_description/urdf/mycobot/joint1.dae"/>
        </geometry>
        <origin xyz = "0.0 0 0.02 " rpy = " 0 0 -1.5708"/>
    </collision>
  </link>

  <joint name="vision_joint" type="fixed">
    <axis xyz="0 0 0"/>
```

```
    <limit effort = "1000.0" lower = "-3.14" upper = "3.14159" velocity = "0"/>
    <parent link="env"/>
    <child link="joint1"/>
    <origin xyz= "0 0 0" rpy = "0 0 0"/>
  </joint>

<link name="world"/>
<joint name="fixed" type="fixed">
  <parent link="world"/>
  <child link="env"/>
</joint>

</robot>
```

It can be seen that the urdf file is not complicated, mainly composed of the two parts of `link` and `joint` that are repeated continuously.

Link section

The link element describes a rigid body with inertia, visual characteristics, and collision properties

Attributes

name:

Name used to describe the link itself

Elements

- `<inertial>` (optional)
- Inertial properties of the link
- `<origin>` (optional, defaults to identity if not specified)
- Defines the reference coordinates of the inertial reference frame relative to the link coordinate system. The coordinates must be defined at the center of gravity of the link, and the coordinate axes may not be parallel to the principal axes of inertia.
- xyz (optional, defaults to zero vector) Represents the offsets in the x, y, z x,y,zx,y,z directions, in meters.
- rpy (optional: defaults to identity if not specified) Represents the rotation of the coordinate axis in the RPY direction, in radians.
- `<mass>` Mass properties of the link
- `<inertia>` 3×3 rotational inertia matrix, consisting of six independent quantities: ixx, ixy, ixz, iyy, iyz, izz.
- `<visual>` (optional)
- Visual properties of the link. Used to specify the shape of the link display (rectangle, cylinder, etc.). The same link can have multiple visual elements, and the shape of the link is formed by two of the multiple elements. In general, if the model is more complex, it can be drawn by soildwork and then generate stl calls. Simple shapes such as adding end effectors can be written directly. At the same time, the position of the geometric shape can be adjusted here according to the gap between the theoretical model and the actual model.
- `<namel>` (optional) The name of the connecting rod geometry.
- `<origin>` (optional, defaults to identity if not specified)

- The coordinate system of the geometric shape relative to the coordinate system of the connecting rod.
- xyz (optional: defaults to zero vector) Indicates the offset in the x, y, z x,y,zx,y,z direction, in meters.
- rpy (optional: defaults to identity if not specified) Indicates the rotation of the coordinate axis in the RPY direction, in radians.

- `<geometry>` (required)

- The shape of the visual object, which can be one of the following:
- `<box>` Rectangle, elements include length, width, and height. The origin is at the center.
- `<cylinder>` Cylinder, elements contain radius, length. Origin center.
- `<sphere>` Sphere, elements contain radius. Origin at center.
- `<mesh>` Mesh, determined by file, and scale is provided to define its boundaries. Collada .dae files are recommended, .stl files are also supported, but must be a local file.
- `<material>` (optional)
- Material of the visual component. Can be defined outside the link tag, but must be in the robot tag. When defined outside the link tag, the link name must be referenced.
- `<color>` (optional) Color, composed of red/green/blue/alpha, size range [0,1].
- `<texture>` (optional) Material properties, defined by file.
- `<collision>` (optional)
- Collision properties of the link. Collision properties are different from the visual properties of the link, and a simple collision model is often used to simplify calculations. The same link can have multiple collision attribute tags. The collision attribute representation of the link is composed of the set of geometric shapes it defines.
- `<name>` (optional) Specifies the name of the link geometry
- `<origin>` (optional, defaults to identity if not specified)
- The reference coordinate system of the collision component relative to the reference coordinate system of the link coordinate system.
- xyz (optional, defaults to zero vector) Represents the offset in the x, y, z x,y,zx,y,z direction, in meters.
- rpy (optional, defaults to identity if not specified) Represents the rotation of the coordinate axis in the RPY direction, in radians.
- `<geometry>` Same as the geometry element description above

For detailed elements and the functions of each element, please go to the official document for viewing

joint section

The joint section describes the kinematics and dynamics of the joint and specifies the safety limits of the joint.

Properties of joint:

name:

Specifies a unique name for the joint

type:

Specifies the type of joint, where type can be one of the following:

- revolute - A hinge joint that rotates along an axis with a range specified by upper and lower limits.
- continuous - A continuous hinge joint that rotates around an axis with no upper and lower limits.
- prismatic - A sliding joint that slides along an axis with a range specified by upper and lower limits.
- fixed - This is not a true joint as it cannot move. All degrees of freedom are locked. This type of joint does not require axis, calibration, dynamics, limits or safety_controller.
- floating - This joint allows motion in all 6 degrees of freedom.

- planar - This joint allows motion in a plane perpendicular to the axis.

Elements of joint

- `<origin>` (optional, defaults to identity if not specified) Transformation from parent link to child link, joint is located at the origin of child link. Modifying this parameter can adjust the position of the link, which can be used to adjust the error between the actual model and the theoretical model, but it is not recommended to modify it drastically, because this parameter affects the position of the link stl, which is easy to affect the collision detection effect.
- xyz (optional: defaults to zero vector) Represents the offset in the x, y, z x, y, z axis direction, in meters.
- rpy (optional: defaults to zero vector) Represents the angle of rotation around a fixed axis: roll around the x axis, pitch around the y axis, yaw around the z axis, expressed in radians.
- `<parent>` (required)
- The name of the parent link is a mandatory attribute.
- link The name of the parent link is the name of this link in the robot structure tree.
- `<child>` (required)
- The name of the child link is a mandatory attribute.
- link The name of the child link, which is the name of this link in the robot structure tree.
- `<axis>` (optional: defaults to (1,0,0))
- The axis of the joint in the joint coordinate system. This is the axis of rotation (revolute joint), the axis along which the prismatic joint moves, and the standard plane of the planar joint. This axis is specified in the joint coordinate system. Modifying this parameter can adjust the axis around which the joint rotates. It is often used to adjust the direction of rotation. If the model's rotation direction is opposite to the actual direction, just multiply by -1. Fixed and floating joints do not need this element.
- xyz (required) The x, y, z components of the axial vector, as a normalized vector.
- `<calibration>` (optional)
- The reference point of the joint, used to calibrate the absolute position of the joint.
- rising (optional) The reference point triggers a rising edge when the joint moves in the positive direction.
- falling (optional)

The reference point triggers a falling edge when the joint moves in the forward direction.

- `<dynamics>` (optional)
- This element is used to specify the physical properties of the joint. Its value is used to describe the modeling properties of the joint, especially during simulation.

`<limit>` (required when the joint is a revolute or translation joint)

- This element is the kinematic constraint of the joint.
- lower (optional, defaults to 0)

Attribute that specifies the lower limit of the joint's range of motion (in radians for revolute joints and meters for prismatic joints). This attribute is ignored for continuous joints.

- upper (optional, defaults to 0)

Attribute that specifies the upper limit of the joint's range of motion (in radians for revolute joints and meters for prismatic joints). This attribute is ignored for continuous joints.

- effort (required)

Attribute that specifies the maximum force with which the joint is applied.

- velocity (required)

Attribute that specifies the maximum velocity with which the joint is applied.

`<mimic>` (optional)

- This tag is used to specify a defined joint to mimic an existing joint. The value of this joint can be calculated using the following formula:

```
value = multiplier * other_joint_value + offset
```

- joint(required) The name of the joint to be mimicked.
- multiplier(optional) Specifies the multiplier factor in the above formula.
- offset(optional) Specifies the offset term in the above formula. The default value is 0

`<safety_controller>` (optional)

- This element is a safety control limit. The data under this element will be read into move_group, but it is actually invalid. move_group will skip this limit and directly read the parameter content under limit. At the same time, setting this element may cause planning failure.
- soft_lower_limit (optional, default is 0) This attribute specifies the lower limit of the joint safety control boundary, which is the starting limit of the joint safety control. This value needs to be greater than the lower value in the limit above.
- soft_upper_limit (optional, default is 0) This attribute specifies the upper limit of the joint safety control boundary, which is the starting limit of the joint safety control. This value needs to be less than the upper value in the limit above.
- k_position (optional, default is 0) This attribute is used to describe the relationship between position and velocity.
- k_velocity (required) This attribute is used to describe the relationship between force and velocity.

For detailed elements and their functions, please visit http://wiki.ros.org/urdf/XML/joint for more information.

A brief introduction and use of rviz

rviz is a 3D visualization platform in ROS. On the one hand, it can realize the graphical display of external information. On the other hand, it can also release control information to objects through rviz, thereby realizing the monitoring and control of robots.

Introduction to the installation and interface of rviz

When installing ros, if you perform a complete installation, rviz has been installed, and you can try to run it directly; if it is not fully installed, you can install rviz separately:

```
# Ubuntu20.04
sudo apt-get install ros-noetic-rviz
```

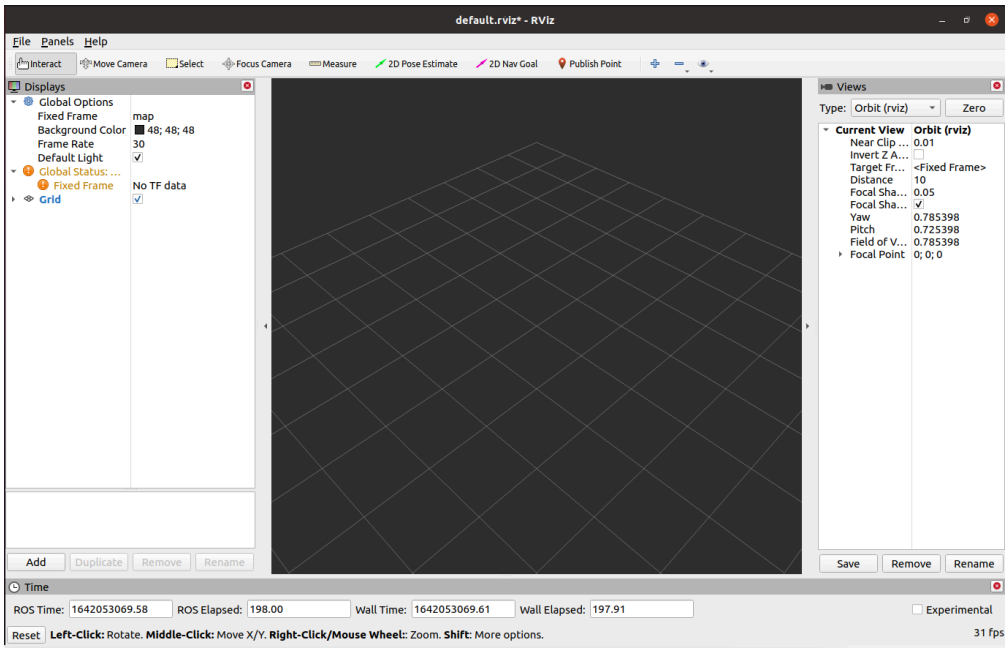
After the installation is complete, please open a new terminal (shortcut key `Ctrl+Alt+T`) and enter the following command:

```
roscore
```

Then open a new terminal (shortcut key `Ctrl+Alt+T`) and enter the command to open rviz

```
rosrun rviz rviz
# or
rviz
```

Open rviz and the following interface will be displayed:



Introduction to each area

- On the left is the display list. A display is something that draws something in the 3D world and may have some options available in the display list.

- On the top is the toolbar, which allows users to select multiple functions with various function keys
- In the middle is the 3D view: it is the main screen that allows users to view various data in three dimensions. The background color, fixed frame, grid, etc. of the 3D view can be set in detail in the Global Options and Grid items displayed on the left.
- Below is the time display area, including system time and ROS time.
- On the right is the observation angle setting area, which can set different observation angles.

In this section, we will only give a rough introduction. If you want to know more details, you can go to the User Guide to check it out.

mycobot_ros installation and update

- **M5 version:** Please see the end of the **ROS1 Environment Setup** section.

Simple use

Start through the launch file

This example is based on the premise that you have completed Environment Construction and successfully copied the company's code from GitHub.

Open a console terminal (shortcut key `Ctrl+Alt+T`) Enter the following command to **ROS environment configuration**.

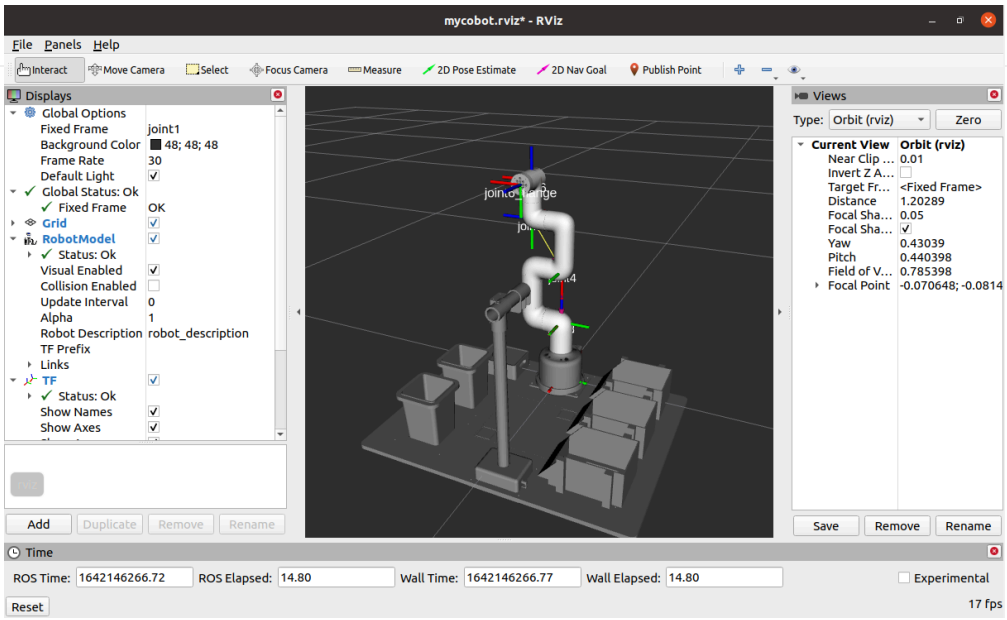
```
cd ~/catkin_ws/
source devel/setup.bash
```

Enter again:

- mycobot 280-M5 version:

```
roslaunch mycobot_280 test.launch
```

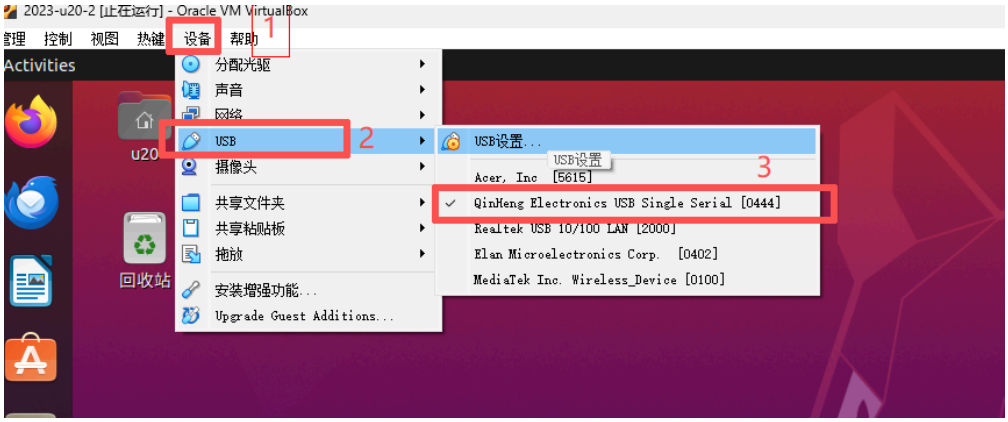
Open rviz and get the following result:



If you want to learn more about rviz, you can go to the official document to view it

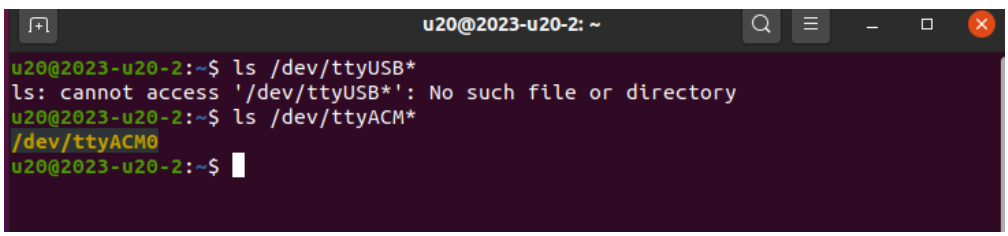
M5 version prerequisites

- Device connection: Select **Device** -> **USB** -> **Check the device serial port name**



- Open the console terminal (shortcut key `Ctrl+Alt+T`), open the terminal window to view the device name:

```
# View the device name of the robot
ls /dev/ttyUSB* # Old version myCobot280 M5


# If the terminal does not display the /dev/ttyUSB related name, you need to use the following command
ls /dev/ttyACM* # New version myCobot280 M5
```



- Grant serial port permissions to the robot:

```
# The default device name is /dev/ttyUSB0. If the device name is not the default value, it needs to be modified.
sudo chmod 777 /dev/ttyUSB0 # Old version myCobot280 M5


sudo chmod 777 /dev/ttyACM0 # New version myCobot280 M5
```

Then enter the user password (**Note:** The password will not be displayed, just enter it correctly).

280 series rviz user guide

Robot arm control

> **Note:** Before using the following example, you need to configure the ROS package environment after opening the terminal command line:

```
cd ~/catkin_ws/
source devel/setup.bash
```

Then proceed with using the example.

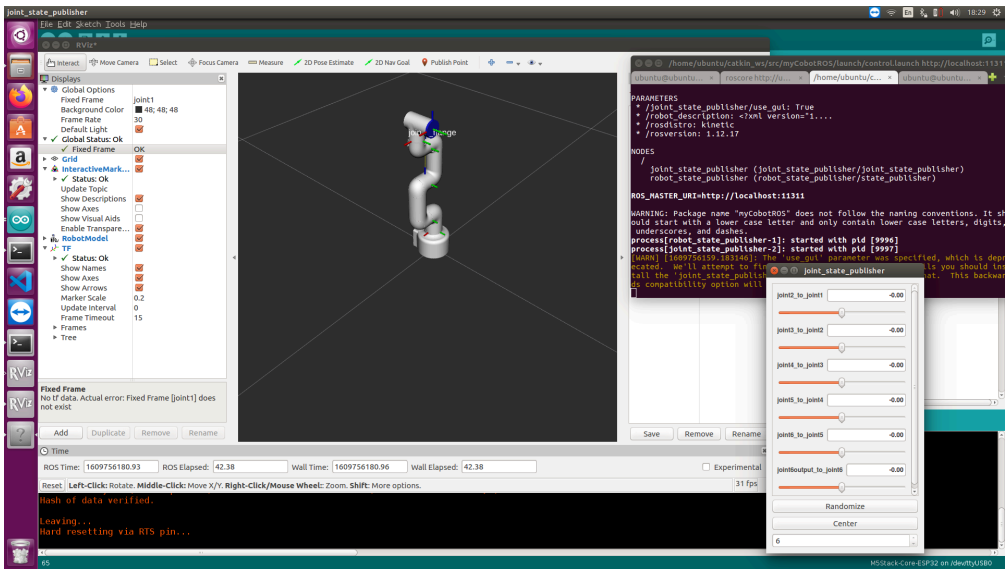
Slider control

Open a command line and run:

- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
roslaunch mycobot_280 slider_control.launch port:=/dev/ttyUSB0 baud:=115200
```

It will **open rviz and a slider component**, you will see the following screen:



Then you can **control the movement of the model in rviz by dragging the slider**. If you want the real mycobot to move with you, you need to open another command line and run:

- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
rosrun mycobot_280 slider_control.py _port:=/dev/ttyUSB0 _baud:=115200
```

Please note: due to the commandThe robot arm will move to the current position of the model while inputting. Before you use the command, please make sure that the model in rviz does not have any penetration Do not drag the slider quickly after connecting the robot arm to prevent damage to the robot arm

Model following

In addition to the above controls, we can also **let the model follow the real robot arm movement**. Open a command line and run:

- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial po
rosrun mycobot_280 follow_display.py _port:=/dev/ttyUSB0 _baud:=115200
```

Then open another command line and run:

- mycobot 280-M5 version:

```
roslaunch mycobot_280 mycobot_follow.launch
```

It will **open rviz to show the model following effect**.

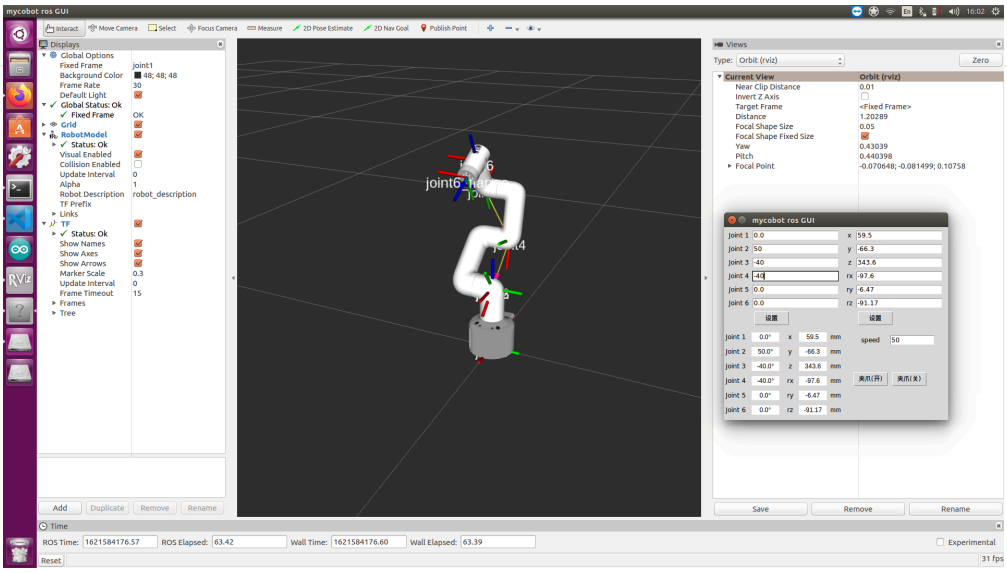
GUI control

Based on the previous, this package also **provides a simple Gui control interface**. This method is intended for real robotic arms to interact with each other, please connect mycobot.

Open the command line:

- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial po
roslaunch mycobot_280 simple_gui.launch port:=/dev/ttyUSB0 baud:=115200
```



Keyboard control

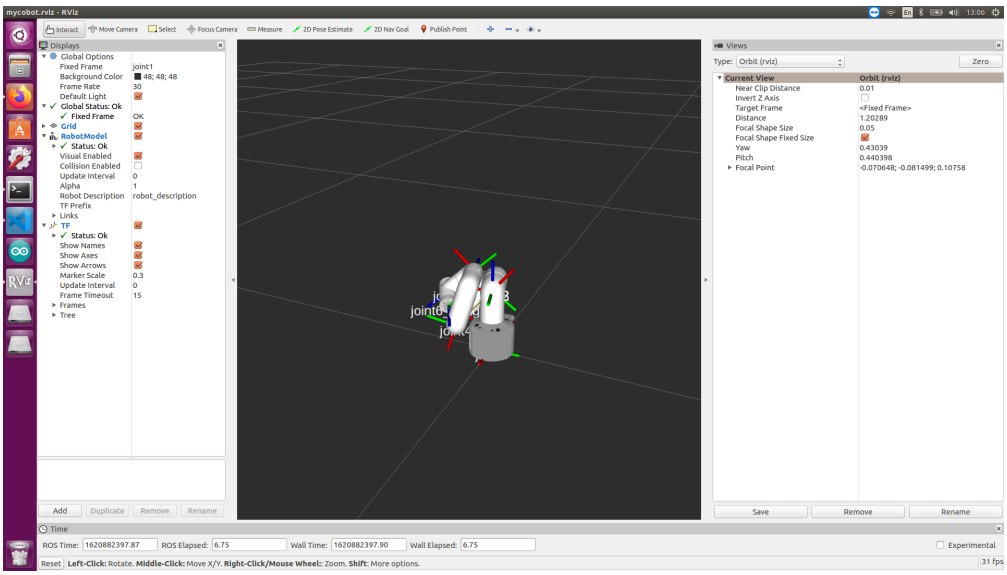
Added the keyboard control function in the `mycobot_280` package, and synchronized it in real time in rviz. This function depends on pythonApi, so make sure it is connected to the real robot arm.

Open a command line and run:

- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
roslaunch mycobot_280 teleop_keyboard.launch port:=/dev/ttyUSB0 baud:=115200
```

The running effect is as follows:



The command line will output mycobot information as follows:

```
SUMMARY
========

PARAMETERS
    * /mycobot_services/baud: 115200
    * /mycobot_services/port: /dev/ttyUSB0
    * /robot_description: <?xml version="1....
    * /rosdistro: noetic
    * /rosversion: 1.16.0

NODES
  /
    mycobot_services (mycobot_communication/mycobot_topics.py)
    real_listener (mycobot_280/listen_real_of_topic.py)
    robot_state_publisher (robot_state_publisher/robot_state_publisher)
    rviz (rviz/rviz)

auto-starting new master
process[master]: started with pid [217714]
ROS_MASTER_URI=http://localhost:11311

setting /run_id to 01e863c8-5642-11f0-a2da-335dad9016e7
process[rosout-1]: started with pid [217728]
started core service [/rosout]
process[robot_state_publisher-2]: started with pid [217731]
process[rviz-3]: started with pid [217733]
process[mycobot_services-4]: started with pid [217738]
process[real_listener-5]: started with pid [217740]
current pymycobot library version: 3.9.9
pymycobot library version meets the requirements!
ls: cannot access '/dev/ttyUSB*': No such file or directory
[INFO] [1751350196.024298]: /dev/ttyUSB0,115200

MyCobot Status
--------------------------------
Joint Limit:
    joint 1: -168 ~ +168
    joint 2: -135 ~ +135
    joint 3: -150 ~ +150
    joint 4: -145 ~ +145
    joint 5: -165 ~ +165
    joint 6: -180 ~ +180

Connect Status: True

Servo Infomation: all connected

Servo Temperature: unknown
```

```
Atom Version: 7.2
```

Next, open another command line and run:

- mycobot 280-M5 version:

```
rosrun mycobot_280 teleop_keyboard.py
#or
rosrun mycobot_280 teleop_keyboard.py _speed:=70
```

You will see the following output in the command line:

```
[INFO] [1751342043.889285]: Waiting to receive current coordinates...
Mycobot Teleop Keyboard Controller (ROS1 - Topic Version)
---------------------------------------------------------
Movement (Cartesian):
              w (x+)
    a (y-)    s (x-)    d (y+)
              z (z-)    x (z+)

Rotation (Euler angles):
    u (rx+)  i (ry+)  o (rz+)
    j (rx-)  k (ry-)  l (rz-)

Movement Step:
    + : Increase movement step size
    - : Decrease movement step size

Gripper:
    g - open    h - close

Pump:
    b - open    m - close

Other:
    1 - Go to init pose
    2 - Go to home pose
    3 - Save current pose as home
    q - Quit

currently:    speed: 5070    change percent: 5
[INFO] [1751342044.199244]: Current moving step: position 12.5 mm, angle attitude 9.0°
```

In this terminal, you can control the state of the robot and move the robot through the keys in the command line.

Parameters supported by this script:

- _speed: robot movement speed.

- _change_percent: movement distance percentage.

Vision

> Install the camera at the end of mycobot. This vision part uses the eye-in-hand method. After reinstalling the camera, a hand-eye calibration is required.

Prerequisites for use

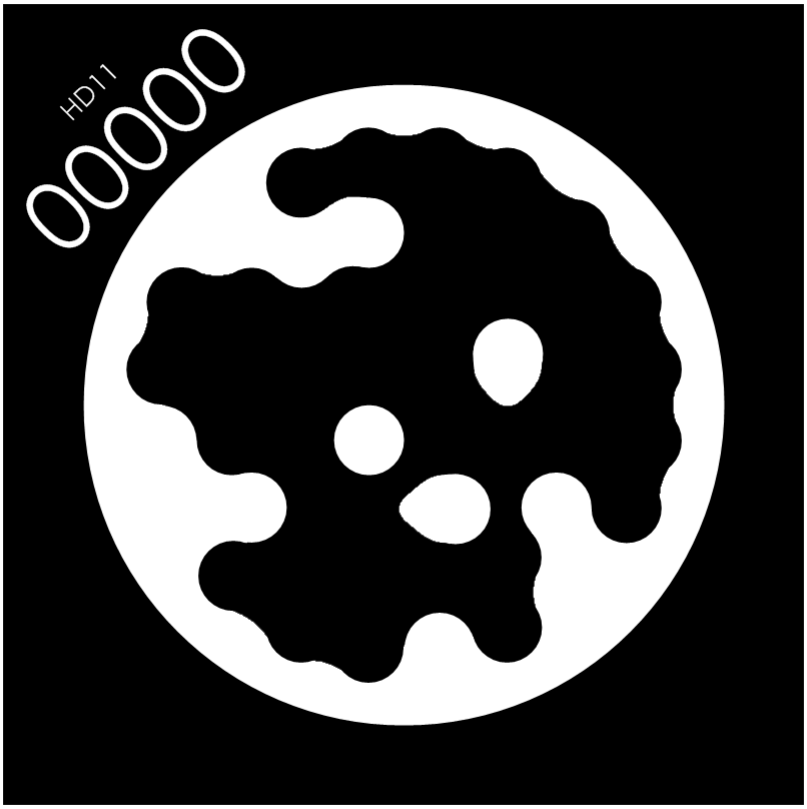
Python dependency libraries

Use pip to install the following Python libraries

```
pip install stag-python

pip install opencv-python

pip install scipy

pip install numpy

pip install pymycobot
```

Stag Code

This article uses stag code for QR code tracking. It is recommended to use color printing, as the recognition rate of black and white printing is low.



Download address: Stag code download

Note: The upper left corner of the stag code is a number, which can be identified by the stag recognition library of OpenCV. You can design different behavior logic for different numbers, such as 00 is set for position tracking, 01 is set for posture tracking, and 02 is set for returning to the observation point.

Firmware Update

Using the stag tracking firmware will give better results. This firmware will limit the deflection of the robot arm. Using the send_coords interface in refresh mode will filter out adjacent coordinates with an angle deviation of more than 90°.

The firmware is named `mycobot280_atom0926_vision.bin` and is located in the folder `~/mycobot_ros/mycobot_280/mycobot_280/config` of this project.

Camera initialization

In this project, the file `~/mycobot_ros/mycobot_280/mycobot_280/camera_calibration/camera_calibration.py` defines a visual recognition class called camera_detect.

```
class camera_detect:
    #Camera parameter initialize
    def __init__(self, camera_id, marker_size, mtx, dist):
```

The four parameters initialized are:

```
camera_id 相机编号（范围一般是0~10，默认为0）
marker_size Stag码的边长（mm）
mtx, dist 相机参数
```

An initialization example has been given in the program. The user only needs to modify camera_id and marker_size.

```
camera_params = np.load("camera_params.npz")  # Camera Profiles
mtx, dist = camera_params["mtx"], camera_params["dist"]
m = camera_detect(0, 32, mtx, dist)
```

Note: The default camera_id in Linux system is usually 0. If it is wrong, change it to other parameters from 0 to 10.

Hand-eye calibration

Hand-eye matrix principle

Hand-eye calibration is an essential part of visual tracking. Its function is to obtain the relative relationship between the robot arm coordinate system (hand) and the camera coordinate system (eye). We use a 4*4 hand-eye matrix to represent this relative relationship. The specific principle can be referred to: Hand-Eye Matrix Principle

Hand-eye calibration method

> **Note:** After reinstalling the camera, a hand-eye calibration is required.

Install the camera on the robotic arm (usually at the end of the robotic arm) and connect the robotic arm to be controlled.

Run the command line:

- mycobot 280-M5版本：

```
cd ~/mycobot_ros/mycobot_280/mycobot_280/camera_calibration  # The terminal switches to the target path
python3 camera_calibration.py  # Camera id, default is 0.
```

At this time, the robotic arm will first move to the observation posture.

```
self.origin_mycbot_level = [0, 5, -104, 14, 0, 0]
def Eyes_in_hand_calibration(self, ml):
    ml.send_angles(self.origin_mycbot_level, 50)  # 移动到观测点
```

Note: Users can customize the observation points, such as rotating the 6 joints to put the camera in a more suitable position.

1. After moving to the observation posture, the terminal will pop up the following prompt, place the stag code in the camera's field of view, and enter any key to continue recognition.

```
make sure camera can observe the stag, enter any key quit
```

1. If the camera recognizes the stag code, it will automatically enter the next step of recognition, the robot arm moves and captures the position information of the robot arm and camera.

```
Move the end of the robot arm to the calibration point, press any key to release servo
```

1. After attaching, follow the prompts and enter any key to complete the hand-eye calibration.

```
focus servo and get current coords
```

1. The EyesInHand_matrix information will be printed at this time, and the calibration is considered complete. The "EyesInHand_matrix.json configuration file is generated. After the calibration is successful, there is no need to repeat the operation!

Please refer to the following video for specific effects, the effect is similar to mycobot 280:

Note: **Hand-eye calibration may have errors due to improper operation, machine virtual position, etc. When the visual tracking effect is not good, hand-eye calibration needs to be re-performed**

Visual Tracking

> The control method of the robot arm in this case: Use the topic in ROS for communication. USB camera startup method: Use the camera usb_cam node in ROS to start.

usb_cam installation command:

```
# Ubuntu 20.04
sudo apt install ros-noetic-usb-cam
```

Mainly involved code files:

1. communication_topic.launch
2. mycobot_topics.py
3. open_camera.launch
4. listen_real_of_topic.py
5. detect_marker_with_topic.launch

6. detect_stag.py

The default camera device parameter in the camera file `open_camera.launch` is `/dev/video0` .

```
<!-- //Specify the device file name, the default is /dev/video0 -->
    <param name="video_device" value="/dev/video0" />
```

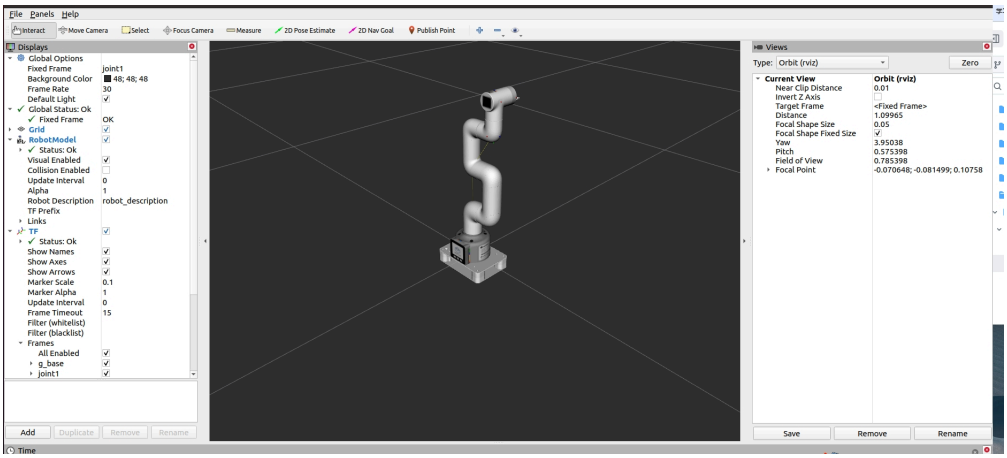
Command line operation:

- mycobot 280-M5 version:

```
cd ~/catkin_ws
source devel/setup.bash
# The default serial port name of mycobot 280-M5 is "/dev/ttyUSB0" and the baud rate is 115200. The serial port name of so
roslaunch mycobot_280 detect_marker_with_topic.launch port:=/dev/ttyUSB0 baud:=115200
```

- port: serial port string
- baud: baud rate

The status of mycobot will be displayed in real time.



Then run the stag recognition and tracking script. Open a new command line:

- mycobot 280-M5 version:

```
cd ~/catkin_ws
source devel/setup.bash
rosrun mycobot_280 detect_stag.py
```

After starting, the robot arm will move to the observation point:

```
self.origin_mycbot_horizontal = [0,60,-60,0,0,0]
ml.send_angles(self.origin_mycbot_horizontal, 50)  # 移动到观测点
```

The specific effects are as follows:

End effector

- **Supported end effectors:** myCobot Adaptive Gripper, myCobot Vertical Suction Pump V2.0, Camera Flange
- **Applicable devices:** myCobot 280 M5, myCobot 280 PI

> Note: myCobot Adaptive Gripper only supports myCobot 280 M5 devices

myCobot Adaptive Gripper

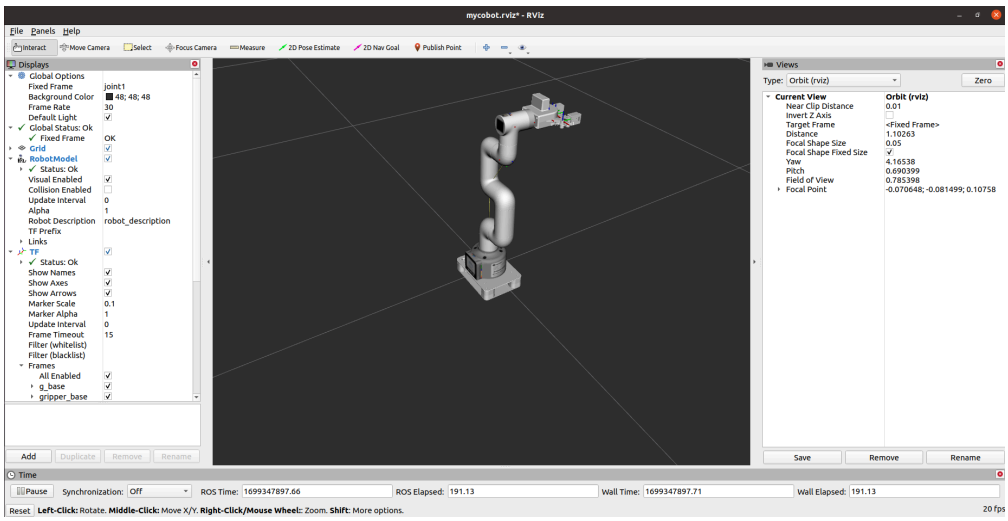
1 Load the model

Open a command line and run:

- myCobot 280-M5 version:

```
roslaunch mycobot_280 test_gripper.launch
```

It will **open rviz**, and you will see the following screen:



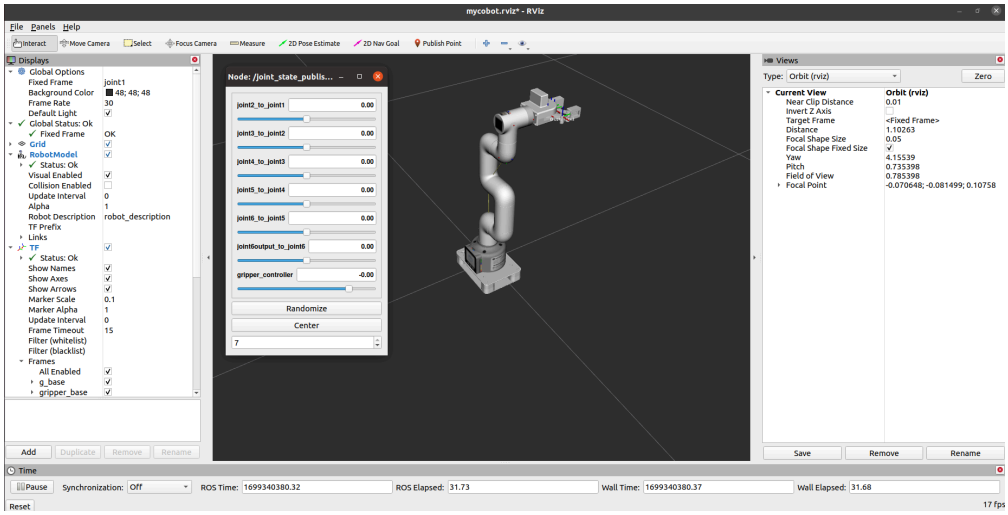
2 Slider Control

Open a command line and run:

- myCobot 280-M5 version:

```
# The default serial port name of myCobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
roslaunch mycobot_280 slider_control_gripper.launch port:=/dev/ttyUSB0 baud:=115200
```

It will **open rviz and a slider component**, and you will see the following screen:



Then you can **control the movement of the model in rviz by dragging the slider.** If you want the real myCobot to move with you, you need to **open another command line** and run:

- myCobot 280-M5 version:

```
# The default serial port name of myCobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
rosrun mycobot_280 slider_control_gripper.py _port:=/dev/ttyUSB0 _baud:=115200
```

Please note: Since the robot arm will move to the current position of the model while the command is input, please make sure that the model in rviz does not have a model penetration phenomenon before you use the command. Do not drag the slider quickly after connecting the robot arm to prevent damage to the robot arm.

3 Model following

In addition to the above control, we can also **let the model follow the movement of the real robot arm**. Open a command line and run:

- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
rosrun mycobot_280 follow_display_gripper.py _port:=/dev/ttyUSB0 _baud:=115200
```

Then open another command line and run:

- mycobot 280-M5 version:

```
roslaunch mycobot_280 mycobot_follow_gripper.launch
```

It will **open rviz to show the model following effect**.

4 GUI control

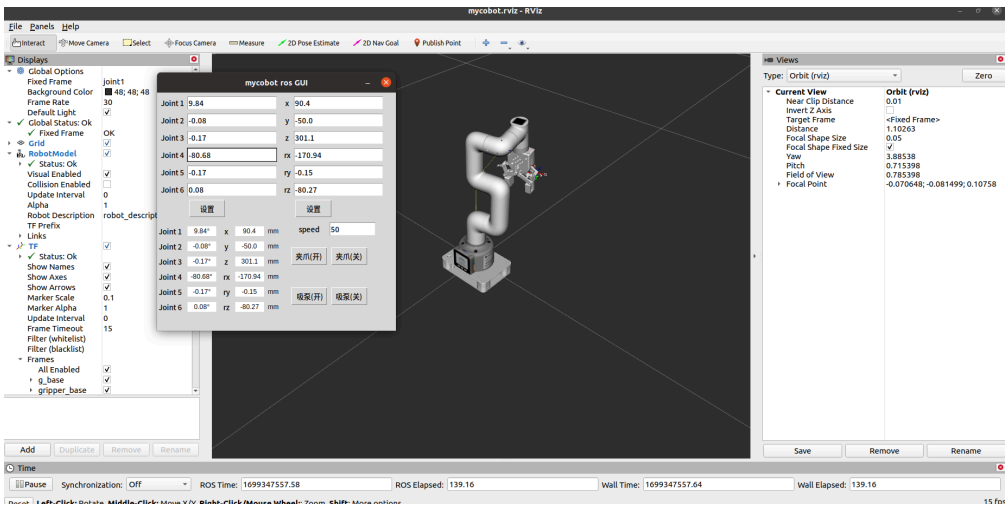
Based on the previous, this package also provides a simple Gui control interface. This method is intended to allow real robotic arms to interact with each other. Please connect myCobot.

Open the command line:

- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
roslaunch mycobot_280 simple_gui_gripper.launch port:=/dev/ttyUSB0 baud:=115200
```

It will **open rviz and a GUI interface**, and you will see the following screen:



5 Keyboard control

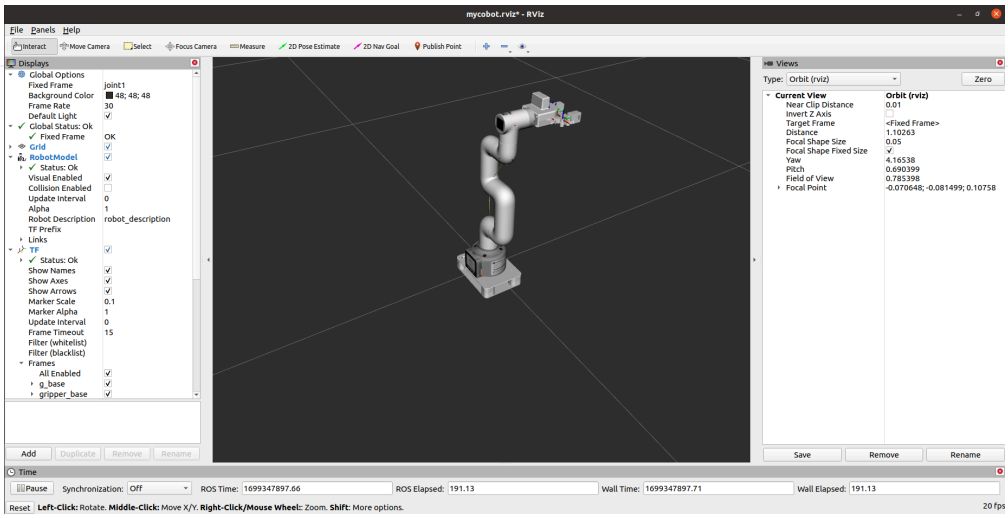
Keyboard control function has been added to the `mycobot_280` package, and it is synchronized in real time in rviz. This function relies on pythonApi, so make sure it is connected to the real robot arm.

Open a command line and run:

- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
roslaunch mycobot_280 teleop_keyboard_gripper.launch port:=/dev/ttyUSB0 baud:=115200
```

The running effect is as follows:



The command line will output mycobot information, as follows:

```
SUMMARY
========

PARAMETERS
    * /mycobot_services/baud: 115200
    * /mycobot_services/port: /dev/ttyUSB0
    * /robot_description: <?xml version="1....
    * /rosdistro: noetic
    * /rosversion: 1.16.0

NODES
  /
    mycobot_services (mycobot_communication/mycobot_topics.py)
    real_listener (mycobot_280/listen_real_of_topic.py)
    robot_state_publisher (robot_state_publisher/robot_state_publisher)
    rviz (rviz/rviz)

auto-starting new master
process[master]: started with pid [217714]
ROS_MASTER_URI=http://localhost:11311

setting /run_id to 01e863c8-5642-11f0-a2da-335dad9016e7
process[rosout-1]: started with pid [217728]
started core service [/rosout]
process[robot_state_publisher-2]: started with pid [217731]
process[rviz-3]: started with pid [217733]
process[mycobot_services-4]: started with pid [217738]
process[real_listener-5]: started with pid [217740]
current pymycobot library version: 3.9.9
pymycobot library version meets the requirements!
ls: cannot access '/dev/ttyUSB*': No such file or directory
[INFO] [1751350196.024298]: /dev/ttyUSB0,115200

MyCobot Status
---------------------------------
Joint Limit:
    joint 1: -168 ~ +168
    joint 2: -135 ~ +135
    joint 3: -150 ~ +150
    joint 4: -145 ~ +145
    joint 5: -165 ~ +165
    joint 6: -180 ~ +180

Connect Status: True

Servo Infomation: all connected

Servo Temperature: unknown
```

```
Atom Version: 7.2
```

Next, open another command line and run:

- mycobot 280-M5 version:

```
rosrun mycobot_280 teleop_keyboard.py
```

You will see the following output in the command line:

```
[INFO] [1751342043.889285]: Waiting to receive current coordinates...
Mycobot Teleop Keyboard Controller (ROS1 - Topic Version)
---------------------------------------------------------
Movement (Cartesian):
              w (x+)
    a (y-)    s (x-)    d (y+)
              z (z-)    x (z+)

Rotation (Euler angles):
    u (rx+)  i (ry+)  o (rz+)
    j (rx-)  k (ry-)  l (rz-)

Movement Step:
    + : Increase movement step size
    - : Decrease movement step size

Gripper:
    g - open    h - close

Pump:
    b - open    m - close

Other:
    1 - Go to init pose
    2 - Go to home pose
    3 - Save current pose as home
    q - Quit

currently:    speed: 50    change percent: 5
[INFO] [1751342044.199244]: Current moving step: position 12.5 mm, angle attitude 9.0°
```

In this terminal, you can control the state of the robot and move the robot by pressing keys in the command line.

Parameters supported by this script:

- _speed: robot movement speed.
- _change_percent: percentage of moving distance.

myCobot vertical pump V2.0

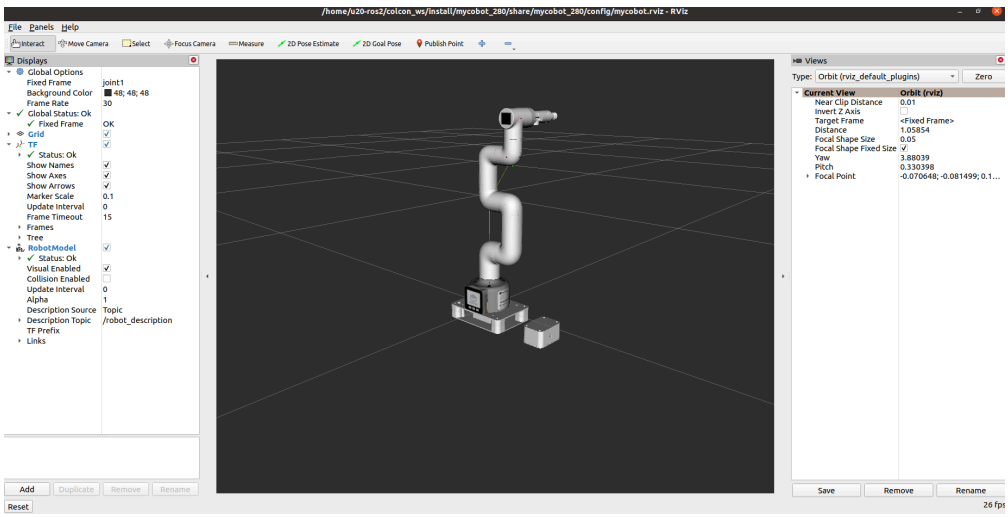
1 Load the model

Open a command line and run:

- myCobot 280-M5 version:

```
roslaunch mycobot_280 test_pump.launch
```

It will **open rviz** and you will see the following screen:



2 Slider control

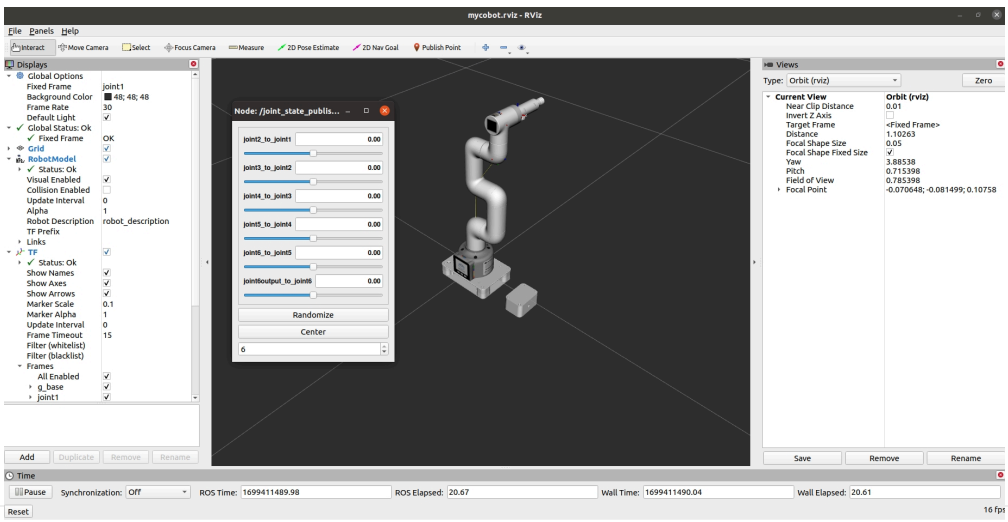
> **Note: This function only supports the control of the robot**

Open a command line and run:

- myCobot 280-M5 version:

```
### The default serial port name of myCobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port
roslaunch mycobot_280 slider_control_pump.launch port:=/dev/ttyUSB0 baud:=115200
```

It will **open rviz and a slider component**, and you will see the following screen:



Then you can **control the movement of the model in rviz by dragging the slider.** If you want the real myCobot to move with you, you need to **open another command line** and run:

- myCobot 280-M5 version:

```
### The default serial port name of myCobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port
rosrun mycobot_280 slider_control.py _port:=/dev/ttyUSB0 _baud:=115200
```

Please note: Since the robot will move to the current position of the model when the command is input, please make sure that the model in rviz does not have any penetration before you use the command. **Do not drag the slider quickly after connecting the robot to prevent damage to the robot**.

3 GUI control

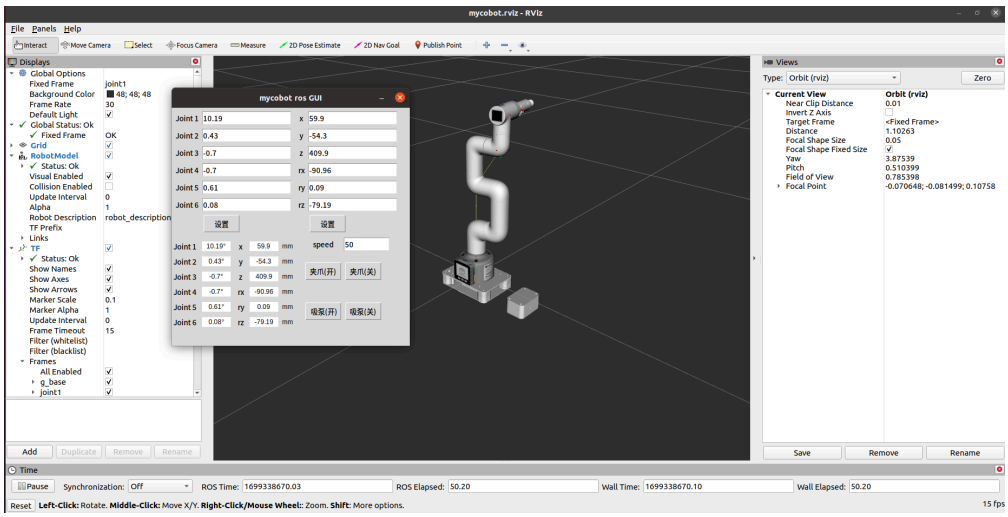
Based on the previous, this package also **provides a simple Gui control interface**. This method is intended for real robots to interact with each other, please connect myCobot.

Open the command line:

- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
roslaunch mycobot_280 simple_gui_pump.launch port:=/dev/ttyUSB0 baud:=115200
```

It will **open rviz and a GUI interface**, and you will see the following screen:



4 Keyboard control

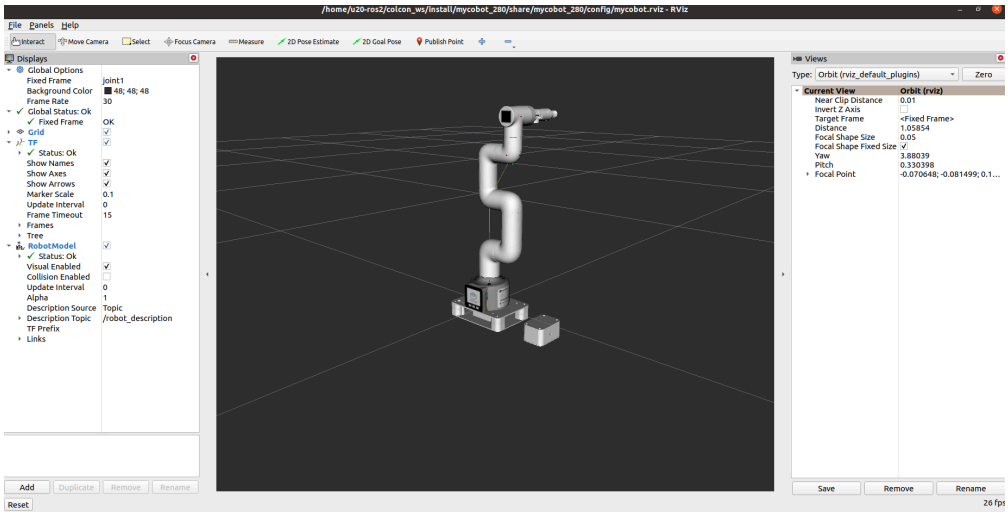
Added keyboard control function in the `mycobot_280` package, and synchronized in real time in rviz. This function depends on python API, so make sure to connect to the real robot arm.

Open a command line and run:

- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
roslaunch mycobot_280 teleop_keyboard_pump.launch port:=/dev/ttyUSB0 baud:=115200
```

The running effect is as follows:



Next, open another command line and run:

- mycobot 280-M5 version:

```
rosrun mycobot_280 teleop_keyboard.py
```

You will see the following output in the command line:

```
[INFO] [1751342043.889285]: Waiting to receive current coordinates...
Mycobot Teleop Keyboard Controller (ROS1 - Topic Version)
---------------------------------------------------------
Movement (Cartesian):
              w (x+)
    a (y-)    s (x-)    d (y+)
              z (z-)    x (z+)

Rotation (Euler angles):
    u (rx+)  i (ry+)  o (rz+)
    j (rx-)  k (ry-)  l (rz-)

Movement Step:
    + : Increase movement step size
    - : Decrease movement step size

Gripper:
    g - open    h - close

Pump:
    b - open    m - close

Other:
    1 - Go to init pose
    2 - Go to home pose
    3 - Save current pose as home
    q - Quit

currently:    speed: 50    change percent: 5
[INFO] [1751342044.199244]: Current moving step: position 12.5 mm, angle attitude 9.0°
```

In this terminal, you can control the state of the robot and move the robot through the keys in the command line.

Parameters supported by this script:

- _speed: robot movement speed.
- _change_percent: movement distance percentage.

Camera Flange

1 Load the model

Open a command line and run:

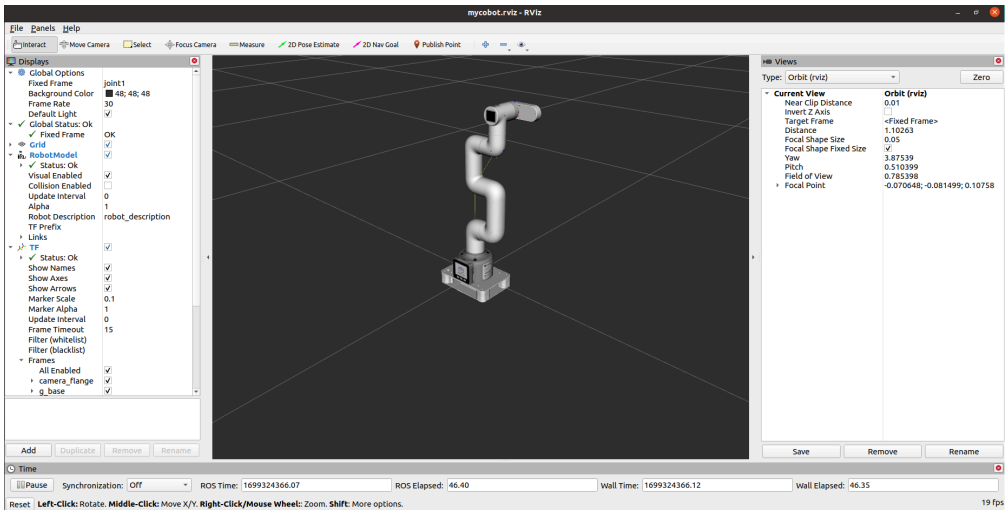
- myCobot 280-M5 version:

```
roslaunch mycobot_280 test_camera_flange.launch
```

- myCobot 280-PI version:

```
roslaunch mycobot_280pi test_camera_flange.launch
```

It will **open rviz** and you will see the following screen:



2 Slider Control

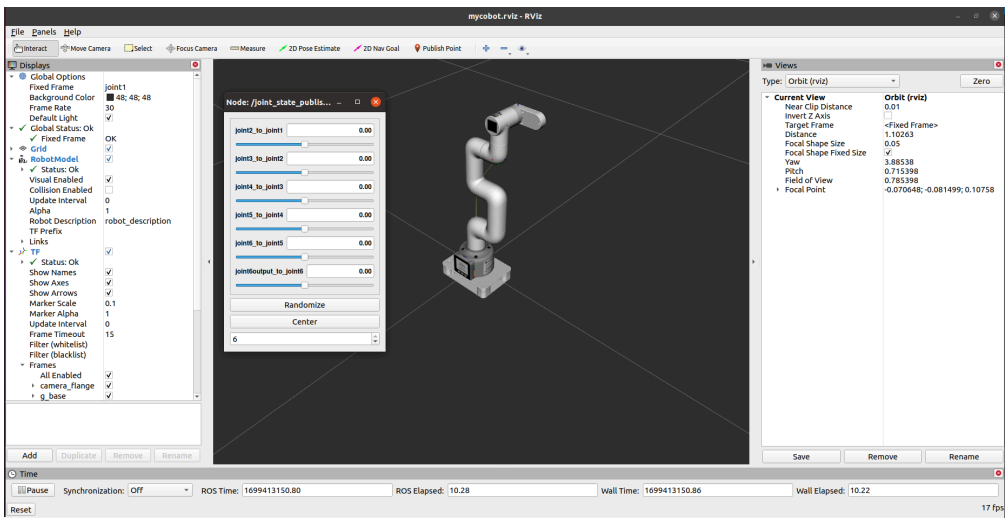
> **Note: This function only supports the control of the robot**

Open a command line and run:

- myCobot 280-M5 version:

```
# The default serial port name of myCobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
roslaunch mycobot_280 slider_control_camera_flange.launch port:=/dev/ttyUSB0 baud:=115200
```

It will **open rviz and a slider component**, and you will see the following screen:



Then you can **control the movement of the model in rviz by dragging the slider.** If you want the real myCobot to move with you, you need to **open another command line** and run:

- myCobot 280-M5 version:

```
# The default serial port name of myCobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
rosrun mycobot_280 slider_control.py _port:=/dev/ttyUSB0 _baud:=115200
```

Please note: Since the robot will move to the current position of the model when the command is input, please make sure that the model in rviz does not have any penetration before you use the command. Do not drag the slider quickly after connecting the robot to prevent damage to the robot.

Camera Flange && Pump

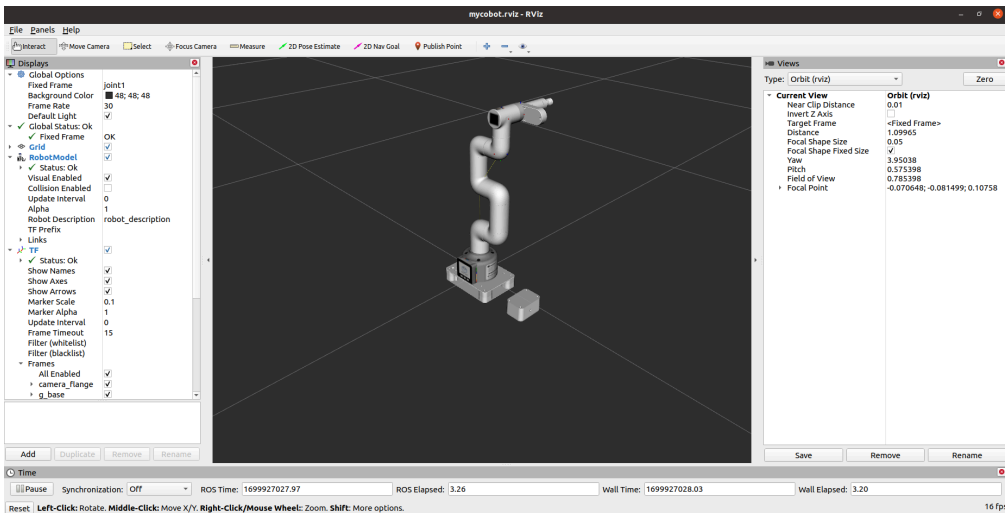
1 Load the model

Open a command line and run:

- myCobot 280-M5 version:

```
roslaunch mycobot_280 test_camera_flange_pump.launch
```

It will **open rviz** and you will see the following:



URDF model address

1 myCobot adaptive gripper

- myCobot 280-M5 version

2 myCobot vertical suction pump V2.0

- myCobot 280-M5 version

3 Camera flange

- myCobot 280-M5 version

4 Camera flange && suction pump

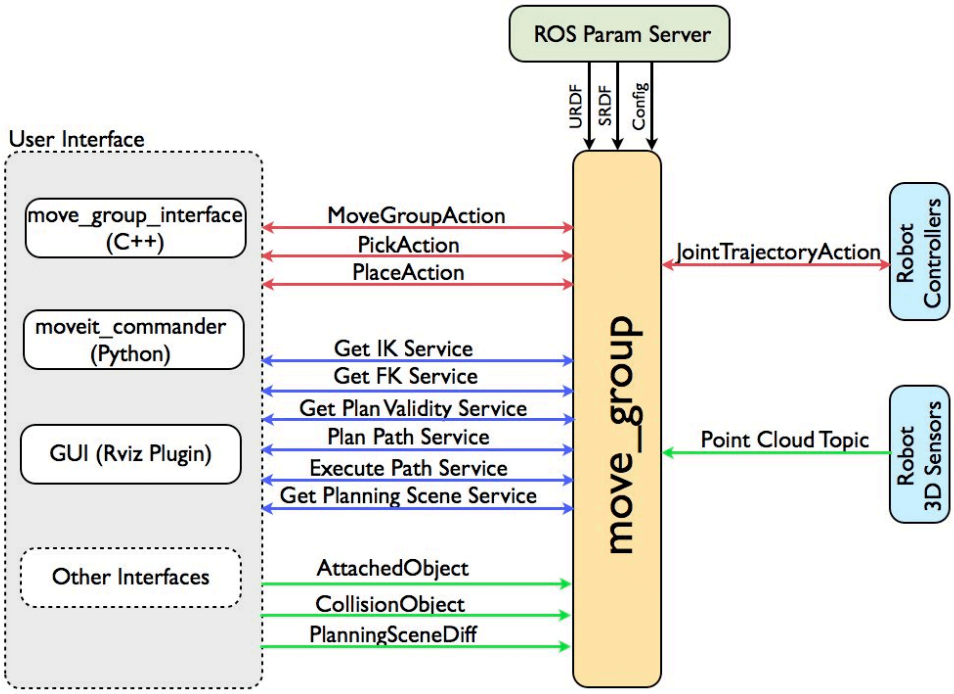
- myCobot 280-M5 version

MoveIt

Introduction to MoveIt

MoveIt is an integrated development platform in ROS, consisting of a variety of function packages for manipulating robotic arms, including: motion planning, manipulation, control, inverse kinematics, 3D perception, and collision detection.

The figure below shows the high-level structure of the main node **move_group** provided by Moveit. It is like a combiner: it integrates all individual components together and provides a series of actions and services for users to use.



User Interface

Users can access the operations and services provided by move_group in three ways:

- In C++: Use the move_group_interface package to facilitate the practical use of move_group.
- In Python: Use the moveit_commander package.
- Via GUI: Use Rviz (ROS Visualizer) from Motion-commander.

move_group can be configured using the ROS parameter server, from which it can also get the robot's URDF and SRDF.

Configuration

move_group is a ROS node. It uses the ROS parameter server to get three kinds of information:

1. URDF - move_group looks up the robot_description parameter on the ROS parameter server to get the robot's URDF.
2. SRDF - move_group looks up the robot_description_semantic parameter on the ROS parameter server to get the robot's SRDF. The SRDF is usually created by the user using the MoveIt Setup Assistant.

3. MoveIt Configuration - move_group will look up additional configuration specific to MoveIt on the ROS parameter server, including joint limits, kinematics, motion planning, perception, and other information. Configuration files for these components are automatically generated by the MoveIt setup assistant and stored in the configuration directory of the corresponding MoveIt configuration package for the robot.

How to use MoveIt

> **Note:** For better motion effects, the Atom firmware version of the end arm is 6.5, and the python driver library pymycobot version is 3.5.3

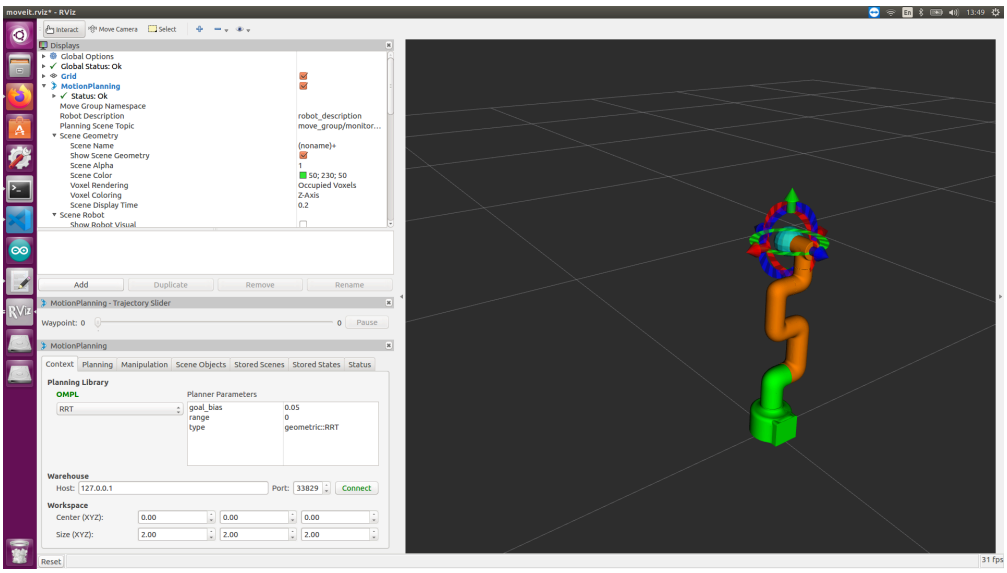
`mycobot_ros` now has MoveIt integrated.

Open the command line and run:

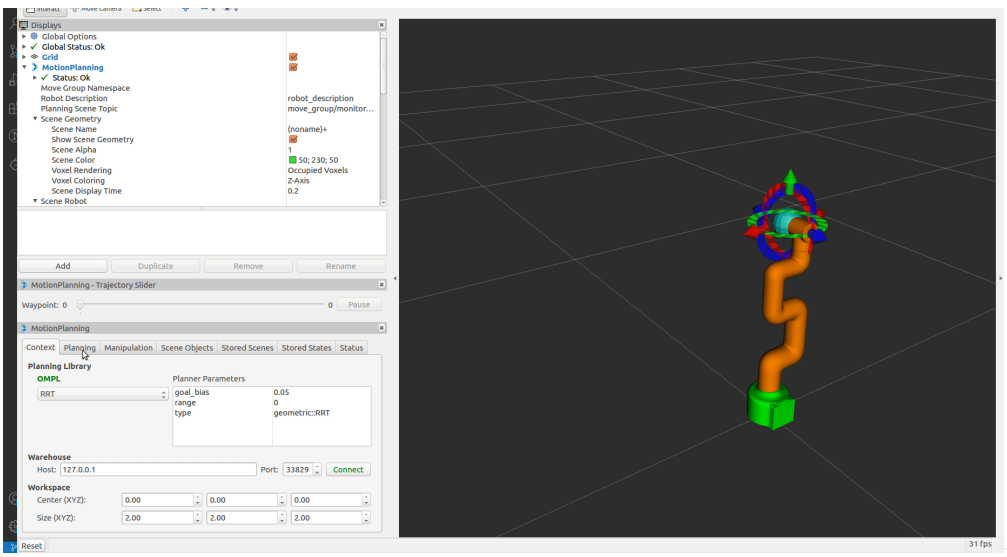
- mycobot 280-M5 version:

```
roslaunch mycobot_280_moveit mycobot_moveit.launch
```

The running effect is as follows:



You can plan and execute, demonstration effect:



If you need to let the real robot arm execute the plan synchronously, you need to open another command line and run:

- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0", and the baud rate is 115200. The serial port n
rosrun mycobot_280_moveit sync_plan.py _port:=/dev/ttyUSB0 _baud:=115200
```

Gazebo

Gazebo Introduction

Gazebo is an integrated development platform in ROS, consisting of various functional packages for manipulating robotic arms, including motion planning, operation, control, inverse kinematics, 3D perception, and collision detection. It features a realistic world simulation platform and can be used in conjunction with Moveit

Local Setup

1. Operation Process

1.1 Prerequisites

To use this package, you need to install the Python API library first.

```
pip install pymycobot --user


# Environment:
ros1 noetic
```

1.2 Package Download and Installation

Download the package to your ROS workspace:

```
$ cd ~/catkin_ws/src
$ git clone https://github.com/elephantrobotics/mycobot_ros.git
$ cd ~/catkin_ws
$ catkin_make
$ source devel/setup.bash
```

MyCobot_280_m5-Gazebo Usage Instructions

1. Slider Control

Slider control through joint_state_publisher_gui is now implemented to control the robot arm model pose in Gazebo.

After connecting the real robot arm to the computer, check the port the robot arm is connected to:

```
ls /dev/tty*
# /dev/ttyACM0 or /dev/ttyUSB0
```

You will get output similar to:

```
/dev/tty    /dev/tty26  /dev/tty44  /dev/tty62      /dev/ttyS20
/dev/tty0   /dev/tty27  /dev/tty45  /dev/tty63      /dev/ttyS21
/dev/tty1   /dev/tty28  /dev/tty46  /dev/tty7       /dev/ttyS22
/dev/tty10  /dev/tty29  /dev/tty47  /dev/tty8       /dev/ttyS23
/dev/tty11  /dev/tty3   /dev/tty48  /dev/tty9       /dev/ttyS24
/dev/tty12  /dev/tty30  /dev/tty49  /dev/ttyACM0   (/dev/ttyUSB0)
/dev/tty13  /dev/tty31  /dev/tty5   /dev/ttyprintk  /dev/ttyS26
/dev/tty14  /dev/tty32  /dev/tty50  /dev/ttyS0      /dev/ttyS27
/dev/tty15  /dev/tty33  /dev/tty51  /dev/ttyS1      /dev/ttyS28
/dev/tty16  /dev/tty34  /dev/tty52  /dev/ttyS10     /dev/ttyS29
/dev/tty17  /dev/tty35  /dev/tty53  /dev/ttyS11     /dev/ttyS3
/dev/tty18  /dev/tty36  /dev/tty54  /dev/ttyS12     /dev/ttyS30
/dev/tty19  /dev/tty37  /dev/tty55  /dev/ttyS13     /dev/ttyS31
/dev/tty2   /dev/tty38  /dev/tty56  /dev/ttyS14     /dev/ttyS4
/dev/tty20  /dev/tty39  /dev/tty57  /dev/ttyS15     /dev/ttyS5
/dev/tty21  /dev/tty4   /dev/tty58  /dev/ttyS16     /dev/ttyS6
/dev/tty22  /dev/tty40  /dev/tty59  /dev/ttyS17     /dev/ttyS7
/dev/tty23  /dev/tty41  /dev/tty6   /dev/ttyS18     /dev/ttyS8
/dev/tty24  /dev/tty42  /dev/tty60  /dev/ttyS19     /dev/ttyS9
/dev/tty25  /dev/tty43  /dev/tty61  /dev/ttyS2
```

Enable communication and add execution permissions to the scripts:

```
sudo chmod -R 777 /dev/ttyACM0  # or sudo chmod -R 777 /dev/ttyUSB0
sudo chmod -R 777 mycobot_280/mycobot_280m5_gazebo_gripper/scripts/follow_display_gazebo.py
sudo chmod -R 777 mycobot_280/mycobot_280m5_gazebo_gripper/scripts/slider_control_gazebo.py
sudo chmod -R 777 mycobot_280/mycobot_280m5_gazebo_gripper/scripts/teleop_keyboard_gazebo.py
roscore
```

After confirming the port, open a terminal and enter the following command (remember to change the port to the value found in the previous step):

```
source devel/setup.bash
roslaunch mycobot_280m5_gazebo_gripper slider.launch _port:=/dev/ttyACM0 _baud:=115200
```

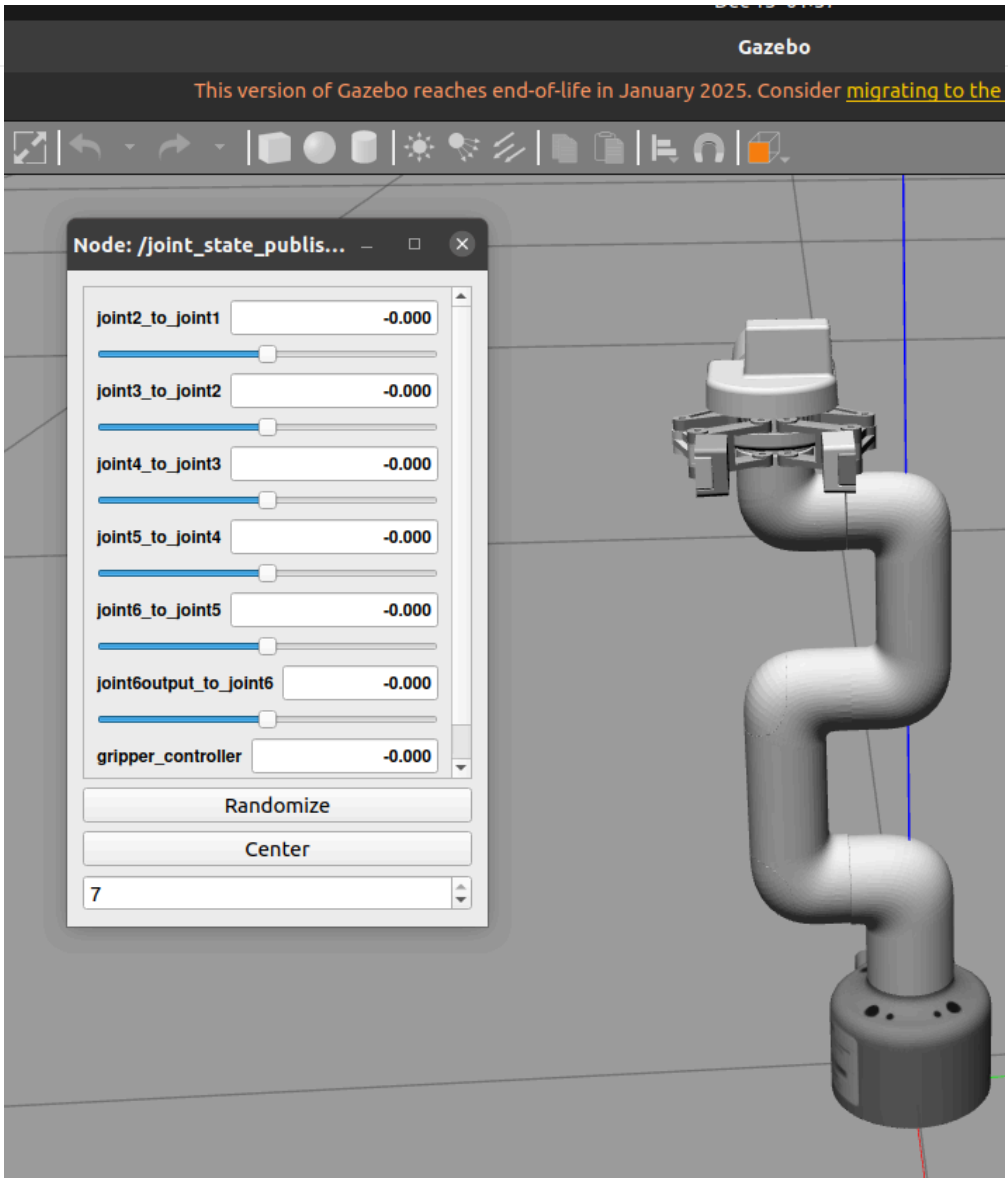
Then open another terminal and enter:

```
source devel/setup.bash
rosrun mycobot_280m5_gazebo_gripper slider_control_gazebo.py _port:=/dev/ttyACM0 _baud:=115200
```

Remember to modify the port number to the one found in the previous step. If successful, you will see the following terminal prompt:

```
('/dev/ttyACM0', 115200)
spin ...
```

Now you can control the Gazebo or robot arm model pose by manipulating the joint_state_publisher_gui sliders.



2. Gazebo Model Following

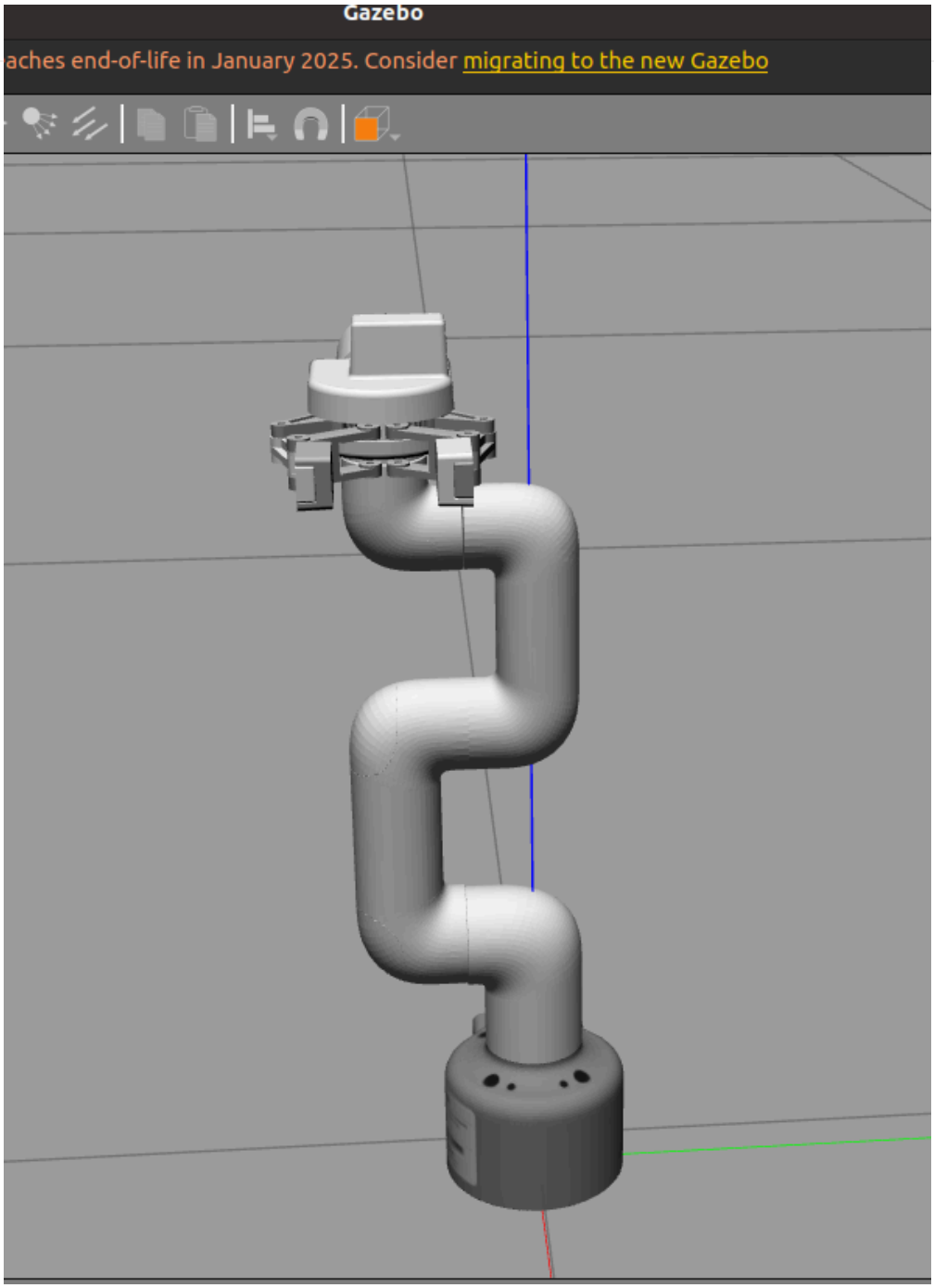
The following commands allow the Gazebo model to follow the actual robot arm's movements. First, run the launch file:

```
source devel/setup.bash
roslaunch mycobot_280m5_gazebo_gripper follower.launch _port:=/dev/ttyACM0
```

If the program runs successfully, the Gazebo interface will load the robot arm model with all joints at their original pose, i.e., [0,0,0,0,0,0]. Then open a second terminal and run:

```
source devel/setup.bash
rosrun mycobot_280m5_gazebo_gripper follow_display_gazebo.py _port:=/dev/ttyACM0 _baud:=115200
```

Now when you manipulate the actual robot arm's pose, you can see the robot arm in Gazebo moving to the same pose.



3. Keyboard Control

You can also use keyboard input to control both the Gazebo robot arm model and the actual robot arm simultaneously. First, open a terminal and enter:

```
source devel/setup.bash
roslaunch mycobot_280m5_gazebo_gripper teleop_keyboard.launch _port:=/dev/ttyACM0 _baud:=115200
```

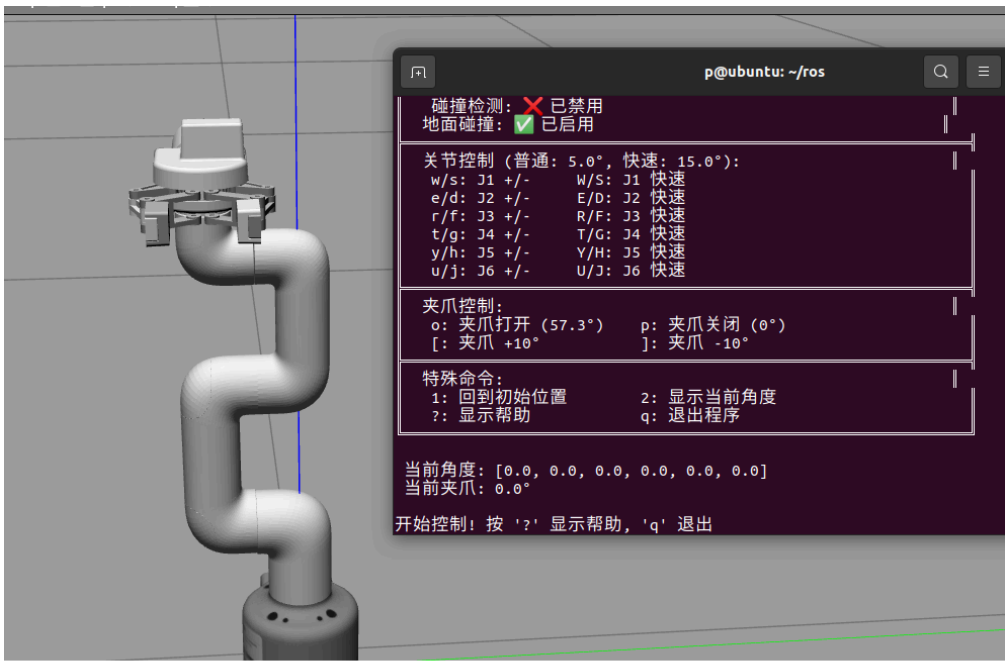
As in the previous section, you will see the robot arm model loaded in Gazebo with all joints at their initial pose. Then open another terminal and enter:

```
source devel/setup.bash
rosrun mycobot_280m5_gazebo_gripper teleop_keyboard_gazebo.py _port:=/dev/ttyACM0 _baud:=115200
```

If successful, you will see the following output in the terminal:

```
Mycobot_280_m5_gripper Teleop Keyboard Controller
---------------------------
Moving options (control the angle of each joint):

w: joint2_to_joint1++   s: joint2_to_joint1--
e: joint3_to_joint2++   d: joint3_to_joint2--
r: joint4_to_joint3++   f: joint4_to_joint3--
t: joint5_to_joint4++   g: joint5_to_joint4--
y: joint6_to_joint5++   h: joint6_to_joint5--
u: joint6output_to_joint6++ j: joint6output_to_joint6--

o: open gripper          p: close gripper

Other:
1 - Go to home pose
q - Quit
```

Based on the prompts above, you can learn how to control the robot arm. Each key press moves the robot arm and the Gazebo model by 1 degree. You can try holding down one of the keys to reach a certain pose.



Introduction to ROS2

ROS2's predecessor is ROS, which stands for Robot Operating System. However, ROS itself is not an operating system, but a software library and tool set. The emergence of ROS solved the communication problem of various robot components. Later, more and more robot algorithms were integrated into ROS. ROS2 inherited ROS and is more powerful and easier to use than ROS.

Design goals and features of ROS2

ROS2 shoulders the historical mission of changing the era of intelligent robots. At the beginning of the design, it was considered to meet the needs of various robot applications.

- **Multi-robot system:** In the future, robots are no longer independent individuals, and robots also need to communicate and collaborate. ROS2 provides standard methods and communication mechanisms for the application of multi-robot systems.
- **Cross-platform:** The control platforms used will be very different in different robot application scenarios. In order to enable all robots to run ROS2, ROS2 can run cross-platform on Linux, Windows, MacOS, and RTOS.
- **Real-time:** Robot motion control and many behavioral strategies require robots to be real-time. For example, a robot must reliably detect pedestrians in front of it within 100 milliseconds, or complete kinematic and dynamic calculations within 1 millisecond. ROS2 provides basic requirements in real time like this.
- **Productization:** A large number of robots have entered our lives, and there will be more and more in the future. ROS2 can not only be used in the robot R&D stage, but can also be directly installed in products and enter the consumer market. This also poses a huge challenge to the stability and robustness of ROS2.
- **Project management:** Robot development is a complex system engineering. Project management tools and mechanisms for the entire process of design, development, debugging, testing, and deployment will also be reflected in ROS2, making it easier for us to develop robots.

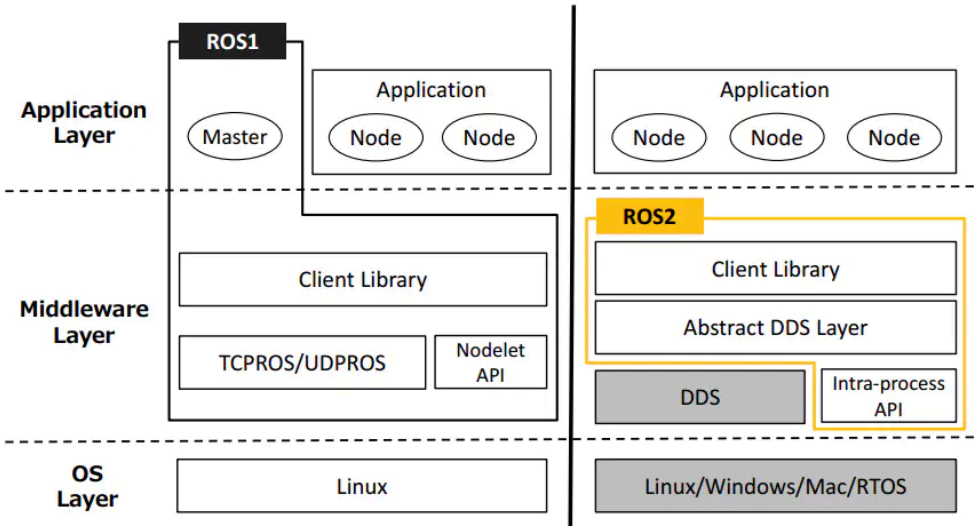
Release version

The corresponding release version and maintenance cycle of ROS2 and Ubuntu.

ROS2 version	Release date	Maintenance period	Ubuntu version
Dashing	2019.5	2021.5	Ubuntu 18.04 (Bionic Beaver)
Eloquent	2019.11	2020.11	Ubuntu 18.04 (Bionic Beaver)
Foxy	2020.6	2023.5	Ubuntu 20.04(Focal Fossa)
Galactic	2021.5	2022.11	Ubuntu 20.04(Focal Fossa)
Humble	2022.5	2027.5	Ubuntu 22.04(Jammy Jellyfish)

Comparison between ROS and ROS2

ROS2 redesigned the system architecture. The architectural changes between the two generations of ROS are as follows:



- **OS Layer:** OS layer. In ROS2, it can be built on Linux or other systems, even bare metal without an operating system.
- **Middleware Layer:** Middleware layer. The communication system of ROS1 is based on TCPROS/UDPROS, while the communication system of ROS2 is based on DDS. DDS is a standard solution for data publishing/subscription in distributed real-time systems.
- **Application Layer:** Application layer. ROS1 relies on ROS Master, while in ROS2, a discovery mechanism called "Discovery" is used between nodes to help each other establish connections.

ROS has designed a complete set of communication mechanisms (topics, services, parameters, actions) to simplify robot development. Through this mechanism, the various components of the robot can be connected. This mechanism designs a node called Ros Master, and the communication of all other components must go through the master node. Once the master node hangs up, it will cause the communication of the entire robot system to collapse! Therefore, the instability of Ros cannot be used to make some high-risk robots such as autonomous driving. In addition, there are the following disadvantages:

- TCP-based communication has poor real-time performance and high system overhead
- Not friendly to python3 support
- Incompatible message mechanism
- No encryption mechanism, low security

ROS2 first removes the master node in ROS. After removing the master node, each node can discover each other through the DDS node. Each node is equal and can achieve one-to-one, one-to-many, and many-to-many communication. After using DDS for communication, reliability and stability are enhanced.

Compared with **ROS** that only supports Linux systems, **ROS2** also supports Windows, Mac and even RTOS platforms.

ROS2 Development Guide

ROS2 Installation Guide

ROS2 Basic Use

rivz Use Guide

ROS2 Environment Setup

This tutorial provides two methods for setting up an Ubuntu 20.04/22.04 + ROS1 development environment:

- **Method 1: Importing a Virtual Machine Image (Recommended)** → Quickest to get started, with a complete built-in environment
- **Method 2: Customizing the Installation Environment** → Building from scratch, suitable for users who require flexible customization

Method 1: Importing A Virtual Machine Image

Applicable Use Case: Using ROS2 or MoveIt2

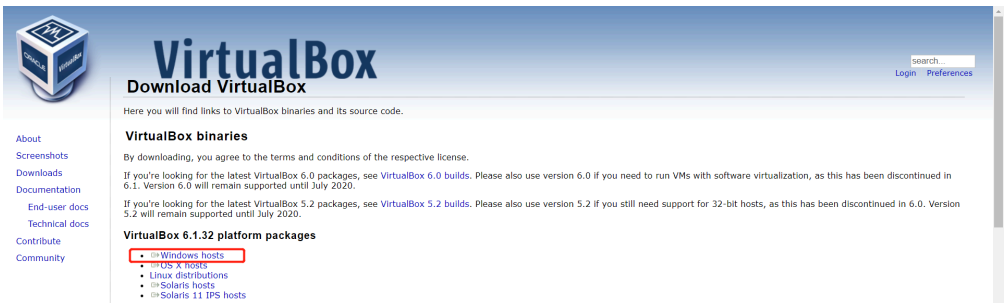
> **Note:** To simplify environment setup, we will provide a Linux system image (Ubuntu 22.04), the Virtual Box installation package, and its extensions. The following instructions will show you how to install Virtual Box and import the Linux system image (the default password is 123). **Built-in Environment:** ROS2 humble + MoveIt2 + Git + pymycobot + mycobot_ros2

1 Install the virtual machine

- Go to the official website to download the virtual machine Virtual Box
- VirtualBox installation package: Windows hosts
- VirtualBox Extension Pack: VirtualBox 7.0.10 Oracle VM VirtualBox Extension Pack
- For instructions on installing VirtualBox extension packs, please refer to: Extension Pack Installation Tutorial

Of course, if you already have your virtual machine, you can skip this step.

We chose to download Virtual box because it is free.



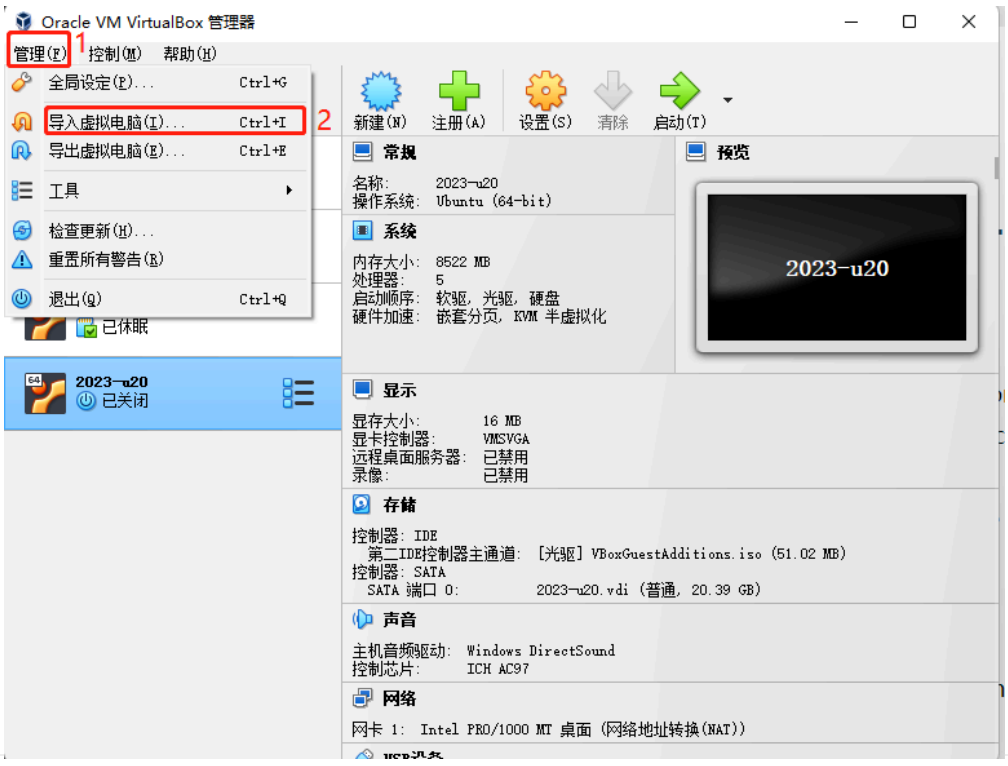
2 Download Linux System Image

Click to download:Linux ubuntu22.04

3 Import Linux System Image

> **Note:** For the import method, please refer to the import method of Ubuntu 20.04 system

In the Virtual Box interface, click Management -> Import Virtual Computer -> Select Virtual Image -> Select the installation path and import, and then install it as follows.




导入虚拟电脑
要导入的虚拟电脑
请选择导入源。可以选择一个本地的文件系统导入OVF包，也可以选择从云服务导入。
来源(S)：
本地文件系统
选择文件导入虚拟电脑。VirtualBox 当前支持导入以开放式虚拟化格式 (OVF) 保存的虚拟电脑。
若要继续，请在下面选择要导入的文件。
文件(F)：
帮助(H)
专家模式(E)
返回(B)
下一步(N)
取消(C)


导入虚拟电脑
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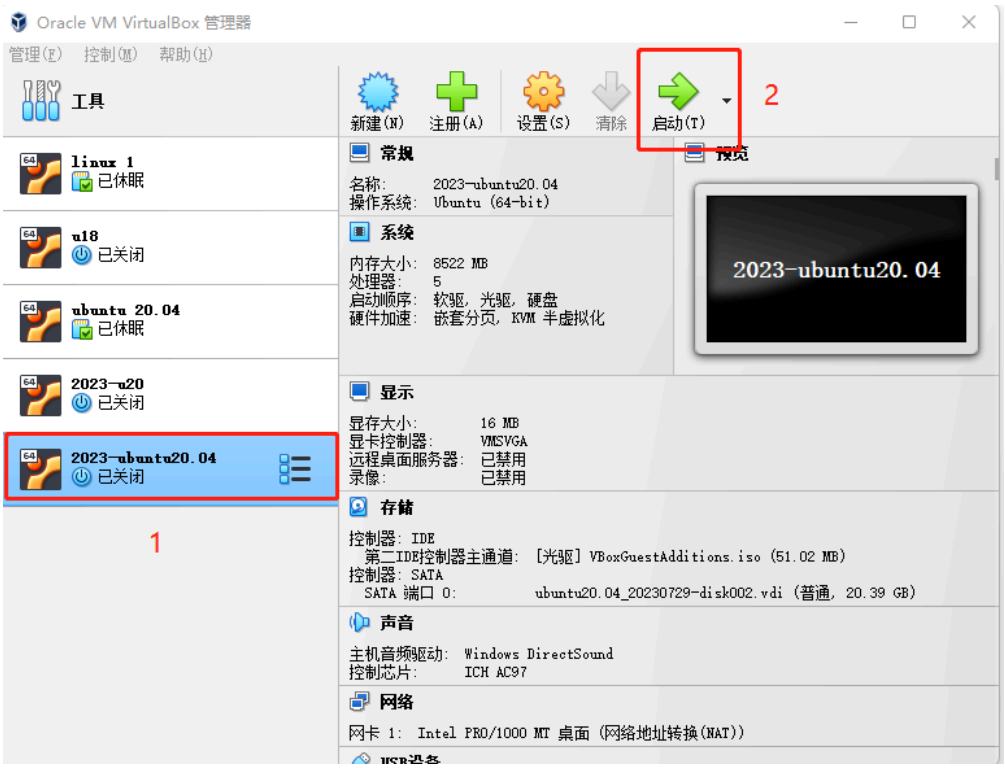
来源(S)：
本地文件系统
选择文件导入虚拟电脑。VirtualBox 当前支持导入以开放式虚拟化格式 (OVF) 保存的虚拟电脑。
若要继续，请在下面选择要导入的文件。
文件(F)：
D:\ROS2\VirtualBox\ubuntu20.04_ROS1_V20230731.ova
帮助(H)
专家模式(E)
返回(B)
下一步(N)
取消(C)

Just wait for the image to be imported. The installation is successful as shown below.



Then start the system, the default password is **123**

4 Update pymycobot

To use the latest robotic arm driver library, open a terminal and execute the following command:

```
pip3 install pymycobot --upgrade
```

5 Update mycobot_ros2

To ensure users have the latest official packages, navigate to the /home/u22/catkin_ws/src folder through a file manager, open a console terminal (shortcut Ctrl+Alt+T), and enter the following command to update:

```
# Clone the code from GitHub
cd ~/colcon_ws/src
# Delete the original mycobot_ros2 package
sudo rm -rf mycobot_ros2

# For the humble branch
git clone -b humble --depth 1 https://github.com/elephantrobotics/mycobot_ros2.git
# For the foxy branch
git clone -b foxy --depth 1 https://github.com/elephantrobotics/mycobot_ros2.git
# For the galactic branch
git clone -b galactic --depth 1 https://github.com/elephantrobotics/mycobot_ros2.git
cd # Return to the workspace
colcon build # Build the code in the workspace
source install/setup.bash # Add environment variables
```

To reduce compilation time, you can compile individual packages. `package_name` is the specific package name; please modify it accordingly.

```
cd ~/colcon_ws
colcon build --packages-select package_name
source install/setup.bash
```

Method 2: Customizing The Installation Environment

1 Virtual Machine Installation

Note: When installing the virtual machine system, please install the **Ubuntu 20.04 version of the system**. The installation method is the same as Ubuntu 18.04. If you want to use the **moveIt2** function, you need to install **Ubuntu 22.04 version system**.

To install different versions of Ubuntu systems in Linux, please refer to ROS1 Environment Setup section.

2 ROS2 Installation

The basic development environment construction requires the installation of the robot operating system ROS2 and the git version manager. The following describes their installation methods and processes respectively.

For **myCobot 280-M5**, **myCobot 320-M5**, **myPalletizer 260-M5** and **mechArm 270-M5** devices, please refer to the following installation methods and processes.

myCobot 280-PI, **myCobot 320-PI**, **myPalletizer 260-PI** and **mechArm 270-PI** devices only need to execute the **mycobot_ros2** installation package.

2.1 Version Selection

ROS2 has a one-to-one correspondence with Ubuntu. Different versions of Ubuntu correspond to different versions of ROS2. For reference, see the following website: http://docs.ros.org/en/foxy/Releases.html

Here are the ROS2 versions supported by Ubuntu:

ROS2 version	Release date	Maintenance deadline	Ubuntu version
Foxy	June 5, 2020	May 2023	Ubuntu 20.04(Focal Fossa)
Galactic	May 23, 2021	November 2022	Ubuntu 20.04(Focal Fossa)
Humble	May 23, 2022	May 2027	Ubuntu 22.04(Jammy Jellyfish)

Please install the corresponding ROS2 version according to the Ubuntu version you installed, moveIt2 only supports the humble version.

If the versions are different, the download will fail. Here we choose Ubuntu 20.04 (recommended), and the corresponding ROS2 version is ROS2 Foxy

> NOTE: Currently we do not provide any reference for installing ROS2 on Windows. If necessary, please refer to http://docs.ros.org/en/foxy/Installation/Alternatives/Windows-Development-Setup.html

2.2 Start installation

1 Add source

There is no ROS2 in the software source list of Ubuntu itself Software source, so you need to first **configure the ROS2 software source to the software list warehouse** before you can download ROS2. Open a console terminal (shortcut key `Ctrl+Alt+T`), enter the following command:

- Official source:

```
echo "deb [arch=$(dpkg --print-architecture) signed-by=/usr/share/keyrings/ros-archive-keyring.gpg] http://packages.ros.or
```

- If the download speed is slow, it is recommended to select a mirror source nearby to replace the above command. For example, Huawei Cloud is:

```
echo "deb [arch=$(dpkg --print-architecture)] https://repo.huaweicloud.com/ros2/ubuntu/ $(lsb_release -cs) main" | sudo te
```

2 Set the key

Configure the public network key, this step is to let the system confirm that our path is safe, so that there is no problem downloading the file, otherwise it will be deleted immediately after downloading:

```
sudo apt install curl gnupg2 -y
curl -s https://gitee.com/ohhuo/rosdistro/raw/master/ros.asc | sudo apt-key add -
```

3 Installation

After adding the new software source, you need to **update the software source list**, open a console terminal (shortcut key `Ctrl+Alt+T`), and enter the following command:

```
sudo apt-get update
```

Execute **install ROS2**, open a console terminal (shortcut key `Ctrl+Alt+T`), please enter the following command according to your Ubuntu version:

```
# Ubuntu 20.04 foxy version
sudo apt install ros-foxy-desktop
```

```
# Ubuntu 20.04 galactic version
sudo apt install ros-galactic-desktop
```

```
# Ubuntu 22.04 humble version
sudo apt install ros-humble-desktop
```

The installation process takes a long time, please wait patiently.

After the installation is complete, refresh the environment variables:

```
source /opt/ros/foxy/setup.bash
```

2.3 Set Up The Ros2 Environment

In order to avoid the need to re-validate the ROS2 function path every time the terminal window is closed, we can **configure the path to the environment variable**, so that the ROS2 function path can be automatically validated every time a new terminal is opened. Execute the following commands in the terminal in sequence, open a console terminal (shortcut key `Ctrl+Alt+T`) and execute the following commands:

```
# Ubuntu 20.04 foxy version
# Add the ros environment to the environment variables of the current console
echo "source /opt/ros/foxy/setup.bash" >> ~/.bashrc
```

```
# Ubuntu 20.04 galactic version
echo "source /opt/ros/galactic/setup.bash" >> ~/.bashrc
```

```
# Ubuntu 22.04 humble version
echo "source /opt/ros/humble/setup.bash" >> ~/.bashrc
```

```
source ~/.bashrc
```

2.4 Install ROS2 Additional Dependencies

Enter the following command in the terminal **Install ROS2 additional dependencies**, open a console terminal (shortcut `Ctrl+Alt+T`):

```
sudo apt install python3-argcomplete -y
```

```
sudo apt install ros-foxy-xacro
```

```
sudo apt-get install python3-colcon-common-extensions
```

```
# Ubuntu 20.04 foxy version
sudo apt install ros-foxy-joint-state-publisher-gui
```

```
# Ubuntu 20.04 galactic version
sudo apt install ros-galactic-joint-state-publisher-gui
```

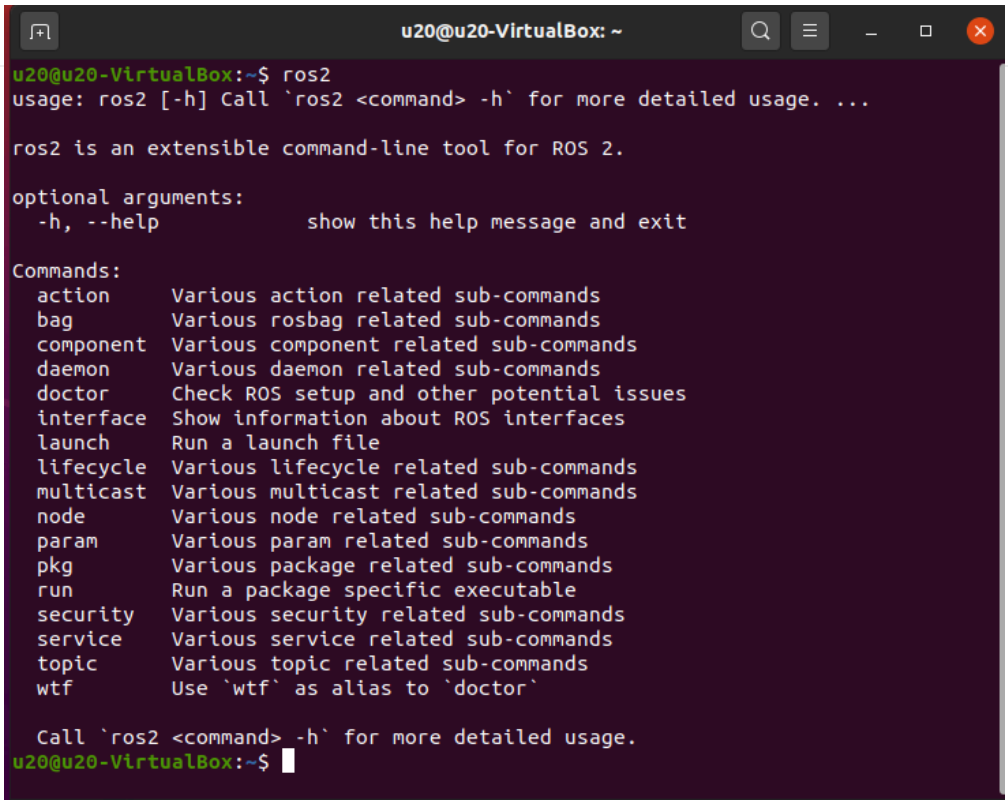
```
# Ubuntu 22.04 humble version
sudo apt install ros-humble-joint-state-publisher-gui
sudo apt install ros-humble-xacro
```

2.5 Verify Installation

To verify ROS2 To check whether the installation is successful, open a console terminal (shortcut key `Ctrl+Alt+T`), and execute the following command in the terminal:

```
ros2
```

When the following interface is displayed, it means that ROS2 is installed successfully



3 MoveIt2 Installation

> **Note:** Only the installation method for Ubuntu 22.04 is provided here

MoveIt2 is a functional package of a series of mobile operations in ros2, mainly including motion planning, collision detection, kinematics, 3D perception, operation control and other functions.

3.1 Update The Software Source List

Open a console terminal (shortcut key Ctrl+Alt+T), and enter the following command in the terminal window to update the software source list:

```
sudo apt update
```

3.2 Install MoveIt2

```
sudo apt-get install ros-humble-moveit
```

```
sudo apt install ros-humble-ros2-control ros-humble-ros2-controllers ros-humble-joint-trajectory-controller ros-humble-joi
```

4 Git Installation

4.1 Update The Software Source List

Open a console terminal (shortcut key `Ctrl+Alt+T`), and enter the following command in the terminal window to **update the software source list**:

```
sudo apt-get update
```

4.2 Installation Git

Open a console terminal (shortcut key `Ctrl+Alt+T`), enter the following command in the terminal window, **execute git installation**:

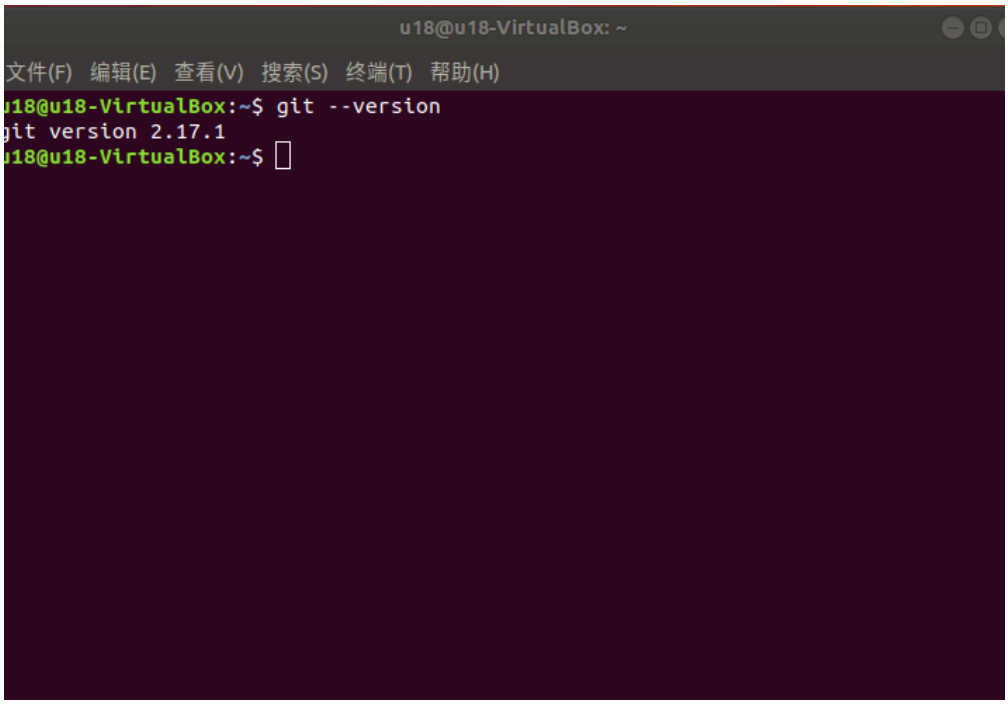
```
sudo apt-get install git
```

4.3 Verify Installation

Read git version, open a console terminal (shortcut key `Ctrl+Alt+T`), enter the following command in the terminal window:

```
git --version
```

The git version number can be displayed in the terminal, as shown below, which means the installation is successful.



5 mycobot_ros2 Installation

`mycobot_ros2` is a ROS2 package launched by ElephantRobotics, which is compatible with its desktop six-axis robot arm mycobot series.

Project address: http://github.com/elephantrobotics/mycobot_ros2

5.1 Prerequisites

Before installing the package, please ensure that you have a ros2 workspace.

Here we give **sample commands for creating a workspace**. Open a console terminal (shortcut key `Ctrl+Alt+T`), and enter the following command in the command line:

```
mkdir -p ~/colcon_ws/src # Create a folder
```

Add workspace environment:

The official default ROS2 workspace is `colcon_ws` .

```
echo "source ~/colcon_ws/install/setup.bash" >> ~/.bashrc
```

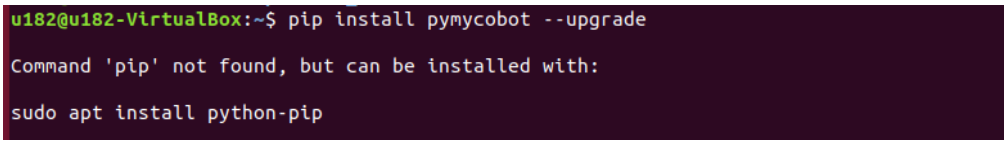
```
source ~/.bashrc
```

5.2 Installation

NOTE:

- This package depends on ROS2 and MoveIT2. Make sure to install ROS2 and MoveIT2 successfully before using it.
- The interaction between this package and the real robot arm depends on PythonApi - `pymycobot`
- The Api project is: https://github.com/elephantrobotics/pymycobot
- Quick installation: `pip install pymycobot --upgrade`

When executing the pip install pymycobot --upgrade command, if the following error message appears:



Enter the following command to install pip according to the prompt

```
sudo apt install python3-pip
```

After pip is installed, execute it again in the terminal

```
pip install pymycobot --upgrade
```

- The installation method depends on Git, please make sure Git is installed on your computer.
- Please download the code from different branches depending on your ROS2 version:
  - Ubuntu 20.04 / ROS2 Foxy - branch `foxy`
  - Ubuntu 20.04 / ROS2 Galactic - branch `galactic`
  - Ubuntu 22.04 / ROS2 Humble - branch `humble`

The official default ROS2 workspace is `colcon_ws` .

```
cd colcon_ws/src # Enter the src folder in the workspace
# For the humble branch
git clone -b humble --depth 1 https://github.com/elephantrobotics/mycobot_ros2.git
# For the foxy branch
git clone -b foxy --depth 1 https://github.com/elephantrobotics/mycobot_ros2.git
# For the galactic branch
git clone -b galactic --depth 1 https://github.com/elephantrobotics/mycobot_ros2.git
cd .. # Return to the workspace
colcon build --symlink-install # Build the code in the workspace. --symlink-install: Avoids recompiling every time you mod
source install/setup.bash # Add environment variables
```

To reduce compilation time, you can compile a certain package separately, where `package_name` is the name of the specific package. Please modify it according to your actual situation.

```
cd ~/colcon_ws
colcon build --packages-select package_name
source install/setup.bash
```

At this point, the ROS2 environment has been set up. For the use of ROS2, please refer to Rviz2 Introduction and Usage.

Basic Tools

In this chapter, you will learn about the common command tools of ROS2.

Topics

ROS 2 breaks down complex systems into many modular nodes. Topics are an important element of the ROS graph, acting as a bus for nodes to exchange messages. Topics are one of the main ways data moves between nodes, and therefore between different parts of the system.

Specific reference: Official tutorial

- **topics help**

```
ros2 topics -h
```

- **Start turtlesim and keyboard control**

```
ros2 run turtlesim turtlesim_node
ros2 run turtlesim turtle_teleop_key
```

- **Node relationship graph**

```
rqt_graph
```

- **Understand topics related commands**

```
ros2 topics -h
```

- **Topic list**

```
ros2 topic list
ros2 topic list -t # Display the corresponding message type
```

- **View topic content**

```
ros2 topic echo <topic_name>
ros2 topic echo /turtle1/cmd_vel
```

- **Display topic related information, type**

```
ros2 topic info <topic_name>
# Output /turtle1/cmd_vel topic interface related information
ros2 topic info /turtle1/cmd_vel
```

- **Display interface related information**

```
ros2 interface show <msg_type>
# Output geometry_msgs/msg/Twist interface related information
ros2 interface show geometry_msgs/msg/Twist
```

- **Publish command**

```
ros2 topic pub <topic_name> <msg_type> '<args>'
# Publish speed command
ros2 topic pub --once /turtle1/cmd_vel geometry_msgs/msg/Twist "{linear: {x: 2.0, y: 0.0, z: 0.0}, angular: {x: 0.0, y: 0.
# Publish speed commands at a certain frequency
ros2 topic pub --rate 1 /turtle1/cmd_vel geometry_msgs/msg/Twist "{linear: {x: 2.0, y: 0.0, z: 0.0}, angular: {x: 0.0, y:
```

- **View the frequency of topic publishing**

```
ros2 topic hz <topic_name>
#Output/turtle1/cmd_vel publishing frequency
ros2 topic pub --rate 1 /turtle1/cmd_vel geometry_msgs/msg/Twist "{linear: {x: 2.0, y: 0.0, z: 0.0}, angular: {x: 0.0, y:
```

Nodes

Each node in ROS should be responsible for a single module purpose (e.g., one node for controlling wheel motors, one node for controlling laser rangefinders, etc.). Each node can send and receive data to other nodes through topics, services, actions, or parameters. A complete robotic system consists of many nodes working together. In ROS 2, a single executable file (C++ program, Python program, etc.) can contain one or more nodes.

Specific reference: Official tutorial

- **nodes help**

```
ros2 nodes -h
```

- **Start turtlesim and keyboard control**

```
ros2 run turtlesim turtlesim_node
ros2 run turtlesim turtle_teleop_key
```

- **View the node list**

```
ros2 node list
```

- **View the node relationship graph**

```
rqt_graph
```

- **Remap**

```
ros2 run turtlesim turtlesim_node --ros-args --remap __node:=my_turtle
ros2 node list
```

- **View node information**

```
ros2 node info <node_name>
ros2 node info /my_turtle
```

Services

Services are another way for nodes in the ROS graph to communicate. Services are based on a call and response model, rather than the publisher-subscriber model of topics. While topics allow nodes to subscribe to a stream of data and get continuous updates, services only provide data when specifically called by a client.

Specific reference: Official tutorial

- **services help**

```
ros2 service -h
```

- **Start turtlesim and keyboard control**

```
ros2 run turtlesim turtlesim_node
ros2 run turtlesim turtle_teleop_key
```

- **View the service list**

```
ros2 service list
# Display service list and message type
ros2 service list -t
```

- **View the message type received by the service**

```
ros2 service type <service_name>
ros2 service type /clear
```

- **Find services that use a certain message type**

```
ros2 service find <type_name>
ros2 service find std_srvs/srv/Empty
```

- **View service message type definition**

```
ros2 interface show <type_name>.srv
ros2 interface show std_srvs/srv/Empty.srv
```

- **Call service command, clear walking track**

```
ros2 service call <service_name> <service_type>
ros2 service call /clear std_srvs/srv/Empty
```

- **Generate a new turtle**

```
ros2 service call /spawn turtlesim/srv/Spawn "{x: 2, y: 2, theta: 0.2, name: 'turtle2'}"
```

Parameters

Parameters are configuration values for a node. You can think of parameters as node settings. Nodes can store parameters as integers, floating point numbers, Boolean values, strings, and lists. In ROS 2, each node maintains its own parameters. For more background on parameters, see the concepts documentation.

Specific reference: Official tutorial

- **parameters help**

```
ros2 param -h
```

- **Start turtlesim and keyboard control**

```
ros2 run turtlesim turtlesim_node
ros2 run turtlesim turtle_teleop_key
```

- **View service list**

```
ros2 param list
```

- **Get parameter value**

```
ros2 param get <node_name> <parameter_name>
ros2 param get /turtlesim background_g
```

- **Set parameter value**

```
ros2 param set <node_name> <parameter_name> <value>
ros2 param set /turtlesim background_r 150
```

- **Export parameter values**

```
ros2 param dump <node_name>
ros2 param dump /turtlesim
```

- **Import parameters independently**

```
ros2 param load <node_name> <parameter_file>
ros2 param load /turtlesim ./turtlesim.yaml
```

- **Start node and import parameters**

```
ros2 run <package_name> <executable_name> --ros-args --params-file <file_name>
ros2 run turtlesim turtlesim_node --ros-args --params-file ./turtlesim.yaml
```

Actions

Actions are a type of communication in ROS 2 used for long-running tasks. They consist of three parts: a goal, a response, and a result.

Actions are based on topics and services. They function like services, except that actions are preemptible (you can cancel them while they are executing). They also provide steady feedback, rather than services that return a single response.

Actions use a client-server model, similar to the publisher-subscriber model (described in the topic tutorial). An "action client" node sends a target to an "action server" node, which confirms the target and returns a stream of feedback and results.

Specific reference: Official tutorial

- **action help**

```
ros2 action -h
```

- **Start turtlesim and keyboard control**

```
ros2 run turtlesim turtlesim_node
ros2 run turtlesim turtle_teleop_key
```

Press G|B|V|C|D|E|R|T to rotate, press F to cancel

- **View the server and client of the node action**

```
ros2 node info /turtlesim
```

- **View the action list**

```
ros2 action list
ros2 action list -t # DisplayAction type
```

- **View action information**

```
ros2 action info <action>
ros2 action info /turtle1/rotate_absolute
```

- **View action message content**

```
ros2 interface show turtlesim/action/RotateAbsolute
```

- **Send action target information**

```
ros2 action send_goal <action_name> <action_type>
ros2 action send_goal /turtle1/rotate_absolute turtlesim/action/RotateAbsolute "{theta: 1.57}"
# With feedback information
ros2 action send_goal /turtle1/rotate_absolute turtlesim/action/RotateAbsolute "{theta: 0}" --feedback
```

RQt

RQt is a graphical user interface framework that implements various tools and interfaces in the form of plugins. You can run all your existing GUI tools as dockable windows in RQt! The tools can still be run in the traditional standalone way, but RQt makes it easier to manage all the different windows in a single screen layout.

Specific reference: Official Tutorial

You can easily run any RQt tool/plugin by:

```
rqt
```

- **rqt help**

```
rqt -h
```

- **Start turtlesim and keyboard control**

```
ros2 run turtlesim turtlesim_node
ros2 run turtlesim turtle_teleop_key
```

- Action browser: / Plugins -> Actions ->Action Type Browser
- Parameter reconfiguration: / Plugins -> configuration ->Parameter Reconfigure
- Node graph: /Node Graph
- Control steering: /Plugins -> Robot Tools -> Robot Steering
- Service call: /Plugins -> Services -> Service Caller
- Service type browser: Plugins -> Services -> Service Type Browser
- Message publishing: Plugins -> Topics -> Message Publisher
- Message type browser: Plugins -> Topics -> Message Type Browser
- Topic list: Plugins -> Topics -> Topic Monitor
- Draw a curve: Plugins -> Visualization -> Plot
- **View log: rqt_console**

```
ros2 run rqt_console rqt_console
ros2 run turtlesim turtlesim_node
ros2 topic pub -r 1 /turtle1/cmd_vel geometry_msgs/msg/Twist "{linear: {x: 2.0, y: 0.0, z: 0.0}, angular: {x: 0.0,y: 0.0,z
```

TF2

tf2 It is a transformation library that allows users to track multiple coordinate systems over time. tf2 maintains the relationship between coordinate systems in a time-buffered tree structure and lets users transform points, vectors, etc. between any two coordinate systems at any desired time point.

Specific reference: Official Tutorial

Let's start by installing the demo package and its dependencies.

```
sudo apt-get install ros-foxy-turtle-tf2-py ros-foxy-tf2-tools ros-foxy-tf-transformations
```

- **Follow**
- launch starts two turtles, the first turtle automatically follows the second

```
ros2 launch turtle_tf2_py turtle_tf2_demo.launch.py
```

- Control the movement of the first turtle through the keyboard

```
ros2 run turtlesim turtle_teleop_key
```

- **View TF tree**

```
ros2 run tf2_tools view_frames.py
evince frames.pdf
```

- **View the relationship between the two coordinate systems**

```
ros2 run tf2_ros tf2_echo [reference_frame] [target_frame]
ros2 run tf2_ros tf2_echo turtle2 turtle1
```

- **View TF relations on rviz**

```
ros2 run rviz2 rviz2 -d $(ros2 pkg prefix --share turtle_tf2_py)/rviz/turtle_rviz.rviz
```

URDF

URDF is the Unified Robot Description Format, which is used to specify robot geometry and organization in ROS.

Specific reference: Official tutorial

- **Full syntax**

```
<robot>
    # describe:
    # Parameters: name=""
    #  Child node:
        <link>
            # Description:
            # Parameters: name=""
            # Child node:
                <visual>
                    # describe:
                    # Parameters:
                    # child nodes:
                        <geometry>
                            # description
                            # parameters
                            # Child node:
                                <cylinder />
                                    # Description:
                                    # Parameters:
                                        # length="0.6"
                                        # radius="0.2"
                                <box />
                                    # description
                                    # Parameters:size="0.6 0.1 0.2"
                                <mesh />
                                    #  Description
                                    #Parameters: filename="package://urdf_tutorial/meshes/l_finger_tip.dae"
                        <collision>
                            # Description: collision element, prioritized
                            # parameters
                            # child node
                                <geometry>
                        <inertial>
                            # description
                            # parameters
                            # Child nodes:
                                <mass />
                                    # description: mass
                                    # Parameters: value=10
                                <inertia />
                                    # Description: Inertia
                                    # Parameters: i+"Cartesian product of xyz" (9 in total)="0.4"
                        <origin />
                            # Description:
                            # Parameters:
                                # rpy="0 1.5 0"
                                # xyz="0 0 -0.3"
                        <material />
                            # Description
                            # Parameters: name="blue"
```

```
        <joint>
            # Description
            # Parameters:
                # name=""
                # type=""
                    # fixed
                    # prismatic
            # child node
                <parent />
                    # Description
                    # Parameters: link=""
                <child />
                    # Description:
                    # Parameters: link=""
                <origin />
                    # Description:
                    # Parameters: xyz="0 -0.2 0.25"
                <limit />
                    # Description
                    # Parameters:
                        # effort="1000.0"    maximum effort
                        # lower="-0.38"      Joint upper limit (radians)
                        # upper="0"          Joint lower limit (radians)
                        # velocity="0.5"     Maximum velocity
                <axis />
                    # Description:  Press ? axis rotation
                    # Parameters: xyz="0 0 1", along the Z axis
        <material>
            # Description:
            # Parameters: name="blue"
            # child node:
                <color />
                    # description:
                    # Parameters: rgba="0 0 0.8 1"
```

- **Download source code**

```
cd ~/dev_ws
git clone - b ros2 https://github.com/ros/urdf_tutorial.git src/urdf_tutorial
```

- **Compile source code**

```
colcon build --packages-select urdf_tutorial
```

- **Run the example**

```
ros2 launch urdf_tutorial display.launch.py model:=urdf/01-myfirst.urdf
```

Launch

The launch system in ROS 2 is responsible for helping users describe the configuration of their system and then executing it accordingly.The configuration of the system consists of the programs to run, where to run them, the arguments to pass to them, and ROS-specific conventions that make it easy to reuse components throughout the system by providing different configurations for each component. It is also responsible for monitoring the status of launched processes and reporting and/or responding to changes in the status of those processes.

Launch files written in Python, XML, or YAML can start and stop different nodes, as well as trigger and handle various events.

Specific reference: Official Tutorial

Setup

Create a new directory to store your launch file:

` ``bash mkdir launch

```
from launch import LaunchDescription
from launch_ros.actions import Node


def generate_launch_description():
    return LaunchDescription([
        Node(
            package='turtlesim',
            namespace='turtlesim1',
            executable='turtlesim_node',
            name='sim'
        ),
        Node(
            package='turtlesim',
            namespace='turtlesim2',
            executable='turtlesim_node',
            name='sim'
        ),
        Node(
            package='turtlesim',
            executable='mimic',
            name='mimic',
            remappings=[
                ('/input/pose', '/turtlesim1/turtle1/pose'),
                ('/output/cmd_vel', '/turtlesim2/turtle1/cmd_vel'),
            ]
        )
    ])
```

Run the ros2 launch file

To run the launch file created above, go to the directory you created earlier and run the following command:

The syntax format is:

```
ros2 launch <package_name> <launch_file_name>
```

```
cd launch
ros2 launch turtlesim_mimic_launch.py
```

- **launch help**

```
ros2 launch -h
```

- **Run Node**

```
ros2 launch turtlesim multisim.launch.py
```

- **Check the parameters of the launch file**

```
ros2 launch turtlebot3_fake_node turtlebot3_fake_node.launch.py -s
ros2 launch turtlebot3_fake_node turtlebot3_fake_node.launch. py --show-arguments
ros2 launch turtlebot3_bringup robot.launch.launch.py -s
```

- **Run launch file with parameters**

```
ros2 launch turtlebot3_bringup robot.launch.launch.py usb_port:=/dev/ opencr
```

- **Run the node and debug**

```
ros2 launch turtlesim turtlesim_node.launch.py -d
```

- **Only output node description**

```
ros2 launch turtlesim turtlesim_node.launch. py -p
```

- **Run component**

```
ros2 launch composition composition_demo.launch.py
```

Run

run is used to run a single node, component program.

- **run help**

```
ros2 run -h
```

- **run node**

```
ros2 run turtlesim turtlesim_node
```

- **run node with parameters**

```
ros2 run turtlesim turtlesim_node --ros-args -r __node:=turtle2 -r __ns:=/ns2
```

- **Run component container**

```
ros2 run rclcpp_components component_container
```

- **Run component** ```bash ros2 run composition manual_composition

Package

A package can be thought of as a container for your ROS 2 code. If you want to be able to install your code or share it with others, you need to organize it in a Packages allow you to publish your ROS 2 work and allow others to easily build and use it.

Package creation in ROS 2 uses ament as its build system and colcon as its build tool. You can create packages using the officially supported CMake or Python, but other build types do exist.

Specific parameters: Official tutorial

Creating a Workspace

Create a new directory for each new workspace. The name is not important, but it helps indicate the purpose of the workspace. Let's choose the directory name ros2_ws for the "development workspace":

```
mkdir -p ~/ros2_ws/src
cd ~/ros2_ws/src
```

- **pkg help**

`ros2 pkg -h`

- **List function packages**

```
ros2 pkg executable turtlesim
```

- **Output a function package executable program**

```
ros2 pkg executable turtlesim
```

- **Create Python Packages**

Before running the package creation command, make sure you are in the src folder.

```
cd ~/ros2_ws/src
```

The command syntax for creating a new package in ROS 2 is:

```
ros2 pkg create --build-type ament_python <package_name>
# You will use the optional parameter -- node-name Create a simple Hello World type executable file in the package.
ros2 pkg create --build-type ament_python --node-name my_node my_package
```

- **Build package**

Put the package in the workspace Especially valuable because you can build many packages at once by running colcon build in the workspace root. Otherwise, you would have to build each package individually.

```
# Return to the workspace directory:
cd ~/ros2_ws# Now you can build your package:
colcon build
```

- **Source setup file**

To use your new package and executable, first open a new terminal and source your main ROS 2 installation.

Then, from the ros2_ws directory, run the following command to source your workspace:

```
source install/setup.bash
```

Now that your workspace is added to your path, you will be able to use your new package's executable.

- **Use package**

To run the executable you created during package creation using the --node-name parameter, enter the following command:

```
ros2 run my_package my_node
```

A brief introduction and use of rviz2

rviz is a three-dimensional visualization platform in ROS. On the one hand, it can realize the graphical display of external information. On the other hand, it can also release control information to objects through rviz, thereby realizing the monitoring and control of robots.

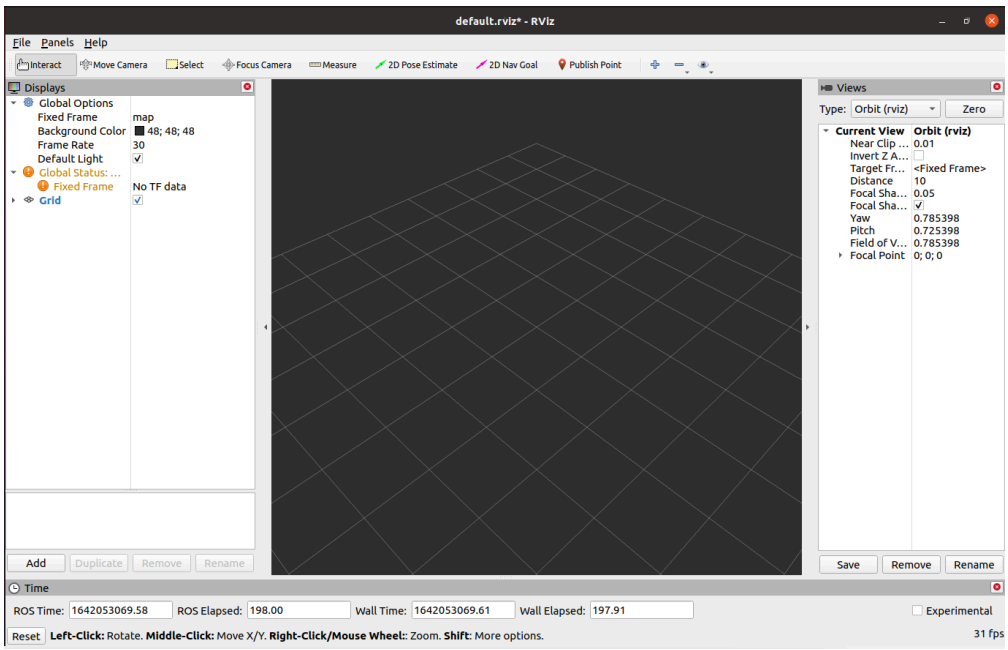
Introduction to rviz2

The successful installation of ros2 indicates that rviz2 is also successfully installed, because the installation of ros2 includes rviz2.

Open a new terminal (shortcut `Ctrl+Alt+T`) and enter the command to open rviz2

```
rviz2
```

Open rviz2 and the following interface will be displayed:



Introduction to each area

- On the left is the display list. The display is something that draws something in the 3D world and may have some options available in the display list.
- Above is the toolbar, which allows the user to select multiple functions with various function keys
- The middle part is the 3D view: it is the main screen for viewing various data in three dimensions. The background color, fixed frame, grid, etc. of the 3D view can be set in detail in the Global Options and Grid items displayed on the left.
- Below is the time display area, including system time and ROS time.
- On the right is the observation angle setting area, where different observation angles can be set.

In this section, we only give a rough introduction. If you want to know more details, you can go to the User Guide to check it out.

mycobot_ros2 installation and update

- **M5 version:** Please check the end of the 12.2.1 ROS2 installation section.

Simple use

Start through the launch.py file

This example is based on the fact that you have completed Environment Setup and successfully copied the company's code from GitHub.

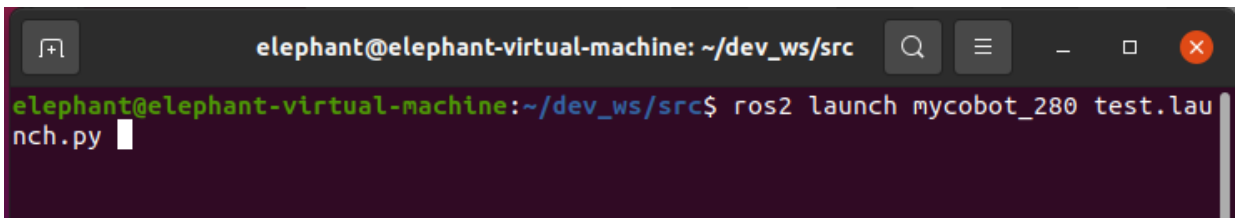
Open a console terminal (shortcut key `Ctrl+Alt+T`) Enter the following command to **ROS2 environment configuration**.

```
cd ~/colcon_ws
colcon build --symlink-install
source install/setup.bash
```

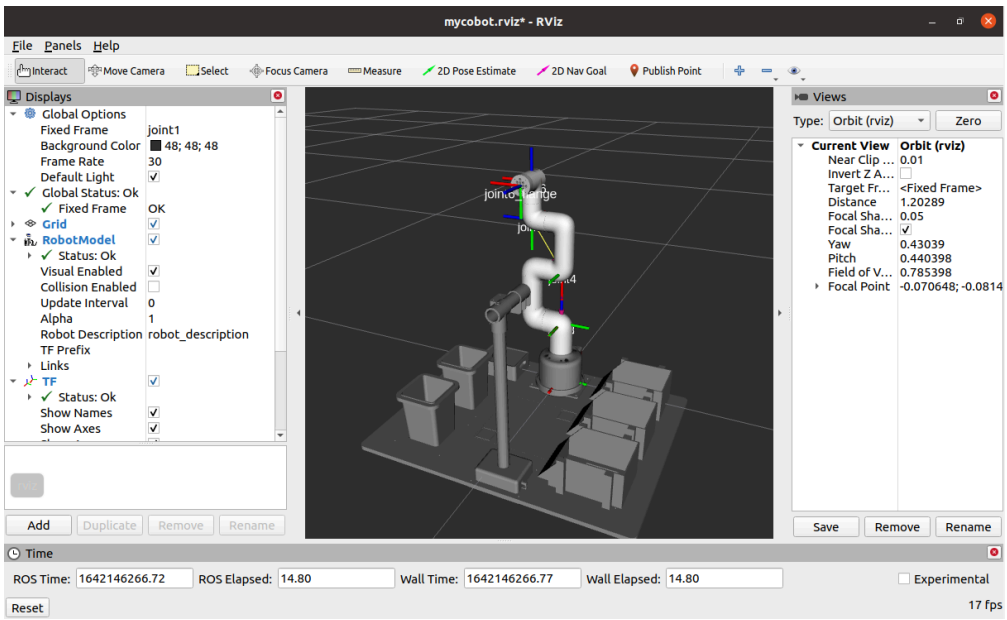
Enter again:

- mycobot 280-M5 version:

```
ros2 launch mycobot_280 test.launch.py
```



Open rviz2 and get the following result:



If you want to learn more about rviz, you can go to the official document to view it

M5 version prerequisites

- Open the console terminal (shortcut key `Ctrl+Alt+T`), open the terminal window to view the device name:

```
# View the device name of the robot arm
ls /dev/ttyUSB* # Old version myCobot280 M5


# If the terminal does not display the /dev/ttyUSB related name, you need to use the following command
ls /dev/ttyACM* # New version myCobot280 M5
```

- Grant serial port permissions to the robot:

```
# The default device name is /dev/ttyUSB0. If the device name is not the default value, you need to modify it.
sudo chmod 777 /dev/ttyUSB0 # Old version myCobot280 M5


sudo chmod 777 /dev/ttyACM0 # New version myCobot280 M5
```

Then enter the user password (**Note:** The password is not displayed, just enter it correctly).

280 series rviz user guide

Robot arm control

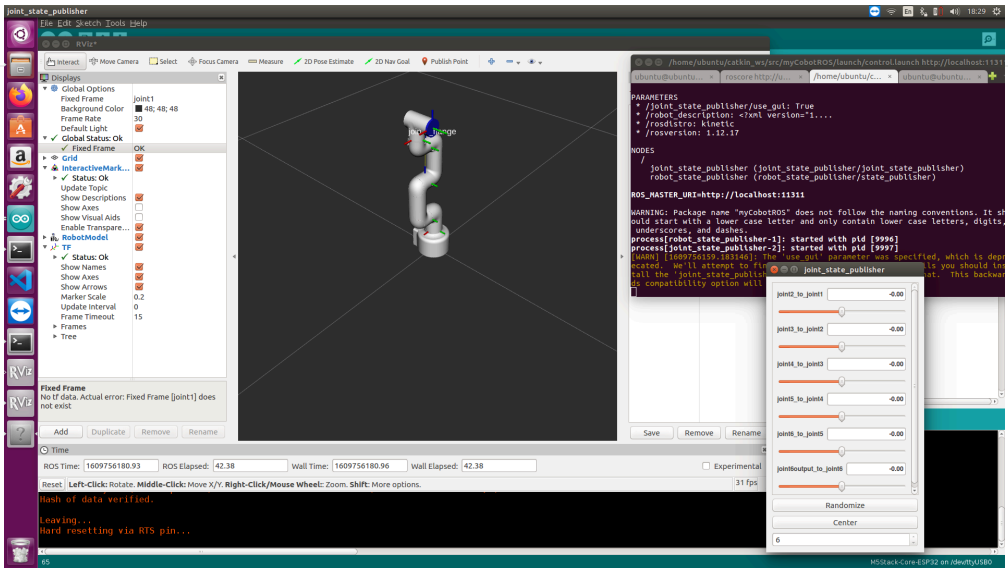
Slider control

Open a command line and run:

- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
ros2 launch mycobot_280 slider_control.launch.py port:=/dev/ttyUSB0 baud:=115200
```

It will **open rviz and a slider component**, and you will see the following screen (the screen of the Raspberry Pi version is slightly different, which does not affect the use):



Then you can **control the movement of the model in rviz by dragging the slider**. The real mycobot will move with it.

Please note: Since the robot arm will move to the current position of the model when the command is entered, please make sure that the model in rviz does not appear to be through the model before you use the command Do not drag the slider quickly after connecting the robot arm to prevent damage to the robot arm

Model following

In addition to the above control, we can also **let the model follow the movement of the real robot arm**. Open a command line and run:

- mycobot 280-M5 version:

  Slider control

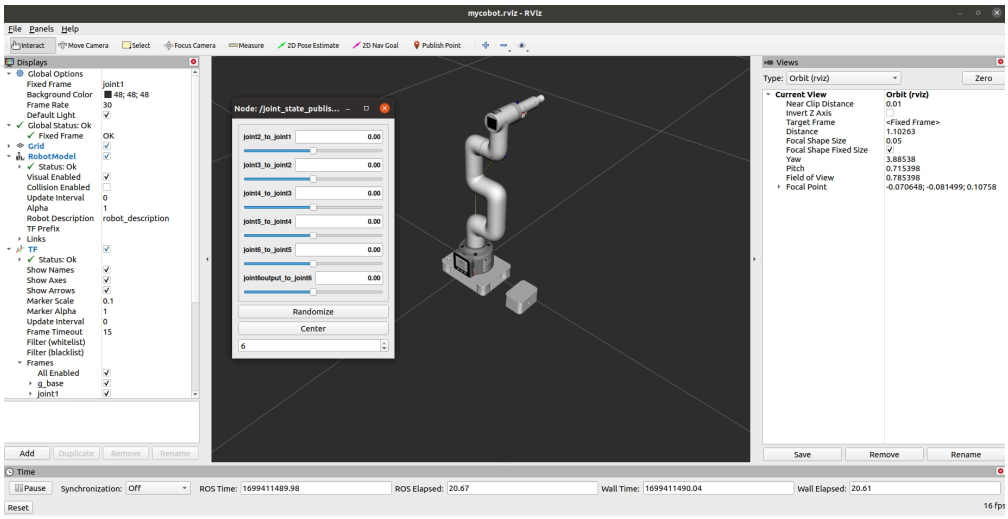
> **Note: This function only supports the control of the robot**

Open a command line and run:

- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
ros2 launch mycobot_280 slider_control_pump.launch.py port:=/dev/ttyUSB0 baud:=115200
```

It will **open rviz and a slider component**, and you will see the following screen (the screen of the Raspberry Pi version is slightly different, which does not affect the use):



Then you can **control the model movement in rviz by dragging the slider**. The real mycobot will move with it.

Please note: Since the robot arm will move to the current position of the model when the command is input, please make sure that the model in rviz does not appear to be through the model before you use the command

Do not drag the slider quickly after connecting the robot arm to prevent damage to the robot arm

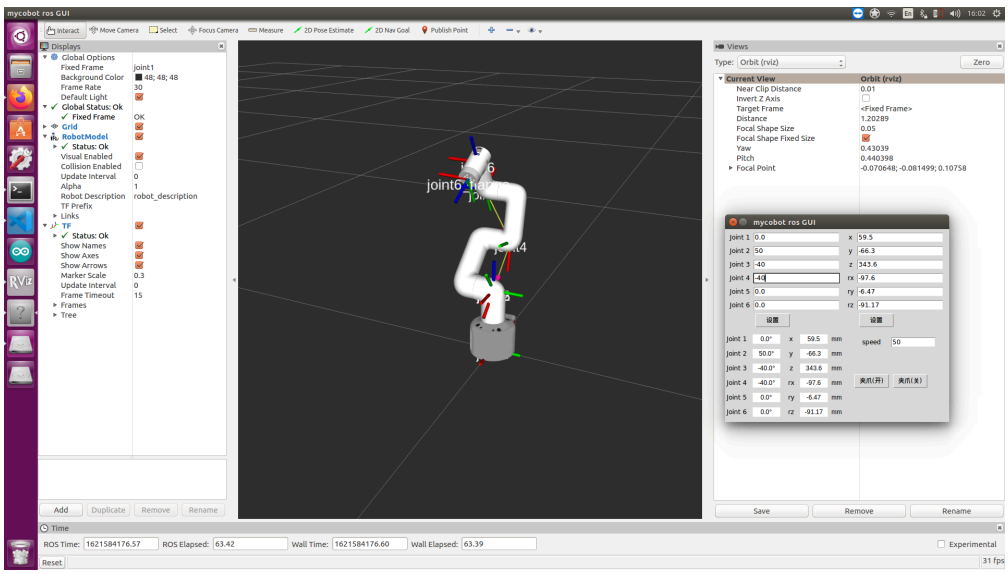
GUI control

Based on the previous, this package also **provides a simple Gui control interface**. This method is intended to allow real robotic arms to interact with each other. Please connect mycobot.

Open the command line:

- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
ros2 launch mycobot_280 simple_gui.launch.py port:=/dev/ttyUSB0 baud:=115200
```



Keyboard control

Keyboard control function has been added to the `mycobot_280` package, and it is synchronized in real time in rviz. This function relies on pythonApi, so make sure it is connected to the real robot arm.

Open a command line and run:

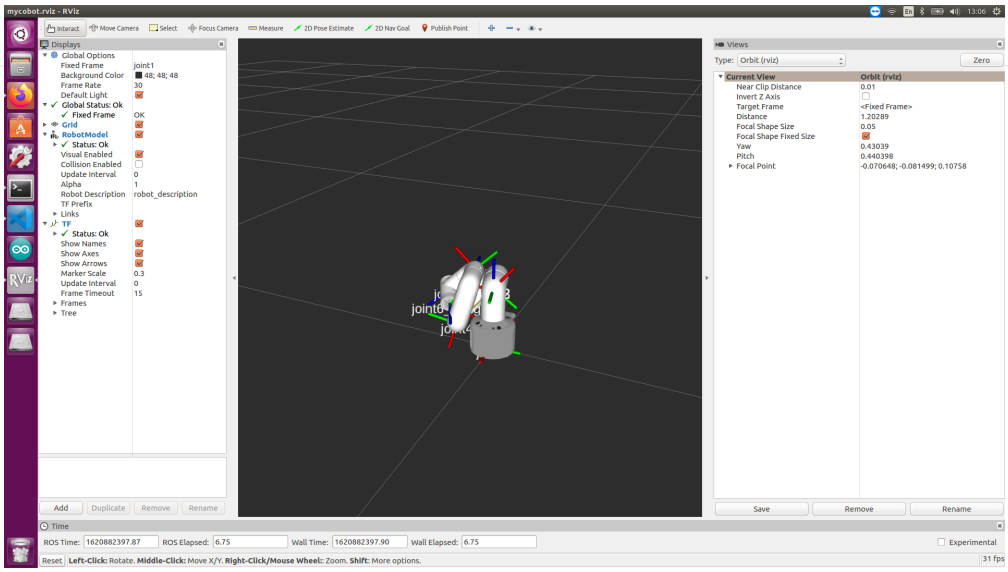
- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
ros2 launch mycobot_280 teleop_keyboard.launch.py port:=/dev/ttyUSB0 baud:=115200
```

Then run the command:

```
[INFO] [launch]: All log files can be found below /home/elephant/.ros/log/2022-05-19-16-25-45-949761-elephant-virtual-mach
[INFO] [launch]: Default logging verbosity is set to INFO
[INFO] [robot_state_publisher-1]: process started with pid [19114]
[INFO] [rviz2-2]: process started with pid [19116]
[INFO] [follow_display-3]: process started with pid [19118]
[robot_state_publisher-1] Parsing robot urdf xml string.
[robot_state_publisher-1] Link joint2 had 1 children
[robot_state_publisher-1] Link joint3 had 1 children
[robot_state_publisher-1] Link joint4 had 1 children
[robot_state_publisher-1] Link joint5 had 1 children
[robot_state_publisher-1] Link joint6 had 1 children
[robot_state_publisher-1] Link joint6_flange had 0 children
[robot_state_publisher-1] [INFO] [1652948746.290904045] [robot_state_publisher]: got segment joint1
[robot_state_publisher-1] [INFO] [1652948746.290967253] [robot_state_publisher]: got segment joint2
[robot_state_publisher-1] [INFO] [1652948746.290973124] [robot_state_publisher]: got segment joint3
[robot_state_publisher-1] [INFO] [1652948746.290977490] [robot_state_publisher]: got segment joint4
[robot_state_publisher-1] [INFO] [1652948746.290981670] [robot_state_publisher]: got segment joint5
[robot_state_publisher-1] [INFO] [1652948746.290985737] [robot_state_publisher]: got segment joint6
[robot_state_publisher-1] [INFO] [1652948746.290989943] [robot_state_publisher]: got segment joint6_flange
[follow_display-3] [INFO] [1652948746.664601707] [follow_display]: port:/dev/ttyUSB0, baud:115200
[rviz2-2] [INFO] [1652948746.828773551] [rviz2]: Stereo is NOT SUPPORTED
[rviz2-2] [INFO] [1652948746.830452458] [rviz2]: OpenGl version: 4.1 (GLSL 4.1)
[rviz2-2] [INFO] [1652948746.874021926] [rviz2]: Stereo is NOT SUPPORTED
[rviz2-2] Parsing robot urdf xml string.
```

The running effect is as follows:



Mycobot information will be output on the command line, as follows:

```bash [INFO] [launch]: All log files can be found below /home/elephant/.ros/log/2022-05-19-16-25-45-949761-elephant-virtual-machine-19111 [INFO] [launch]: Default logging verbosity is set to INFO [INFO] [robot_state_publisher-1]: process started with pid [19114] [INFO] [rviz2-2]: process started with pid [19116] [INFO] [follow_display-3]: process started with pid [19118] [robot_state_publisher-1] Parsing robot urdf XML string. children [robot_state_publisher-1] Link joint3 had 1 children [robot_state_publisher-1] Link joint4 had 1 children [robot_state_publisher-1] Link joint5 had 1 children [robot_state_publisher-1] Link joint6 had 1 children [robot_state_publisher-1] Link joint6_flange had 0 children [robot_state_publisher-1] [INFO] [1652948746.290904045] [robot_state_publisher]: got segment joint1 [robot_state_publisher-1] [INFO] [1652948746.290967253] [robot_state_publisher]: got segment joint2 [robot_state_publisher-1] [INFO] [1652948746.290973124] [robot_state_publisher]: got segment joint3 [robot_state_publisher-1] [INFO] [1652948746.290977490] [robot_state_publisher]: got segment joint4 [robot_state_publisher-1] [INFO] [1652948746.2 90981670] [robot_state_publisher]: got segment joint5 [robot_state_publisher-1] [INFO] [1652948746.290985737] [robot_state_publisher]: got segment joint6 [robot_state_publisher-1] [INFO] [1652948746.290989943] [robot_state_publisher]: got segment joint6_flange [follow_display-3] [INFO] [1652948746.664601707] [follow_display]: port:/dev/ttyUSB0, baud:115200 [rviz2-2] [INFO] [1652948746.828773551] [rviz2]: Stereo is NOT SUPPORTED [rviz2-2] [INFO] [1652948746.830452458] [rviz2]: OpenGl version: 4.1 (GLSL 4.1) [rviz2-2] [INFO] [1652948746.874021926] [rviz2]: Stereo is NOT SUPPORTED [rviz2-2] Parsing robot urdf xml string.
```

```
You will see the following output in the command line:
```bash
Mycobot Teleop Keyboard Controller
---------------------------
Movimg options(control coordinations [x,y,z,rx,ry,rz]):
w(x+)

a(y-) s(x-) d(y+)

z(z-) x(z+)

u(rx+) i(ry+) o(rz+)

j(rx-) k(ry-) l(rz-)

Gripper control:
g - open
h - close

Other:
1 - Go to init pose
2 - Go to home pose
3 - Resave home pose
q - Quit

currently: speed: 10 change percent: 2
```

In this terminal, you can control the state of the robot and move the robot by pressing keys in the command line.

End effector

- **Supported end effectors:** myCobot vertical suction pump V2.0, camera flange
- **Applicable devices:** myCobot 280 M5, myCobot 280 PI

myCobot vertical suction pump V2.0

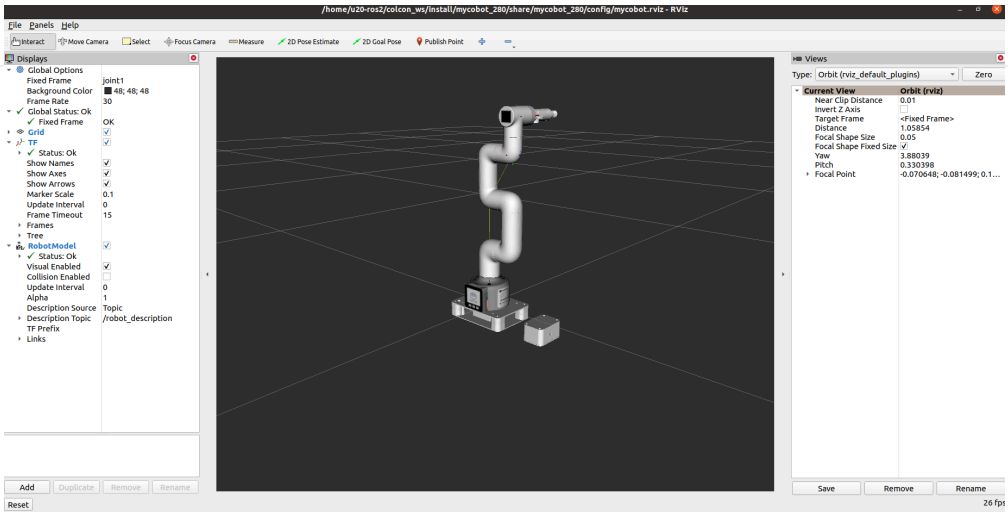
1 Load the model

Open a command line and run:

- mycobot 280-M5 version:

```
ros2 launch mycobot_280 test_pump.launch.py
```

It will **open rviz**, and you will see the following screen (the screen of the Raspberry Pi version is slightly different, which does not affect the use):
```



2 Slider control

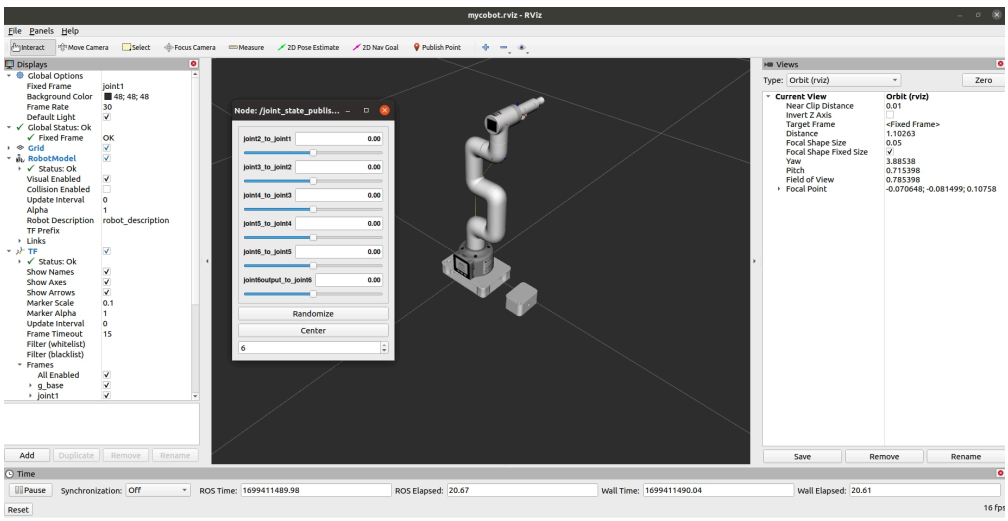
> **Note: This function only supports the control of the robot arm**

Open a command line and run:

- mycobot 280-M5 version:

```
# mycobot The default serial port name of the 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial por
ros2 launch mycobot_280 slider_control_pump.launch.py port:=/dev/ttyUSB0 baud:=115200
```

It will open rviz and a slider component, you will see the following screen (the Raspberry Pi version screen is slightly different, which does not affect the use):



Then you can **control the movement of the model in rviz by dragging the slider**. The real mycobot will move with it.

Please note: Since the robot arm will move to the current position of the model while the command is input, please make sure that the model in rviz does not appear to be through the model before you use the command Do not drag the slider quickly after connecting the robot arm to prevent damage to the robot arm

3 GUI control

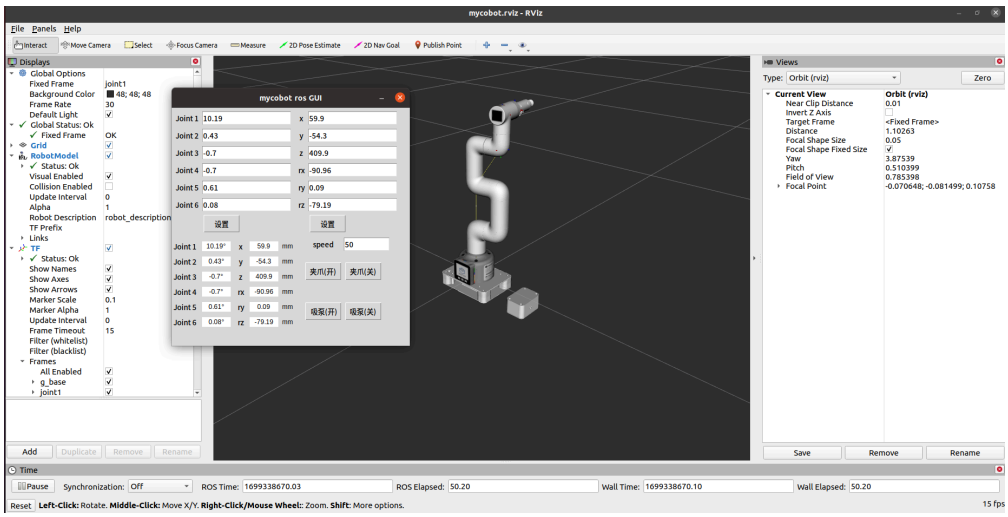
Based on the previous, this package also **provides a simple Gui control interface**. This method is intended for real robot arms to be linked to each other. Please connect mycobot.

Open the command line:

- mycobot 280-M5 version:

```
# The default serial port name of mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial port na
ros2 launch mycobot_280 simple_gui_pump.launch.py port:=/dev/ttyUSB0 baud:=115200
```

It will **open rviz and a GUI interface**, and you will see the following screen:



Camera flange

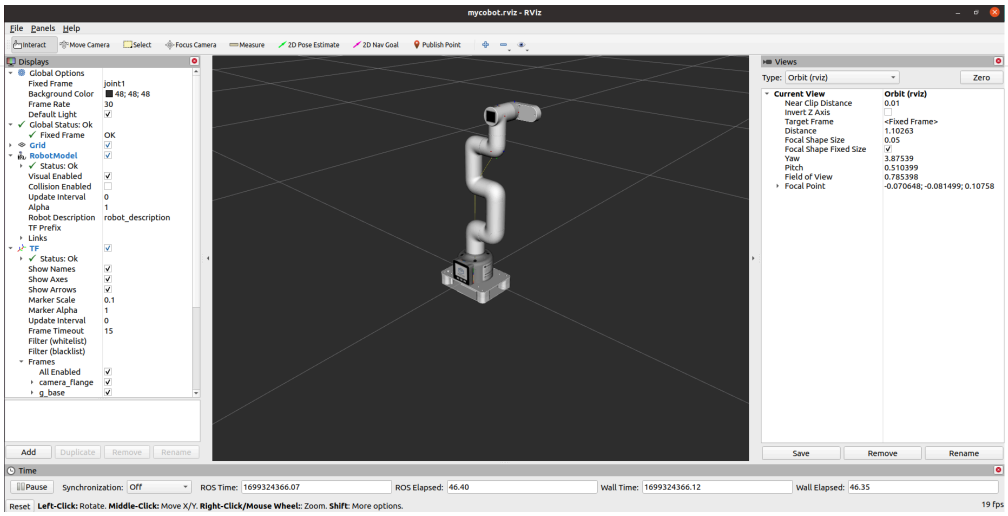
1 Load the model

Open a command line and run:

- mycobot 280-M5 version:

```
ros2 launch mycobot_280 test_camera_flange.launch.py
```

It will **open rviz**, you will see the following screen (the screen of the Raspberry Pi version is slightly different, which does not affect the use):



2 Slider control

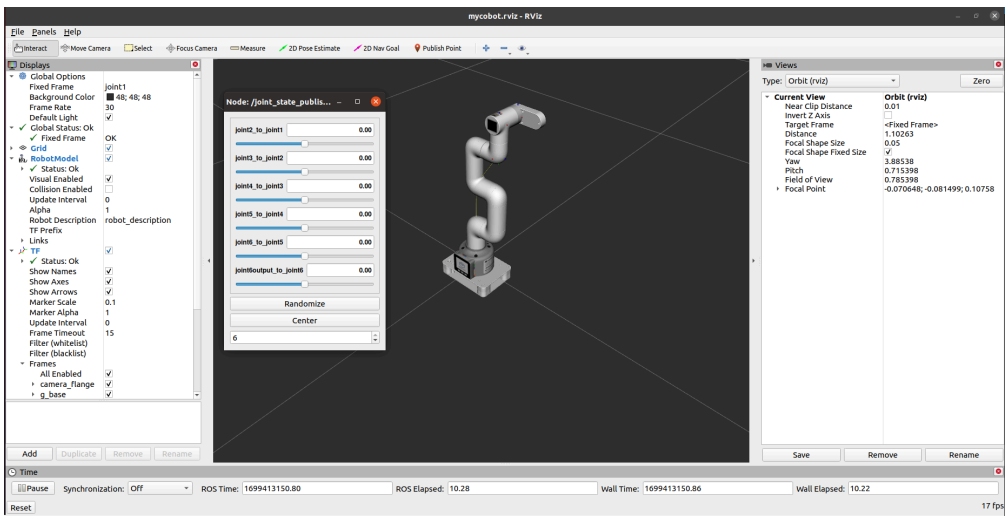
> **Note: This function only supports the control of the robot arm**

Open a command line and run:

- mycobot 280-M5 version:

```
# The default serial port name of the mycobot 280-M5 version is "/dev/ttyUSB0" and the baud rate is 115200. The serial por
ros2 launch mycobot_280 slider_control_camera_flange.launch.py port:=/dev/ttyUSB0 baud:=115200
```

It will **open rviz and a slider component**, and you will see the following screen (the screen of the Raspberry Pi version is slightly different, which does not affect the use):



Then you can **control the movement of the model in rviz by dragging the slider**. The real mycobot will move with it.

Please note: Since the robot arm will move to the current position of the model when the command is entered, please make sure that the model in rviz does not appear to be through the model before you use the command. Do not drag the slider quickly after connecting the robot arm to prevent damage to the robot arm.

Camera flange && pump

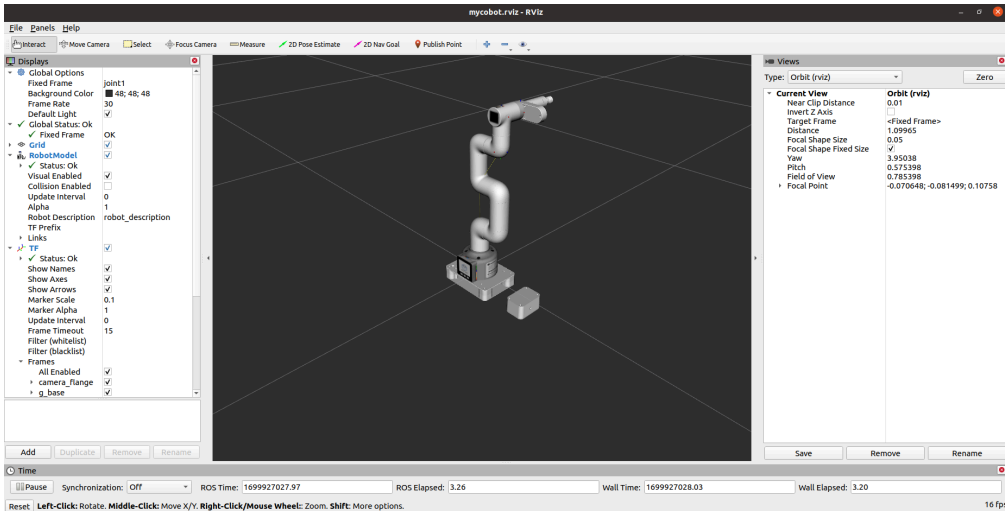
1 Load the model

Open a command line and run:

- mycobot 280-M5 version:

```
ros2 launch mycobot_280 test_camera_flange_pump.launch.py
```

It will **open rviz**, you will see the following screen (the screen of the Raspberry Pi version is slightly different, which does not affect the use):



URDF model address

1 myCobot vertical suction pump V2.0

- myCobot 280-M5 version

2 Camera flange

- myCobot 280-M5 Version

3 Camera Flange && Pump

- myCobot 280-M5 Version

MoveIt2

Introduction to MoveIt2

MoveIt2 is an integrated development platform in ROS2, consisting of a variety of function packages for manipulating robotic arms, including: motion planning, manipulation, control, inverse kinematics, 3D perception, and collision detection.

Core functions

1. **Motion Planning** MoveIt 2 provides motion planning capabilities based on OMPL (Open Motion Planning Library) and other third-party libraries, supporting a variety of planning algorithms and constraints.
2. **Inverse Kinematics (IK)** MoveIt 2 uses a plug-in mechanism to support different IK solvers, which can quickly calculate the target pose of the robotic arm.
3. **Collision Detection & Avoidance** MoveIt 2 has built-in powerful collision detection capabilities to ensure that the robot does not collide with the surrounding environment when planning and executing movements.
4. **Dynamic Scene Awareness** MoveIt 2 supports dynamic updates of the environment model and can sense changes in obstacles in real time.
5. **Control & Execution** MoveIt 2 provides a motion control interface that is tightly integrated with the robot hardware to ensure that the planned path can be accurately executed.
6. **Visualization Tools** Integrated with RViz 2, it supports intuitive interaction and debugging functions, and can display the motion planning and execution process in real time.

Advantages of MoveIt 2

- **Real-time support based on ROS 2** The DDS communication architecture of ROS 2 enables MoveIt 2, which has significantly improved real-time performance and reliability.
- **Modular design** MoveIt 2 adopts a modular architecture, which supports users to load or replace modules as needed, providing great flexibility.
- **Cross-platform support** MoveIt 2 supports running on multiple operating systems (such as Ubuntu, Windows) and hardware platforms.
- **Active Community Support** MoveIt 2 has a global developer community that continuously provides updates, feature extensions, and technical support.

Configuration

1. URDF - Universal Robot Description Format.
2. SRDF - includes the robot's joint groups, virtual and passive joints, robot poses, self-collisions, and is usually created by the user using the MoveIt2 Setup Assistant.
3. MoveIt2 Configuration - includes joint limits, kinematics, motion planning, perception, and other information. Configuration files for these components are automatically generated by the MoveIt2 Setup Assistant (MoveIt2 Configuration Assistant) and stored in the configuration directory of the robot's corresponding MoveIt2 configuration package.

How to use MoveIt2

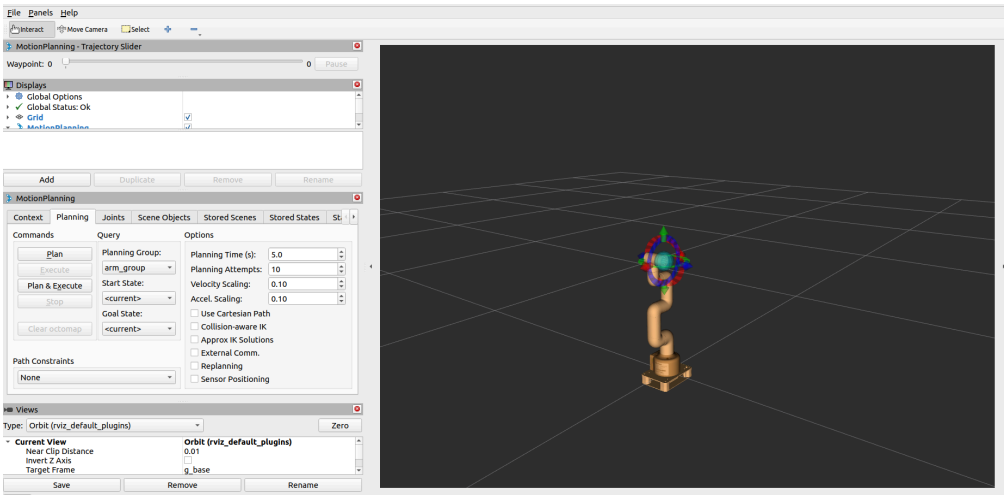
> **Note:** For better motion planning, the Atom firmware version of the end-arm is 6.5, and the python driver library pymycobot version is 3.5.3

`mycobot_ros2` has now integrated the MoveIt2 part.

Open the command line and run:

```
ros2 launch mycobot_280_moveit2 demo.launch.py
```

The operation effect is as follows:



If you need to let the real robot arm execute the plan synchronously, you need to open another command line and run:

```
ros2 run mycobot_280_moveit2_control sync_plan
```

Case demonstration:

What is myBlockly?

myBlockly is a fully visual modular programming software, a graphical programming language.

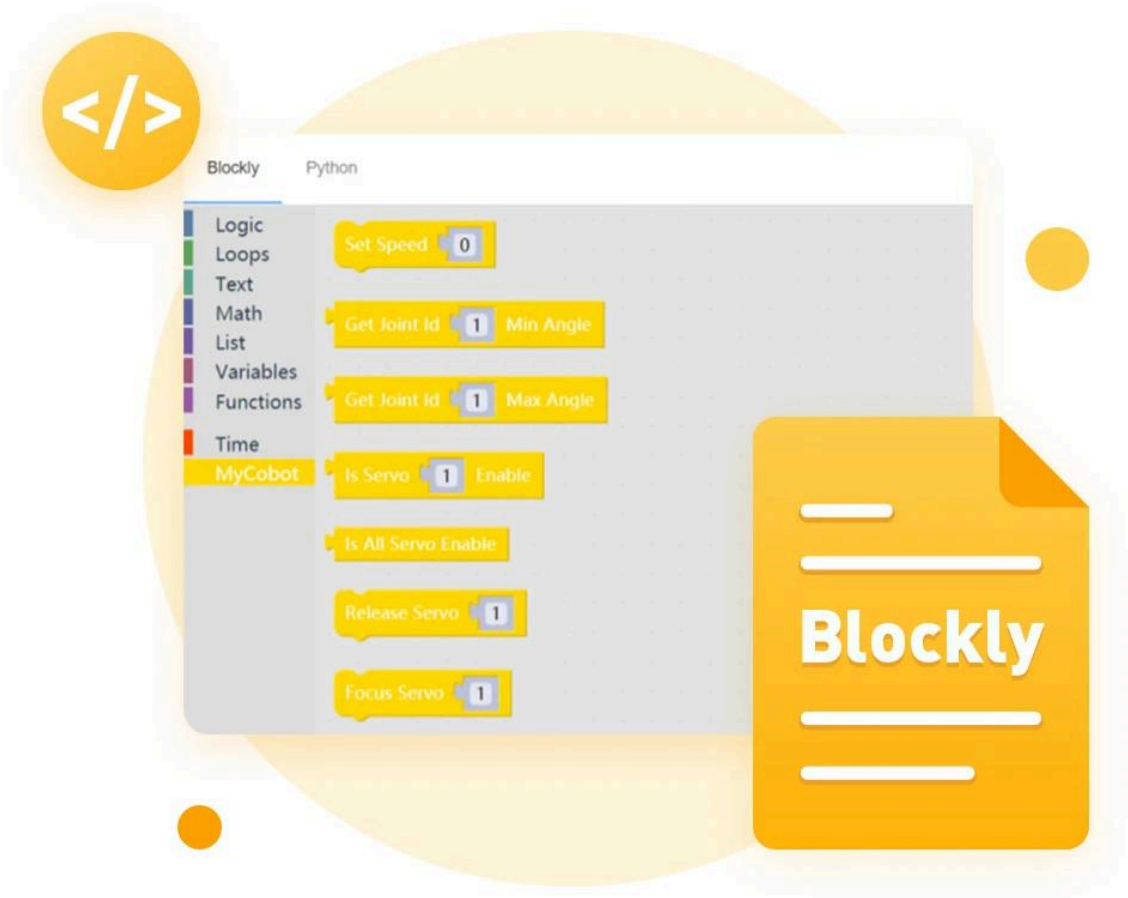
myBlockly is similar to MIT's children's programming language Scratch in terms of function/design.

When using **myBlockly**, users can drag and drop modules to build code logic, which is very similar to building blocks.

From the user's perspective, **myBlockly** is a simple and easy-to-use visual tool for generating code. From the developer's perspective, **myBlockly** is a text box that contains the code entered by the user.

The process of generating code into the text box is the process of the user dragging in **myBlockly**.

myBlockly installation



myBlockly download address:

- GitHub address: https://github.com/elephantrobotics/myblockly-package/releases
- Official website address: https://www.elephantrobotics.com/download/

Applicable devices:

- myCobot 280
- **myCobot 280 M5**
- myCobot 280 PI
- myCobot 280 Jetson Nano
- myCobot 280 for Arduino

Prerequisites:

- **M5** series version, **M5Stack-basic** burn **miniRobot** at the bottom, select **Transponder** function, **ATOM** burn the latest version of **atomMain** at the end (factory default burned)
- **Pi \ jetsonnano** series, **ATOM** burn the latest version of **atomMain** (factory default burned)
- Configure **Python environment**, please refer to the Python ▶ chapter

myBlockly Development and Use Guide

You can use myBlockly to develop our robotic arm according to the following guidelines

1.MyBlockly Initial Use

2.Control RGB Light Board

3.Control the Robotic Arm to Return to Origin

4.Control Single Joint Movement

5.Control Multiple Joints

6.Control the robot arm to swing left and right

7.Control the robot arm to dance

8.Use of gripper

9.Use of suction pump

10.Gripper test

11.IO test

12.Q&A

Initial use of myBlockly

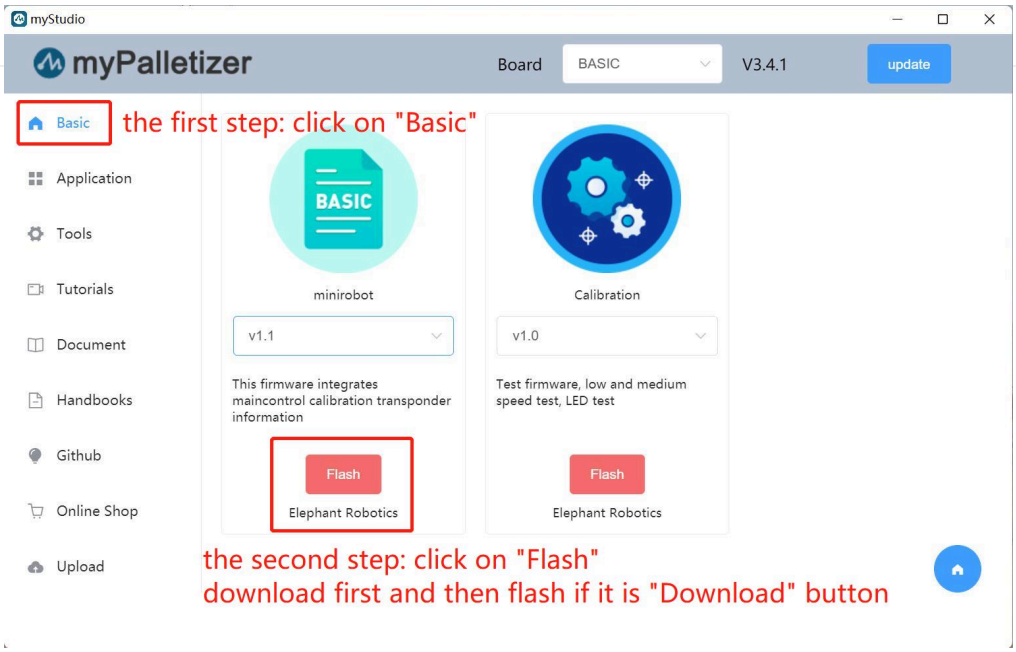
Preparation

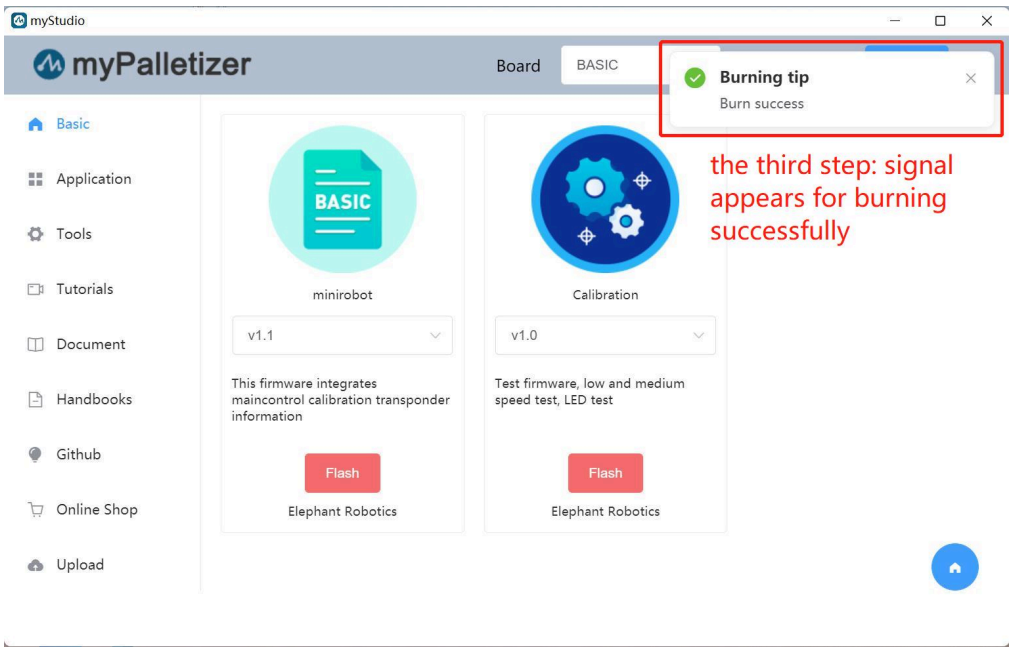
Before downloading myBlockly, you need to configure the Python environment and use myStudio to burn the firmware. Please refer to the following operation method for details.

1. Environment configuration. Before using myBlockly, please make sure that the Python environment has been configured on the computer
2. Firmware burning.
3. Before using myStudio for burning, you need to download the serial port driver, that is, the CP210X or CP34X driver compression package. There are currently two driver chip versions, CP210X (for CP2104 version)/CP34X (for CH9102 version) driver compression package. If you are not sure about the USB chip used by your device, you can install both drivers at the same time. (CH9102_VCP_SER_MacOS may report an error during the installation process, but in fact the installation has been completed, just ignore it). Please click the link below to download it according to your computer system (for specific installation steps, please refer to the animated picture in the **myStudio driver installation** section).
4. Bottom M5Stack Basic serial port driver + CP210X: **Windows 10**, **MacOS**, **Linux** + CP34X: **Windows 10**, **MacOS** - Terminal Atom Serial Driver
5. **Windows 10**

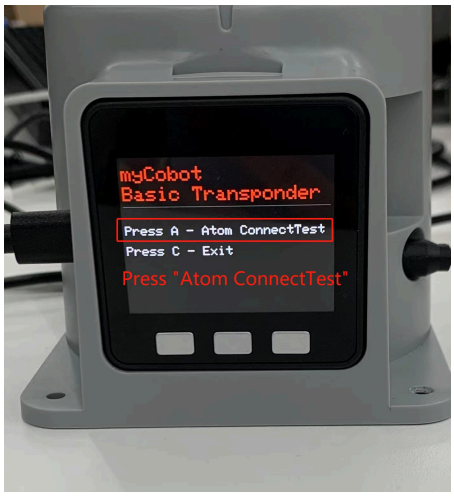
Note: For MacOS, make sure that the system "Preferences->Security and Privacy->General" is set before installation, and allow downloads from the App Store and approved developers.

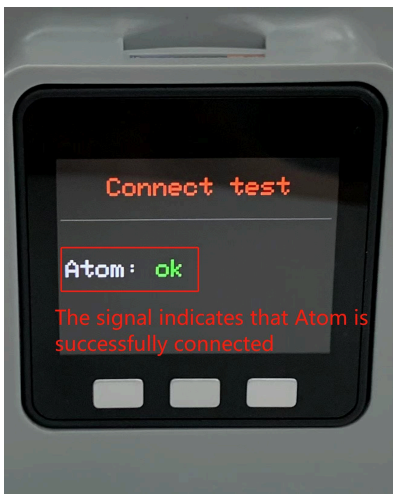
- The terminal ATOM needs to burn the latest version of atomMain (it is burned by factory default, no need to burn it yourself).
- The M5Stack series needs to burn the firmware miniRobot required by the bottom M5Stack Basic through myStudio, and the terminal ATOM needs to burn the latest version of atomMain (it is burned by factory default). Burning requires myStudio, a firmware burner. To download and install it, please click **Basic Application myStudio**. The following figure shows the specific steps for using myStudio to burn firmware (for specific burning steps, please refer to **Update Device Firmware**). The following figure shows the specific steps for using myStudio to burn firmware.





- After burning is completed, select the Transponder function (one of the device's factory firmware functions, please refer to **Factory Firmware Introduction** chapter through the bottom M5Stack Basic, and then click Press A. If the prompt "Atom: ok" appears, it means success. The specific steps are as follows.





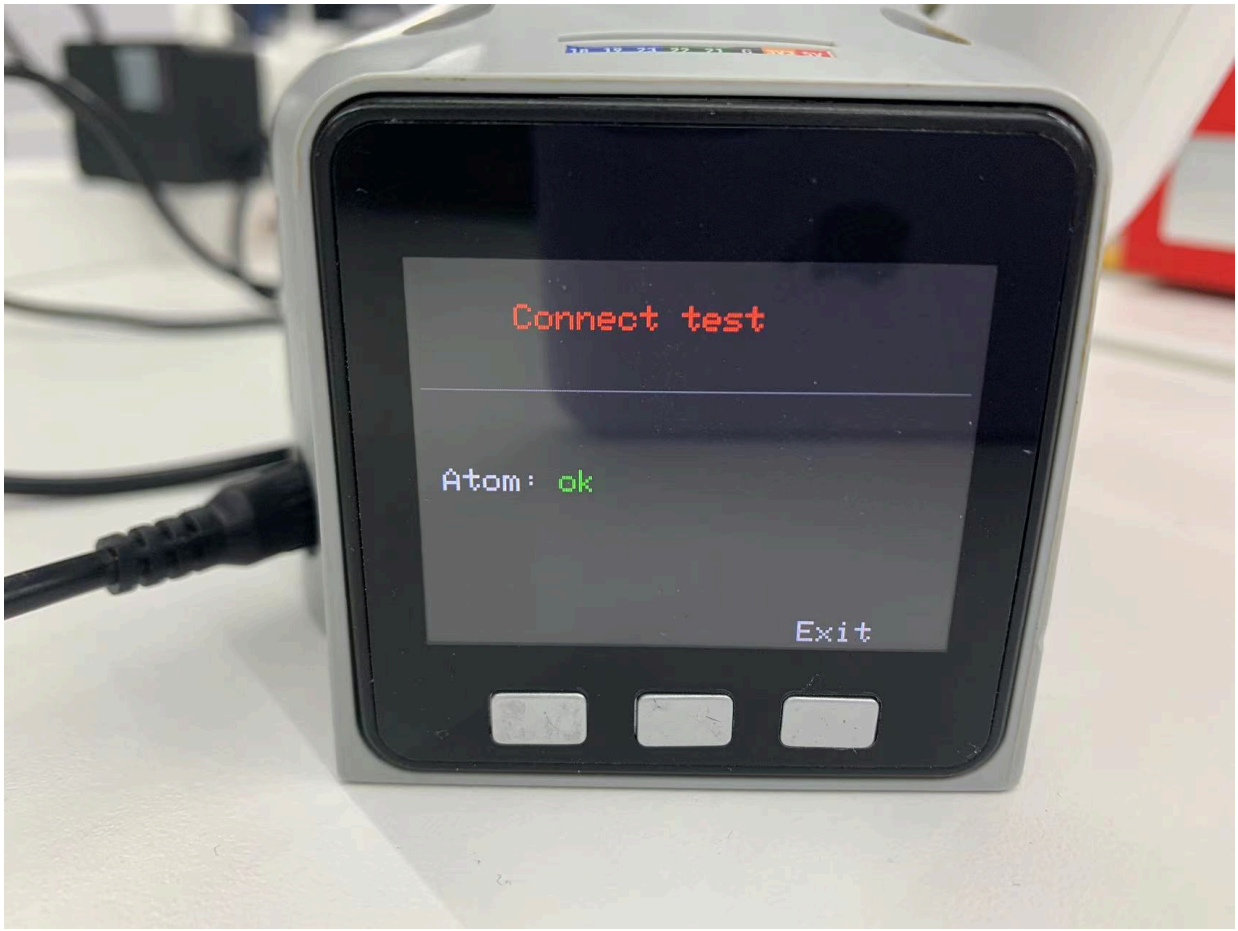
myBlockly download and install

After the preparation is completed, you can download and install myBlockly. Download address:

- **Github address**
- **Official website address**

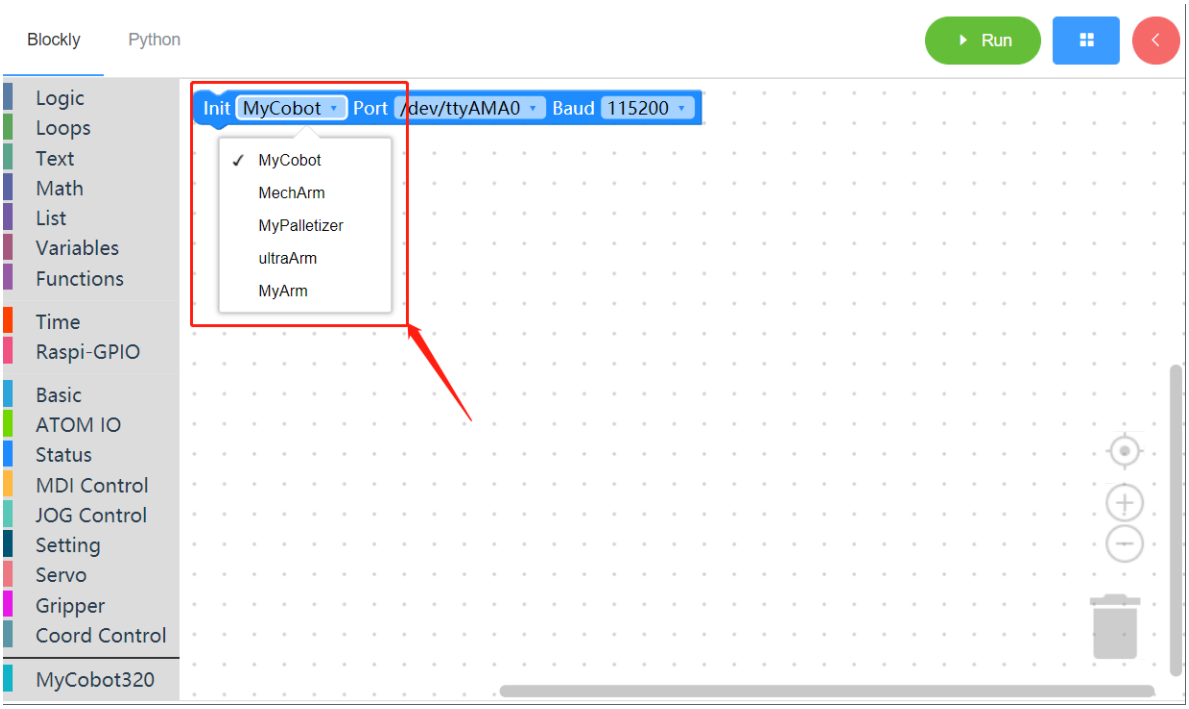
Note: Please make sure to download the latest version.

When running the myBlockly program, please keep the robot connected and keep the following interface. If you exit the robot connection interface, the myBlockly program will not run correctly.

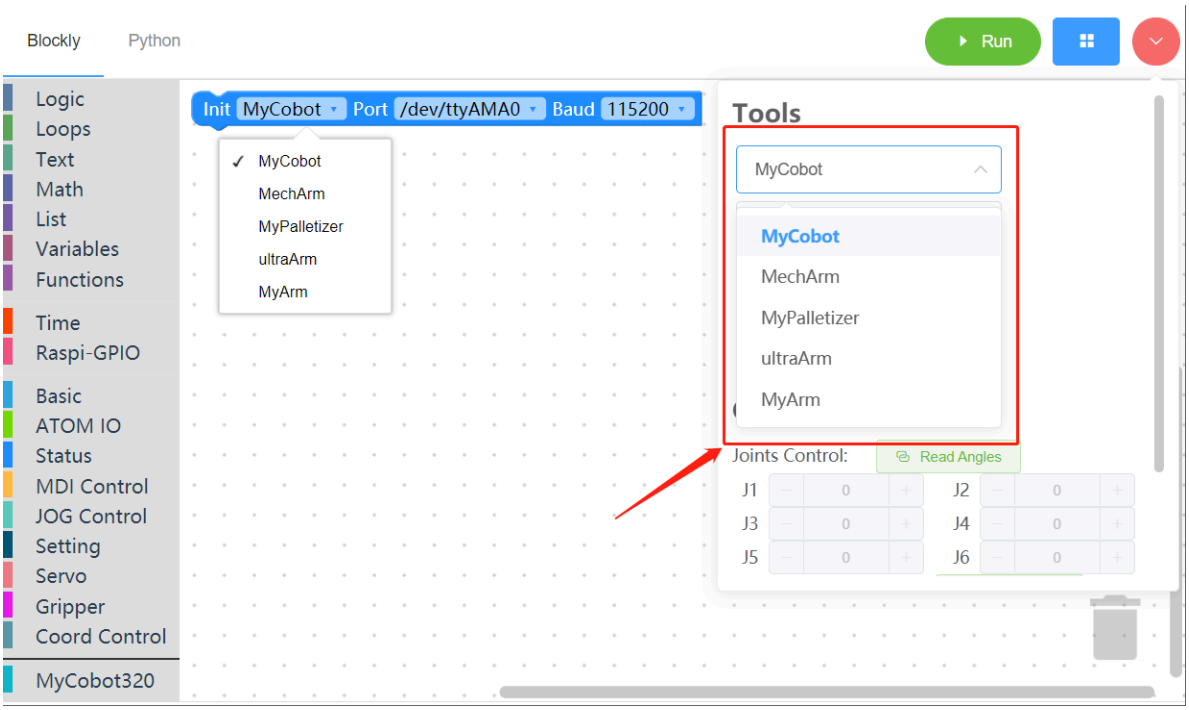


Prerequisites for use

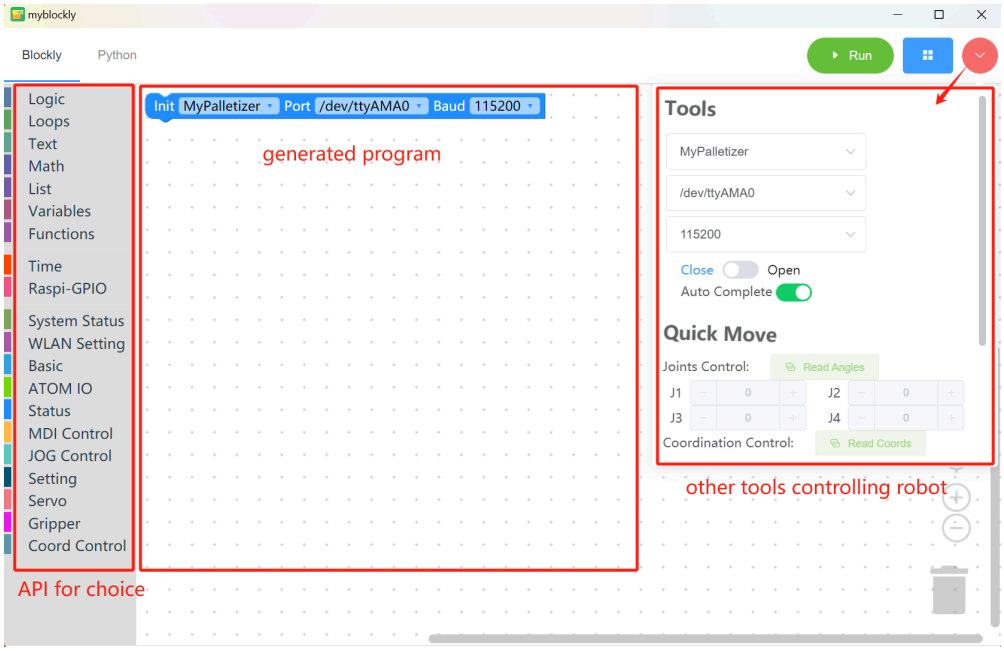
- Before you start programming, you must select the corresponding **machine model**, otherwise it is easy to cause hardware damage



- When using the control panel to control the machine, you must select the corresponding **machine model**, otherwise it is easy to cause hardware damage



myBlockly interface display



- Module bar:
- Contains the method modules required for program writing, which can be placed in the program editing area for splicing by mouse
- MyCobot320 module
- Small toolbar:

Click the pink button in the upper right corner to display a small toolbar, where you can select the correct model, serial port number and baud rate. You can also get the real-time joint angle and coordinates of the robot arm by clicking the "Read Angle" or "Read Coordinate" button. Click "+/-" in the joint control or coordinate control bar to control the movement of the robot arm.

- Program editing area:
- Before running the program, you need to select the correct model, port and baud rate in the initialization module or the small toolbar, otherwise the program will not run normally.
- Drag the required module methods to this area and splice them to realize your own program.
- If the baud rate and serial port have been modified in the right toolbar, but it is still /dev/ttyAMA0, it is due to the myBlockly version. You need to update the software version on the official website first (the latest version will change the information in the editing area after selecting the serial port and baud rate in the toolbar).

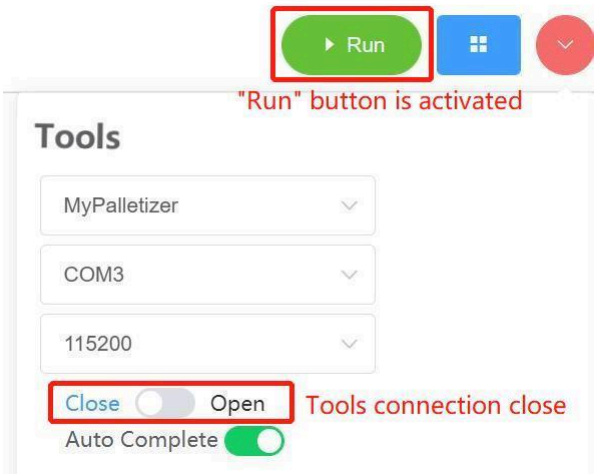
Note:

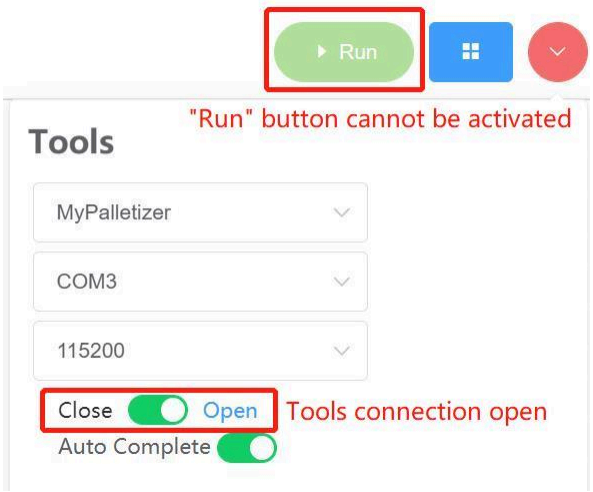
1. The baud rate of the M5Stack series is generally 115200, and the baud rate of the Raspberry Pi series is generally 1000000.

Machine model	Serial port number	Baud rate
280 M5	**Win: COM*; Linux: /dev/ttyUSB**;	**115200**

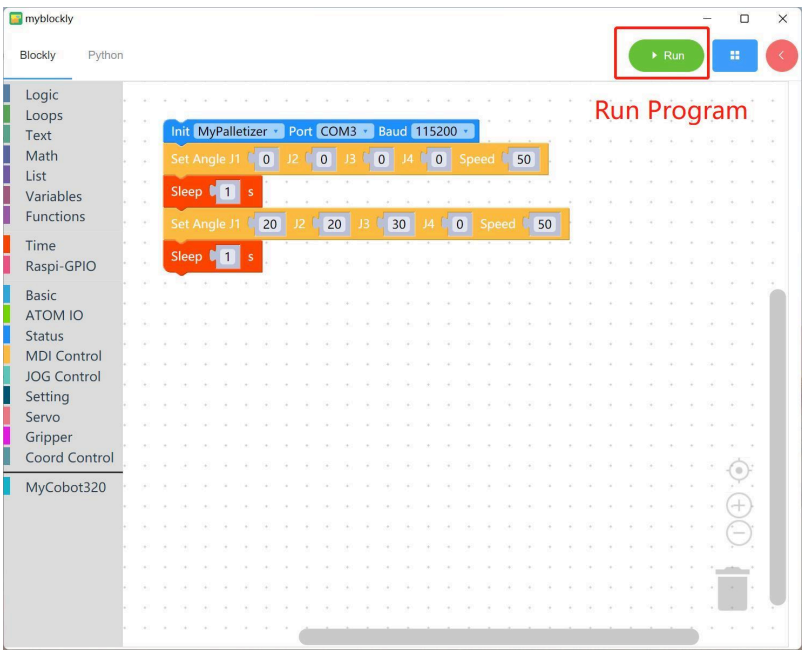
1. To check the serial port number and baud rate of the machine, please go to **myStudio Driver Installation** section.

2. When the program cannot run, please check whether the small toolbar is disconnected (as shown in the figure below).





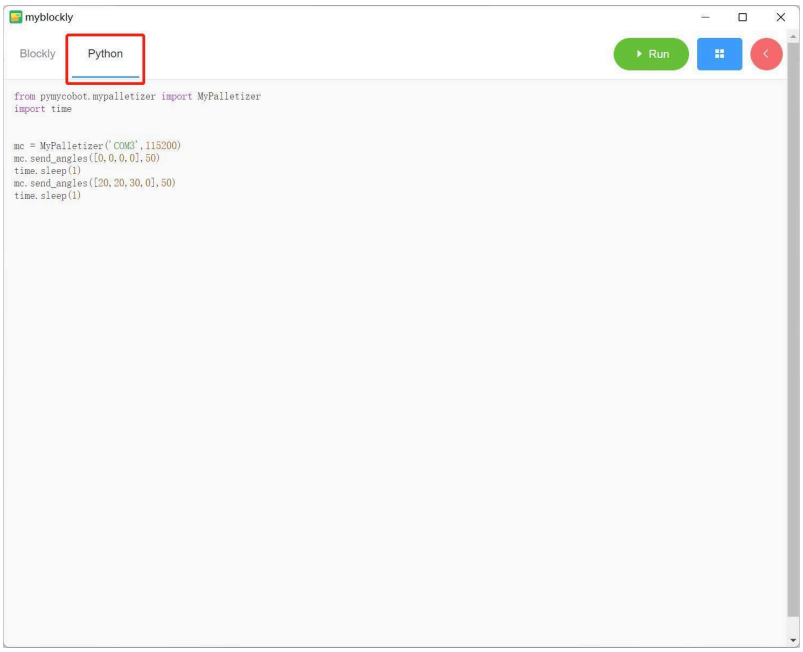
Program run

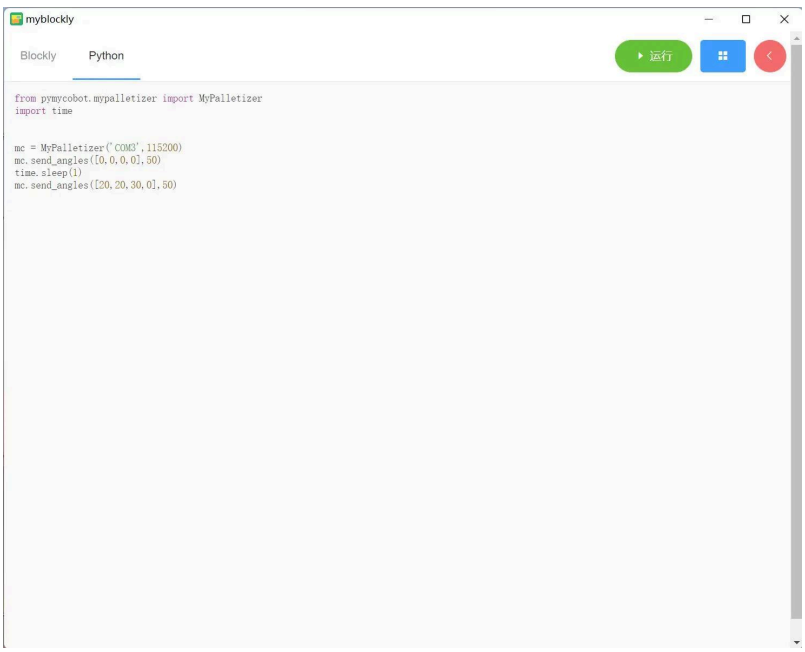


Drag the desired method module, edit your own program (as shown above), combine each module structure together (there is a ki sound), and then click "Run" to upload the code to the robot arm to run.

Note: The program that operates the robot arm movement takes time to complete, so after an action, you need to connect a `sleep` module to give the robot arm time to move before the next movement. (Determine the required time according to the situation. The robot arm is set by default to run myBlockly with a minimum sleep time of no less than 0.5s) Otherwise, the robot arm will not be able to achieve the desired movement.

Click the "Python" option in the upper left corner to view the corresponding Python code, as shown below.

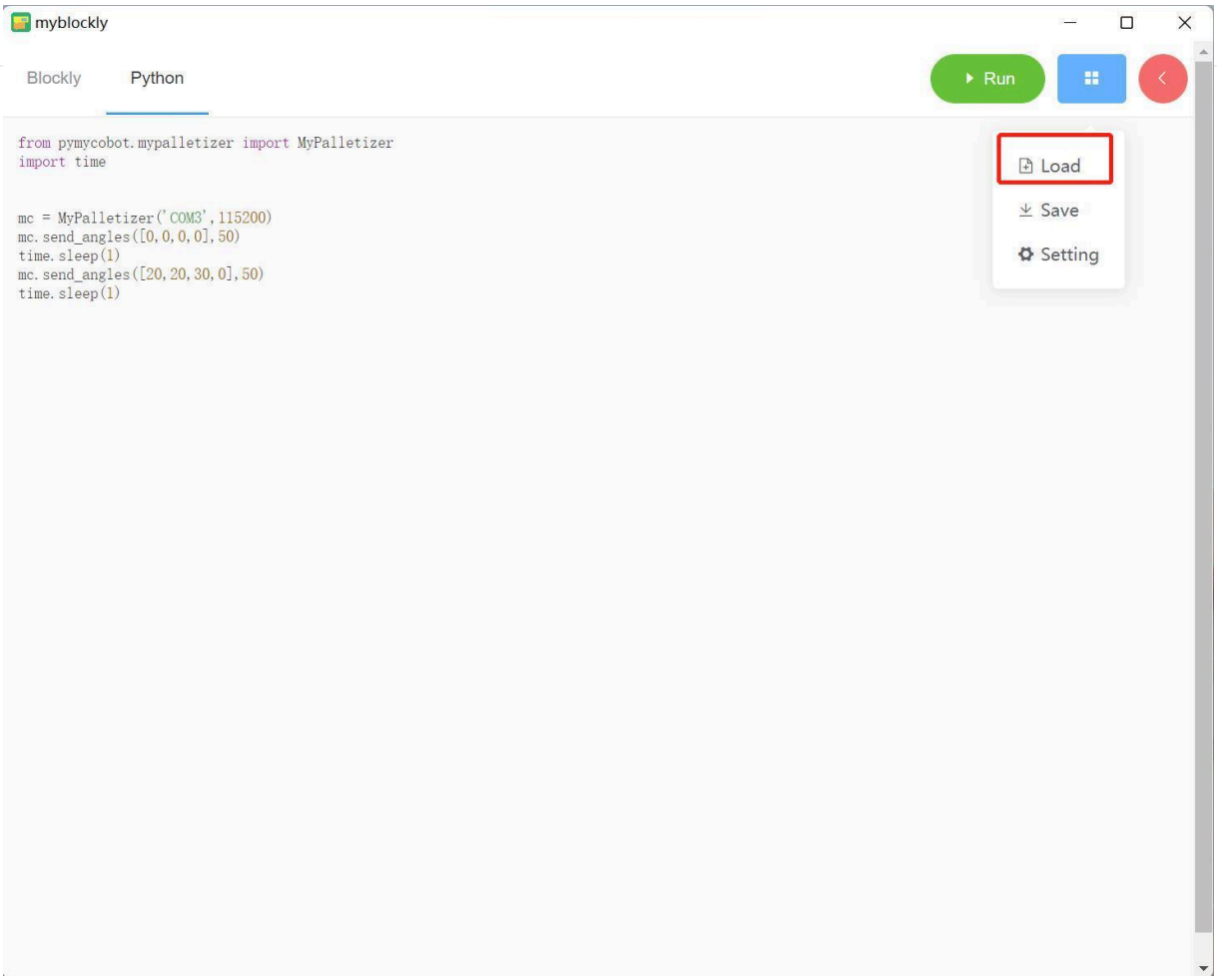




Program Saving and Loading

MyBlockly programs are saved in *.json format. Click the blue box in the upper right corner of the interface. Click the "Save" option to save the program.

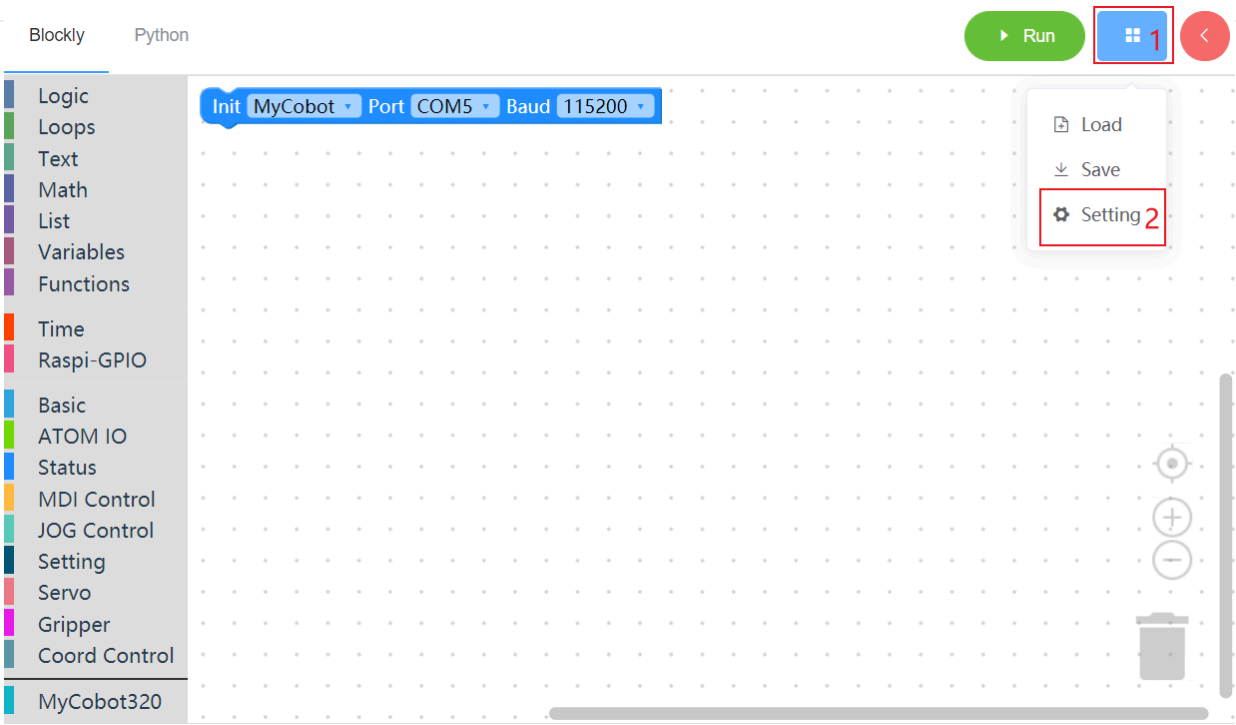
Similarly, click the blue box and click the "Load" option to import the saved program.

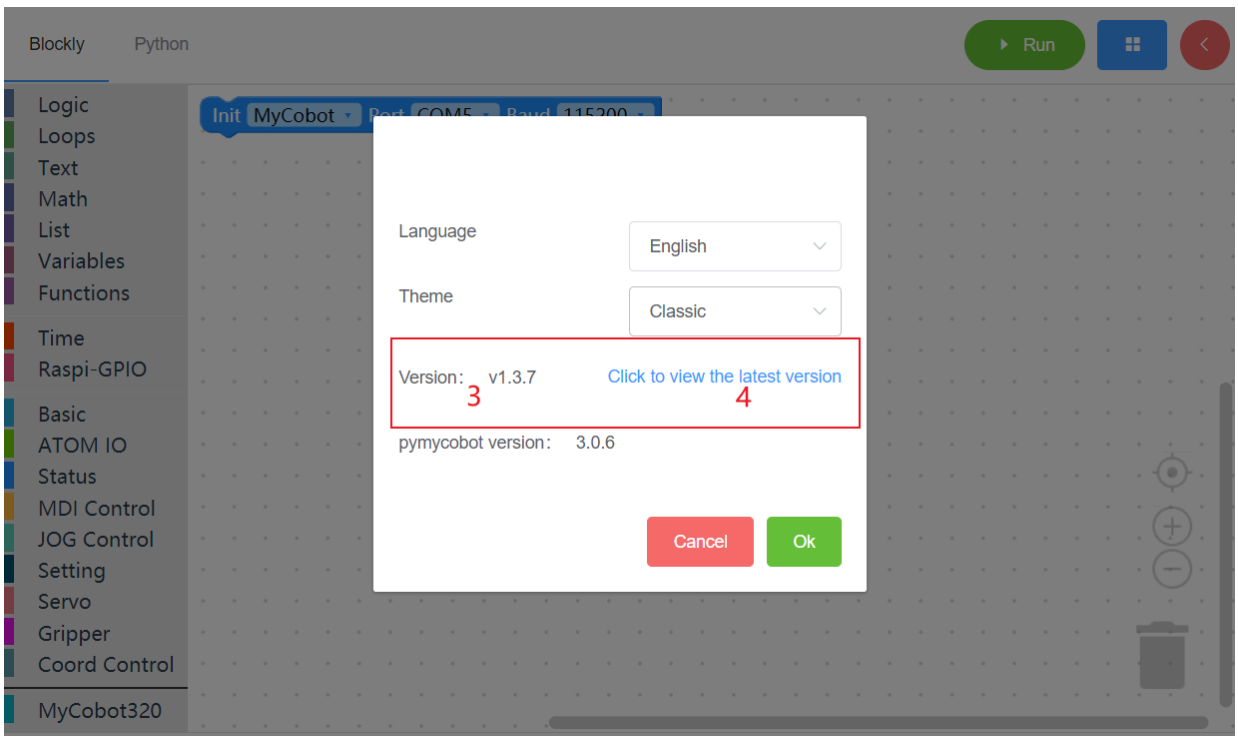


How to install and update the software

The installation and update of myBlockly need to go to the official website to download the latest version.

Inside the software, you can update the software through the following steps.





1 Mouse move here 2 Click setting 3 This is your current version 4 Click this link to view the latest version and download And if you need to know the detailed update log of the software, you can go to github to view.

Control RGB light board

Preparation before starting

M5Stack series: Make sure the robot arm is connected to the computer

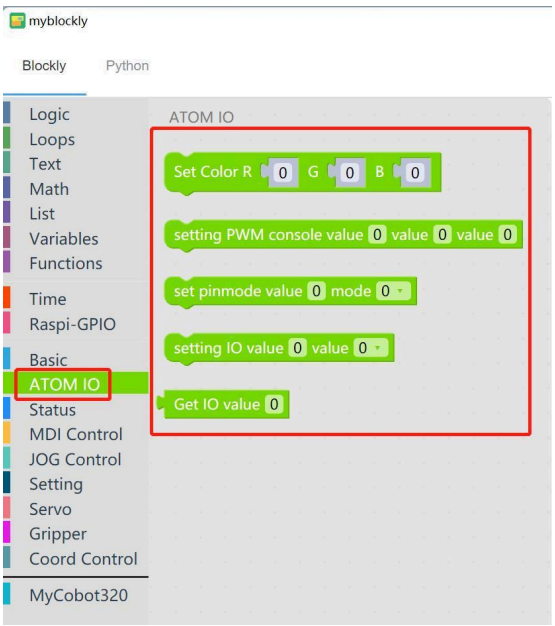
Other series: Make sure the machine is normal

Learning content in this chapter

How to use myBlockly to control the RGB light board

API introduction

- Method module: `Color setting`



- Scope of application: **myCobot 280 series**, myCobot 320 series, myCobot Pro 600 series and myPalletizer 260 series

- Parameter introduction:
- The parameters to be set are R (`x`), G (`x`), B (`x`), and different values represent different colors.
- Parameter range (for details, please refer to the RGB parameter table):

R: 0~255

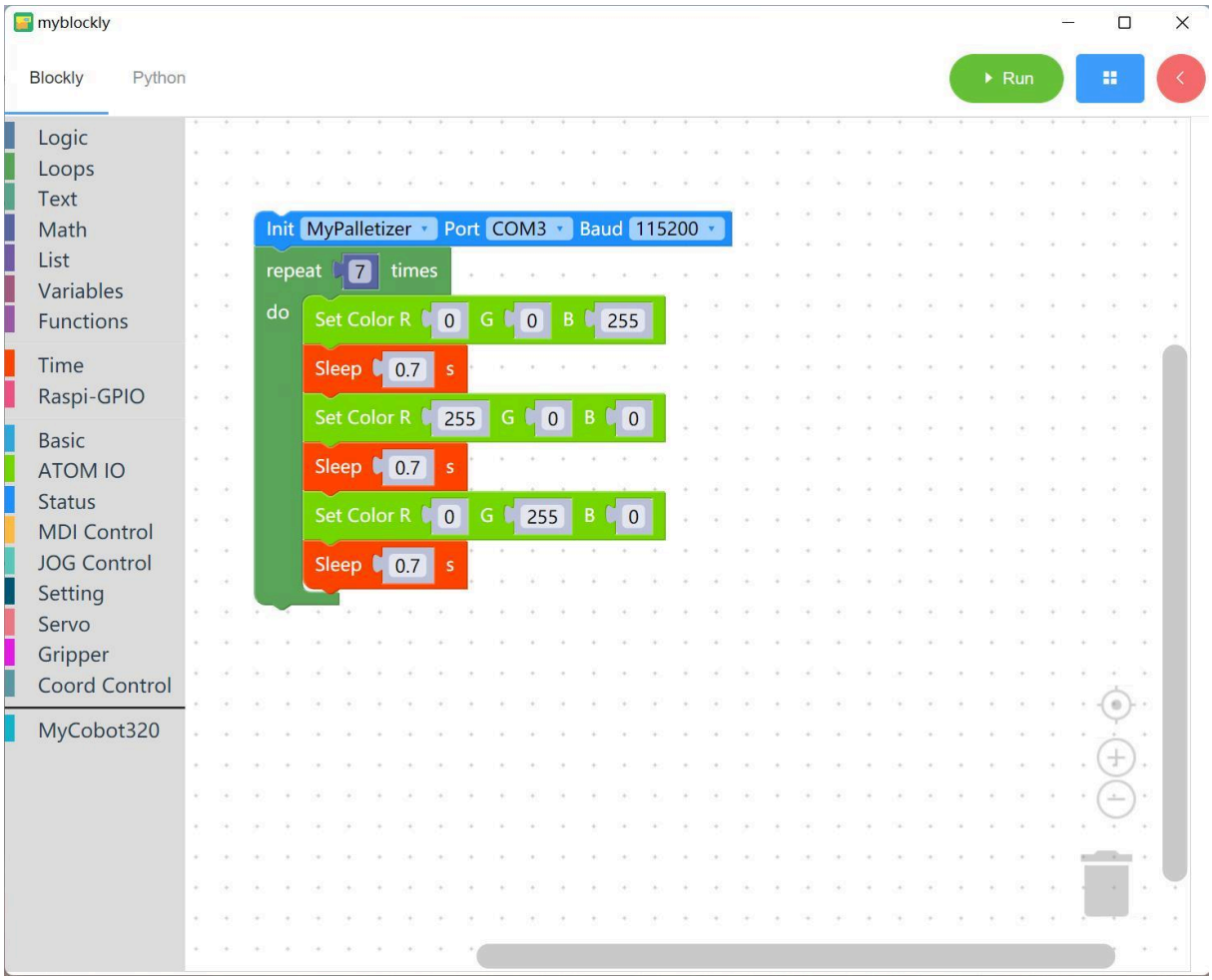
G: 0~255

B: 0~255

- Purpose: Control the color of the RGB light board.

Simple demonstration

- Graphic code is as follows:



- Implemented content:

Control the color of the robot arm RGB light board to change from "blue-red-green" in sequence, and the whole process is repeated seven times.

Control the robot arm to return to the origin

Preparation before starting

M5Stack series: Make sure the robot arm is connected to the computer

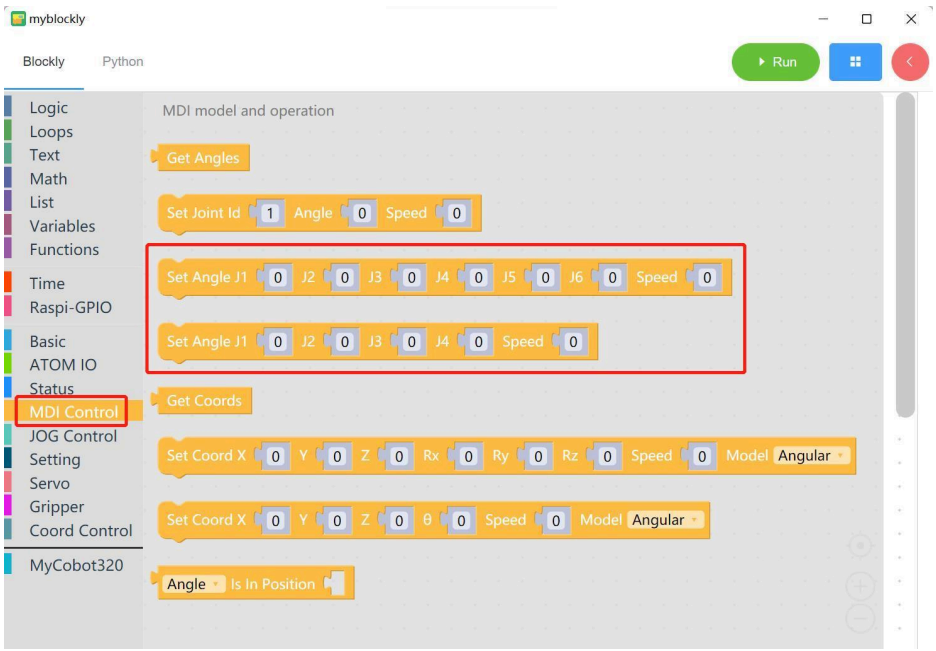
Other series: Make sure the machine is normal

Learning content in this chapter

How to use myBlockly to control the robot arm to return to the origin

API introduction

- Method module: `Set angle`



- Scope of application: This module is applicable to the 6-axis myCobot 280 series, mechArm series, myCobot 320 series

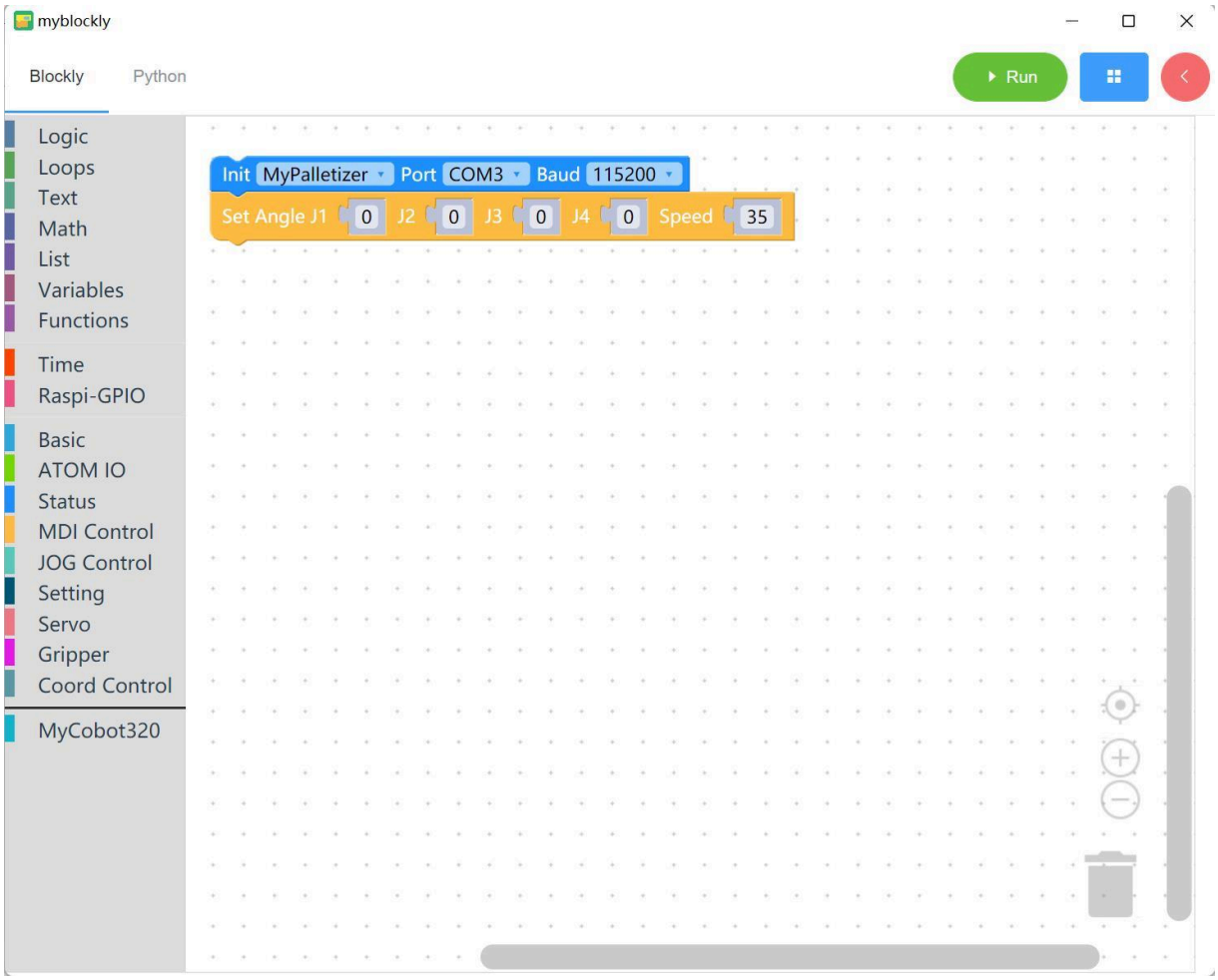
- Scope of application: This module is applicable to the 4-axis myPalletizer series
- Parameter introduction:

This module has two parameters that can be adjusted:

- Joint angle parameters: If the robot arm is returned to the origin, all joint angle parameters must be set to 0
- Speed parameters: Please refer to the robot parameter introduction section of **2. Product Introduction**
- Purpose: Control the robot arm and return the angles of all axes of the robot arm to the origin (angle is 0)

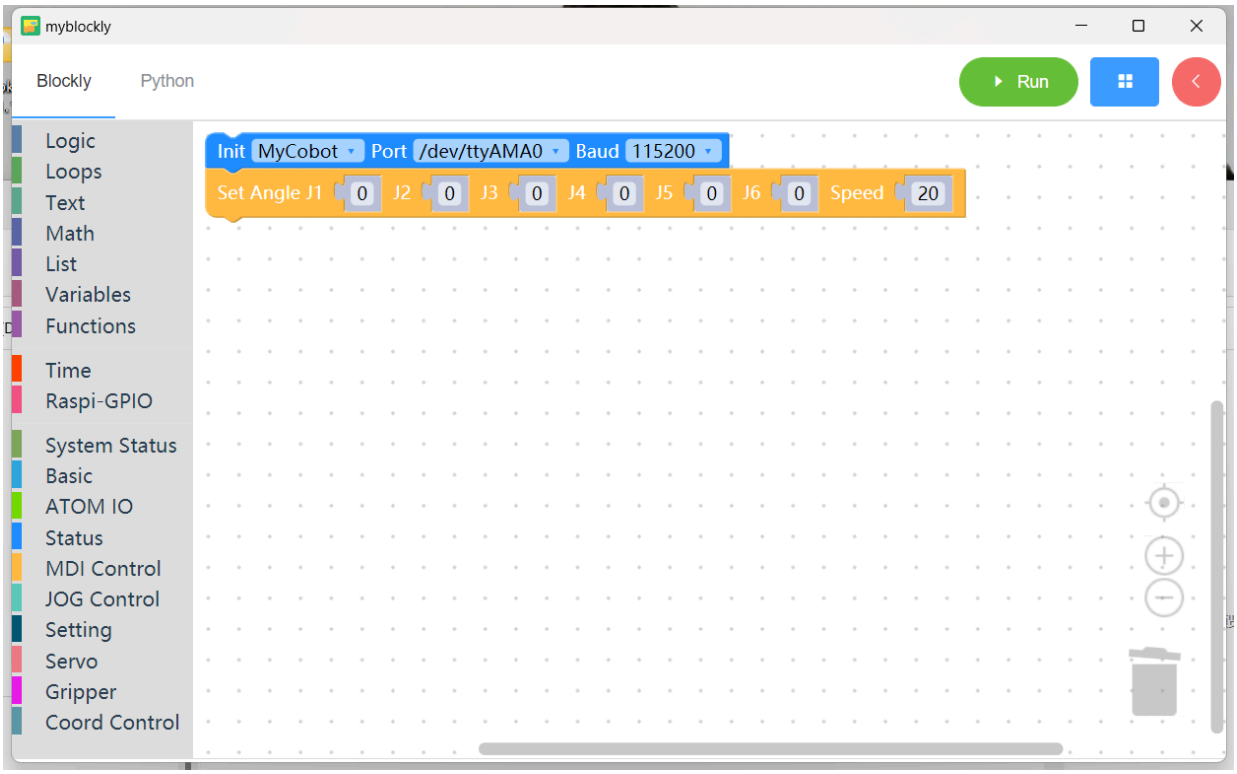
myPalletizer

Simple demonstration



myCobot

Simple demonstration



- Implementation content: Control the robot arm to move back to the origin, so that the angles of all axes of the robot arm are 0

Control single joint motion

Preparation before starting

M5Stack series: Make sure the robot is connected to the computer

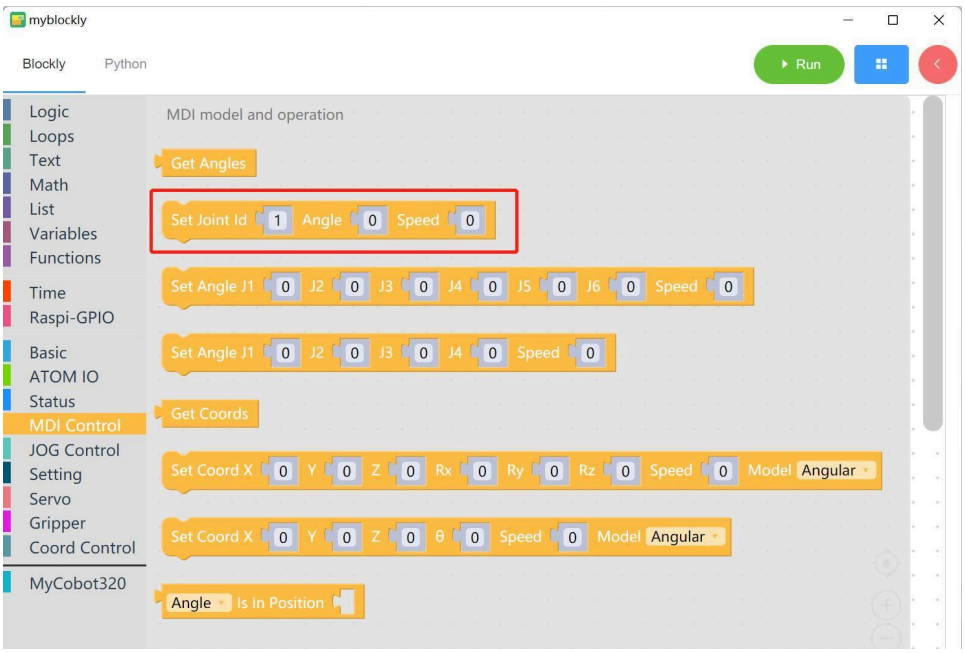
Other series: Make sure the machine is normal

Learning content in this chapter

How to use myBlockly to control the single joint motion of the robot

API introduction

- Method module: `Set joint`



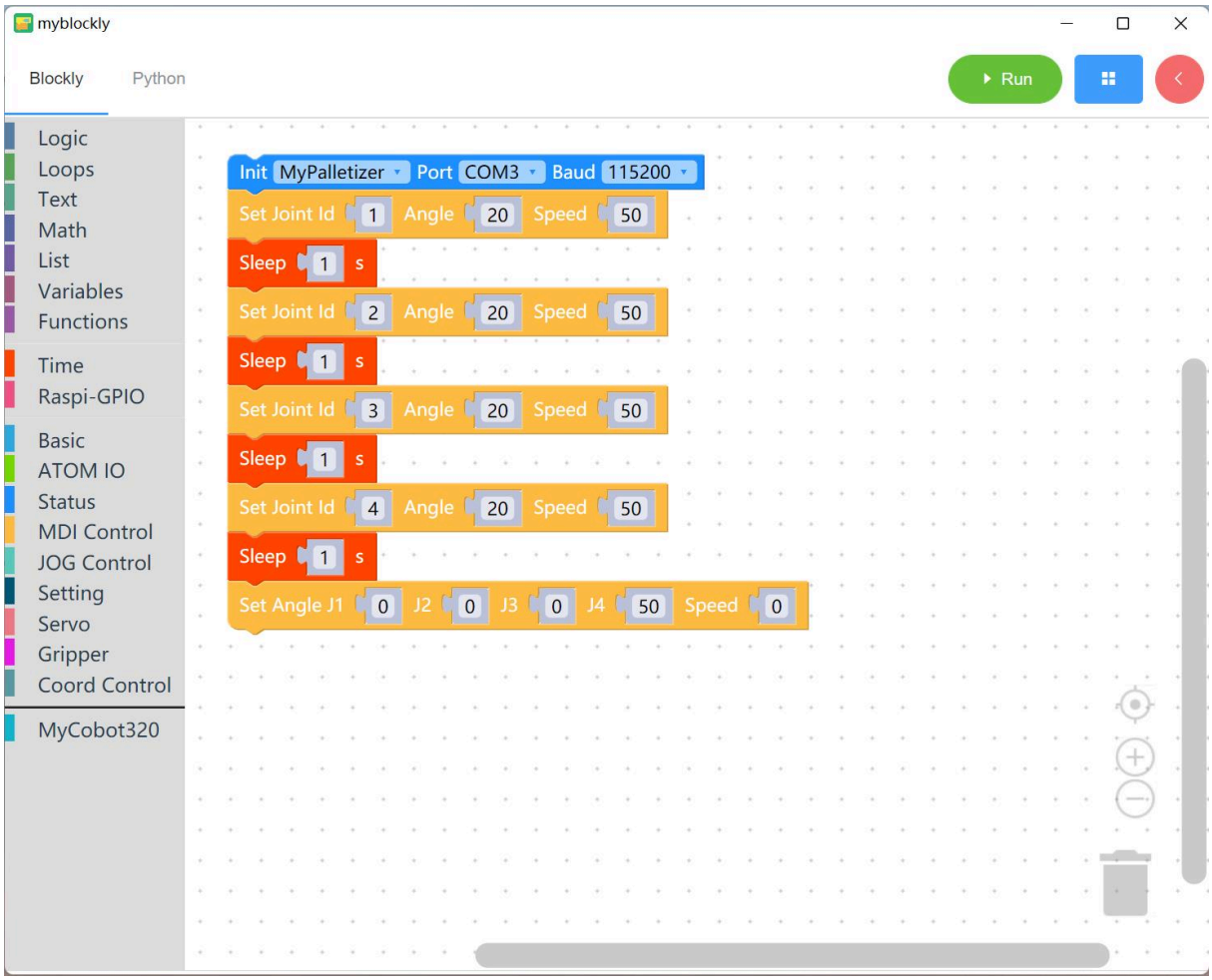
- Applicable scope: myCobot280 series, myCobot320 series, mechArm series, myPalletizer series
- Parameter introduction:

This method has three parameters that can be adjusted:

- Joint parameters: The parameter range of myCobot280 series, myCobot320 series and mechArm series is: 1-6; the parameter range of myPalletizer series is: 1-4 (corresponding to the joints of the robot arm)
- Angle parameters: refer to the parameters of the corresponding model
- Speed: Control the speed of the robot arm movement, the parameter range is: 0~100
- Purpose: Control the movement of a single joint of the robot arm

Simple demonstration

- The graphic code is as follows:



- Implementation content:

Control the robot arm 1 joint, run to the position of 1 joint angle 20 at a speed of 50, after one second,

Control the robot arm 2 joint, run to the position of 2 joint angle 20 at a speed of 50, after one second,

Control the robot arm 3 joint, run to the position of 3 joint angle 20 at a speed of 50, after one second,

Control the robot arm 4 joint, run to the position of 4 joint angle 20 at a speed of 50, after one second,

Return all joints of the robot arm to the origin at a speed of 60, and end the program.

Control multiple joints

Preparation before starting

M5Stack series: Make sure the robot is connected to the computer (for details, please refer to **myBlockly** chapter)

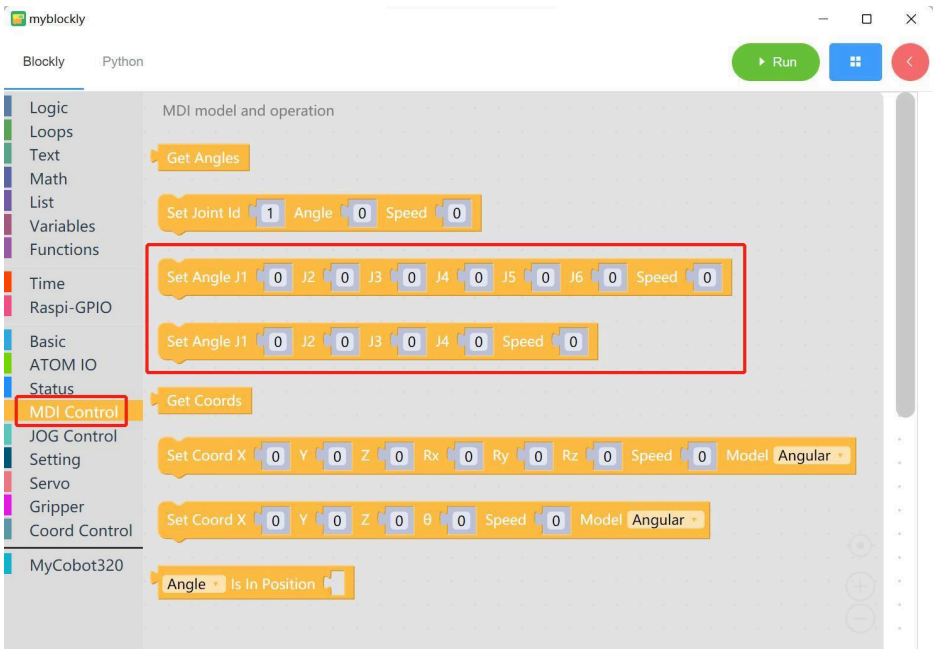
Other series: Make sure the machine is normal

Learning content in this chapter

How to use myBlockly to control the movement of multiple joints of the robot

API introduction

- Method module: `Set full angle`



- Scope of application: This module is applicable to the 6-axis myCobot 280 series, mechArm series, myCobot 320 series

- Scope of application: This module is applicable to the 4-axis myPalletizer series
- Parameter introduction:

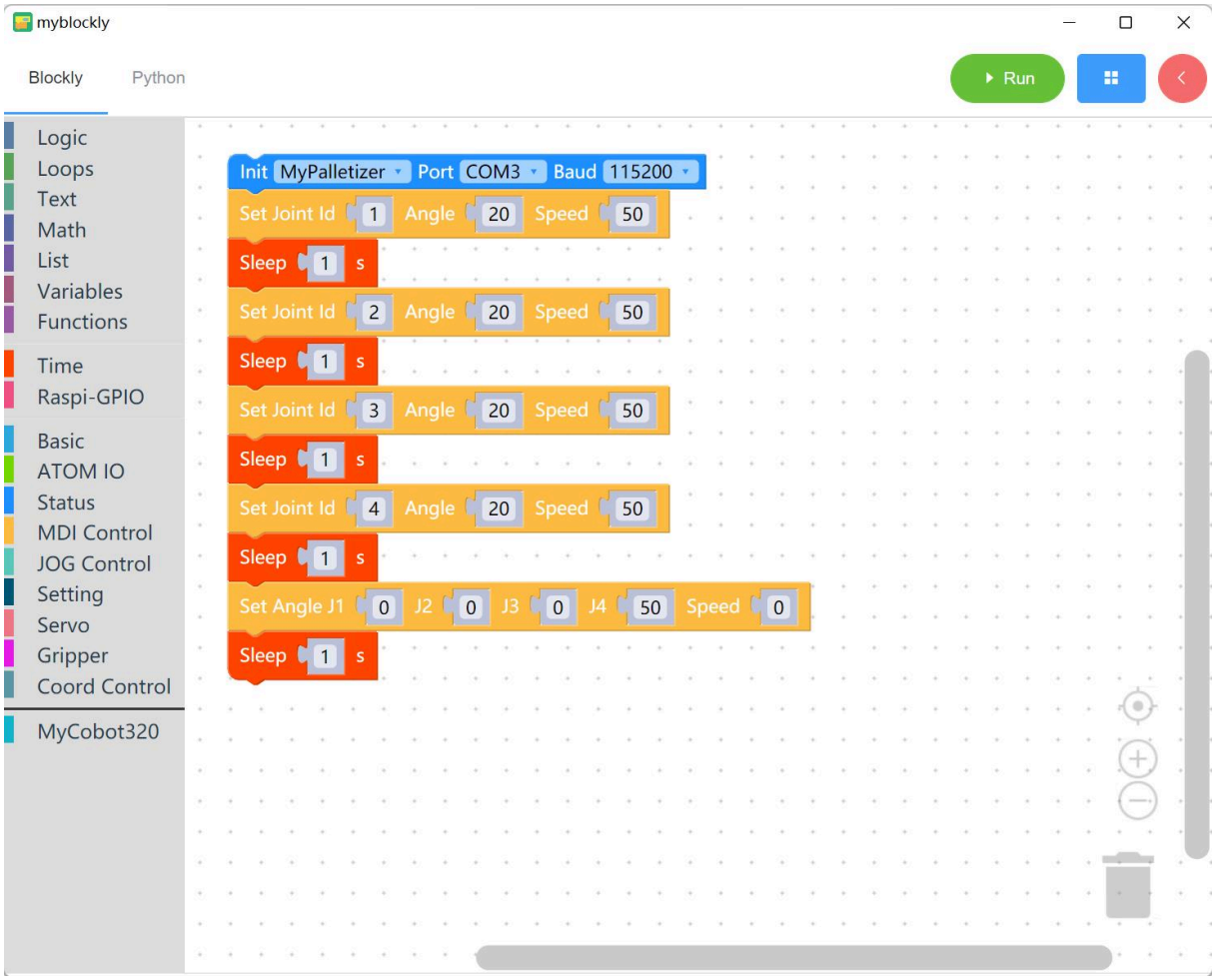
This module has two parameters that can be adjusted:

- Joint angle parameters: You can set the parameters within the range of joint motion of the robot arm as needed (for details of the joint motion range, please refer to **2. Product Introduction**)

- Speed parameters: You can set the parameters within the range of robot arm motion speed as needed (for the maximum motion speed, please refer to **2. Product Introduction**)
- Purpose: Control the motion of multiple joints of the robot arm

Simple demonstration

- The graphic code is as follows:



- Implementation content:

Control all joints of the robot to return to the origin. After two seconds,

Control joints 1, 2, 3 and 4 of the robot to run at a speed of 50 to 30 degrees, 30 degrees, -30 degrees and 50 degrees respectively. After two seconds,

Control all joints of the robot to return to the origin at a speed of 50. After two seconds,

Control joints 1, 2, 3 and 4 of the robot to run at a speed of 50 to -30 degrees, 0 degrees, 30 degrees and -50 degrees respectively. After two seconds, end the program.

Control the robot arm to swing left and right

Preparation before starting

M5Stack series: Make sure the robot arm is connected to the computer (for details, please refer to **myBlockly**)

Other series: Make sure the machine is normal

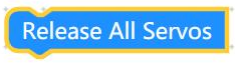
Learning content in this chapter

How to use myBlockly to control the robot arm to swing left and right

API display

- Method module **1**: `Power on`

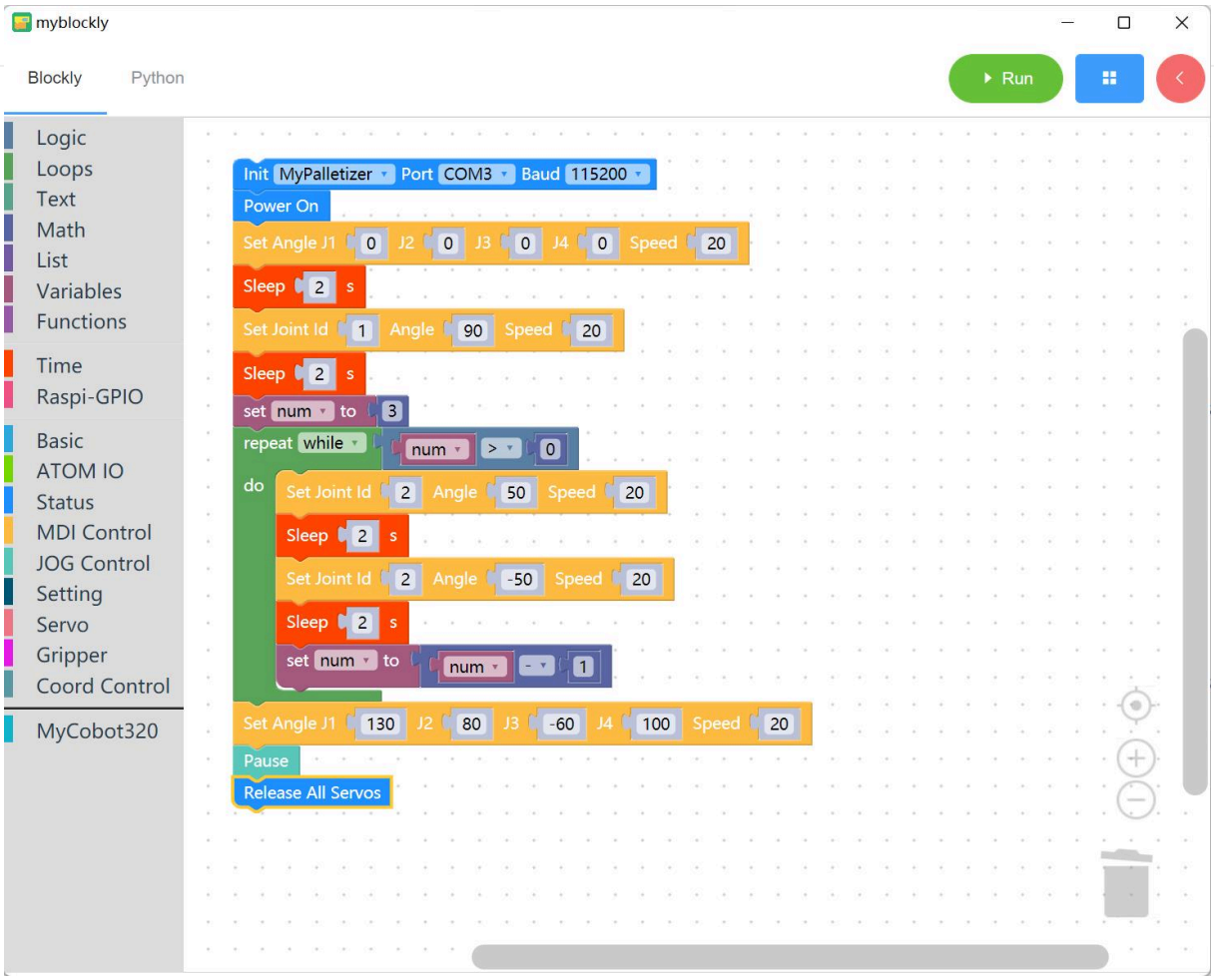
- Applicable scope: myCobot280 series, myCobot320 series, mechArm series, myPalletizer series
- Purpose: Start the system
- Method module **2**: `Release joints`



- Applicable scope: myCobot280 series, myCobot320 series, mechArm series, myPalletizer series
- Purpose: Stop the movement of the robot arm and lock each joint

Simple demonstration

- The graphic code is as follows:



- Implementation content:

Power on the robot arm and control the robot arm to move back to the origin. After two seconds,

Control the robot arm 1 joint to run to the angle 50 position at a speed of 20. After two seconds,

Control the robot arm 2 joint to run to the angle 20 position at a speed of 20. After two seconds,

Control the robot arm 2 joint again to run to the angle -50 position at a speed of 20. After two seconds,

Loop the control of the 2 joints twice. After the loop ends,

Run the 1st joint, 2nd joint, 3rd joint and 4th joint at a speed of 20 to the angles of 130, 80, -60 and 100 respectively.

Finally, the robot arm movement is paused, all joints are released, and the program ends.

Control the robot to dance

Preparation before starting

M5Stack series: Make sure the robot is connected to the computer

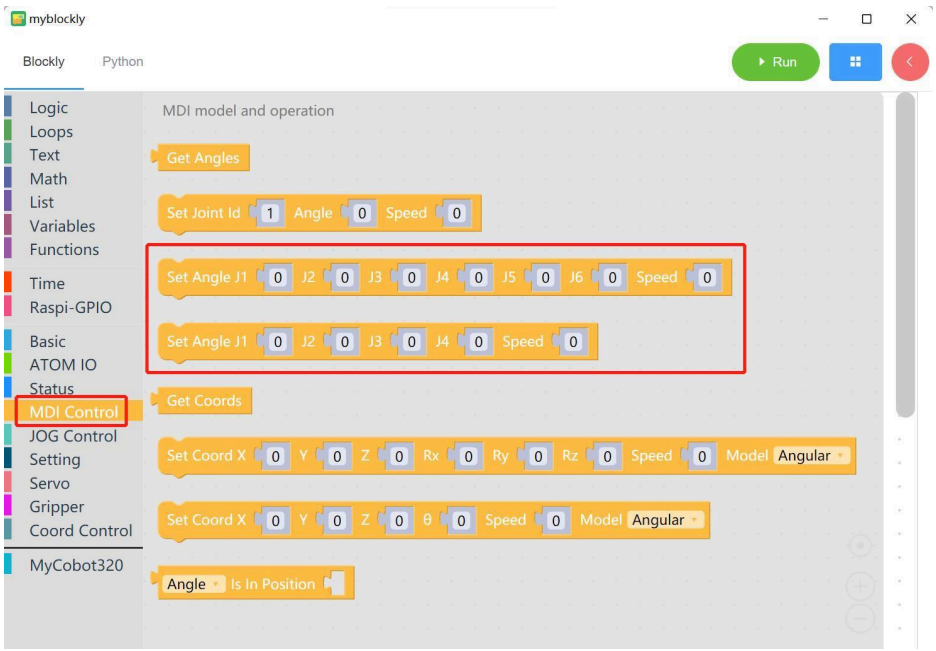
Other series: Make sure the machine is normal

Learning content in this chapter:

How to use myBlockly to control the robot to dance

API display

- Method module: `Set full angle`



- Scope of application: This module is suitable for 6-axis myCobot 280 series, mechArm series, myCobot 320 series

- Scope of application: This module is suitable for 4-axis myPalletizer series
- Parameter introduction:

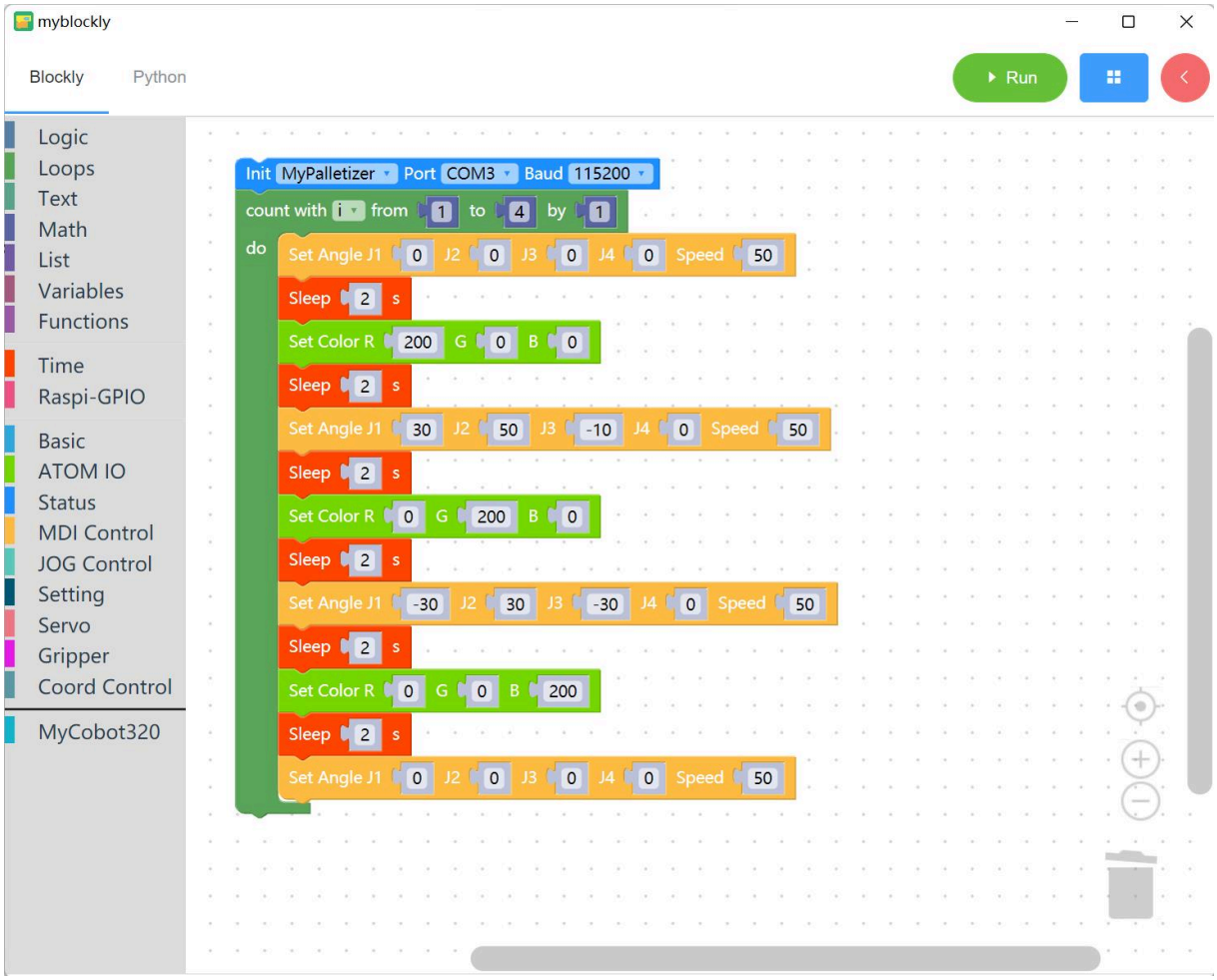
This module has two parameters that can be adjusted:

- Joint angle parameters: You can set the parameters within the range of joint motion of the robot arm as needed (for details of the joint motion range, please refer to Product Introduction chapter

- Speed parameters: You can set the parameters within the range of robot arm motion speed as needed (for the maximum motion speed, please refer to **Product Introduction**)
- Purpose: Control the motion of multiple joints of the robot arm

Simple demonstration

- The graphic code is as follows:



- Implementation content:

Control all joints of the robot arm to return to their original positions, and the RGB light board turns red.

After one second, control joints 1, 2, and 3 to run at a speed of 50 to 30 degrees, 50 degrees, and -10 degrees respectively.

After one second, the RGB light board turns green.

After one second, control joints 1, 2, and 3 to run at a speed of 50 to -30 degrees, 30 degrees, and -30 degrees respectively.

After one second, the RGB light board turns blue.

After one second, control all the robot arms to shut down and return to their original positions.

Use of grippers

Preparation before starting

M5Stack series: Make sure the robot is connected to the computer (for details, please refer to myBlockly chapter

Other series: Make sure the machine is normal

Grippers include adaptive grippers, electric grippers, and pneumatic grippers. Different grippers are compatible with different robot arm models. For details, please refer to **Accessories**. Here, we take the adaptive gripper and myPalletizer 260 M5Stack robot arm as an example to explain how to use myBlockly to control the gripper.

Learning content in this chapter

How to use myBlockly to control the adaptive gripper connected to the myPalletizer 260 M5Stack robot

API display

- Method module **1**: `Reinitialize the gripper`

- Applicable scope: myCobot 280 series, myPalletizer 260 series, mechArm 270 series
- Purpose: Set the initial position of the gripper
- Method module **2**: `Set the gripper state`

- Applicable scope: myCobot 280 series, myPalletizer 260 series, mechArm 270 series
- Parameter introduction:

This module has two parameters that can be adjusted:

- Gripper state parameter: 1 indicates the gripper is closed, 0 indicates the gripper is open
- Speed parameter: indicates the speed of rotation, the value range is 0~100
- Purpose: Make the gripper enter the specified state (open or closed) at the specified speed
- Method module **3**: `Set the value of the gripper`

- Applicable scope: myCobot 280 series, myPalletizer 260 series, mechArm 270 series
- Parameter introduction:

This module has two parameters that can be adjusted:

- Gripper value parameter: indicates the position to be reached by the gripper, with a value range of 0~256.

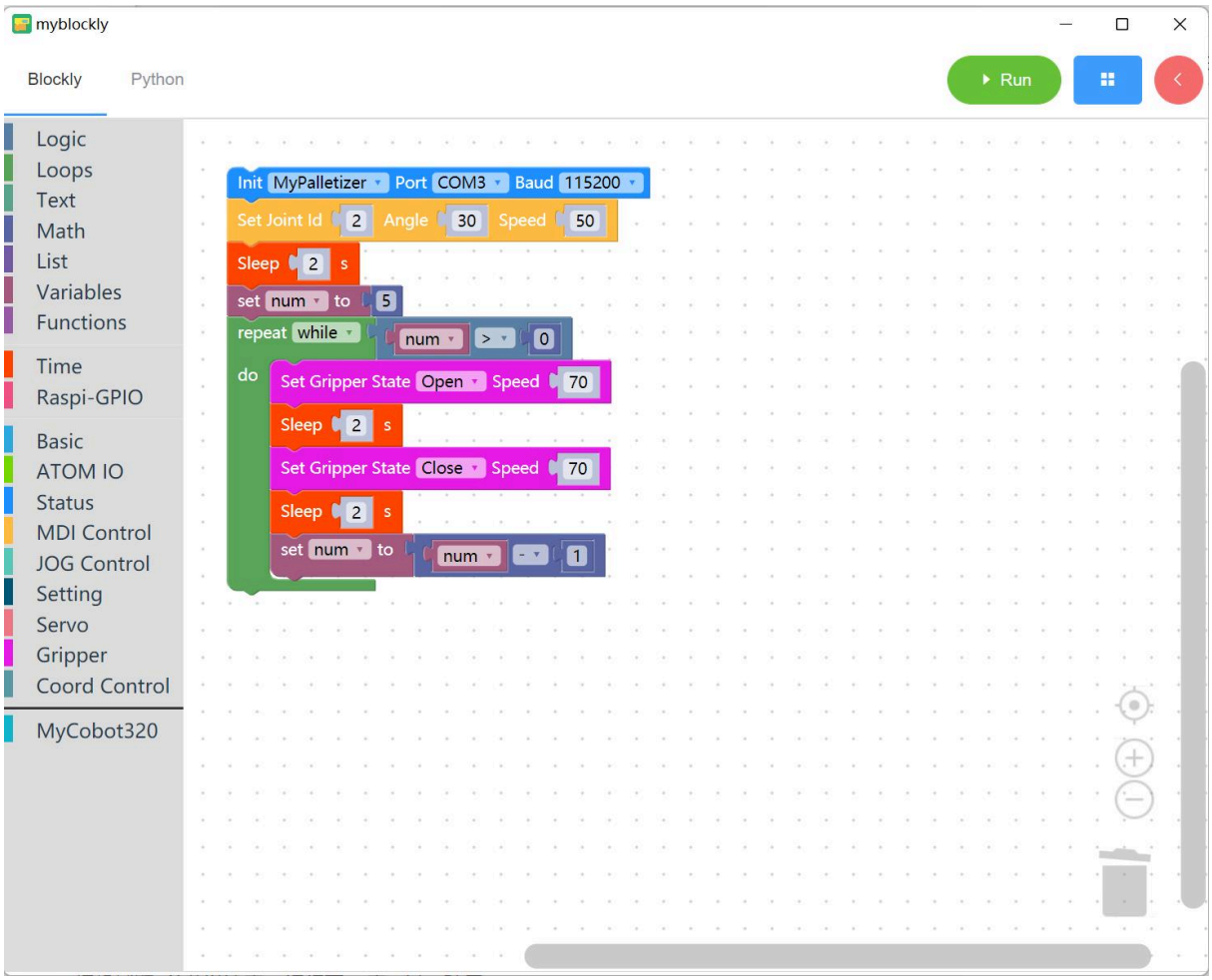
- Speed parameter: indicates the speed of rotation, with a value range of 0~100.

- Purpose: Make the gripper rotate to the specified position at a specified speed.
- Method module **4**: `Is the gripper moving`

- Applicable scope: myCobot 280 series, myPalletizer 260 series, mechArm 270 series
- Purpose: Determine whether the gripper is running

Simple demonstration

- The graphic code is as follows:



- Implementation content:

The robot arm 2 joint runs at a speed of 50 to 30 degrees. After one second,

the gripper opens at a speed of 70. After one second,

the gripper closes at a speed of 70.

After the gripper opens and closes 5 times, the program ends.

Use of suction pump

Preparation before starting

M5Stack series: Make sure the robot is connected to the computer

Other series: Make sure the machine is normal

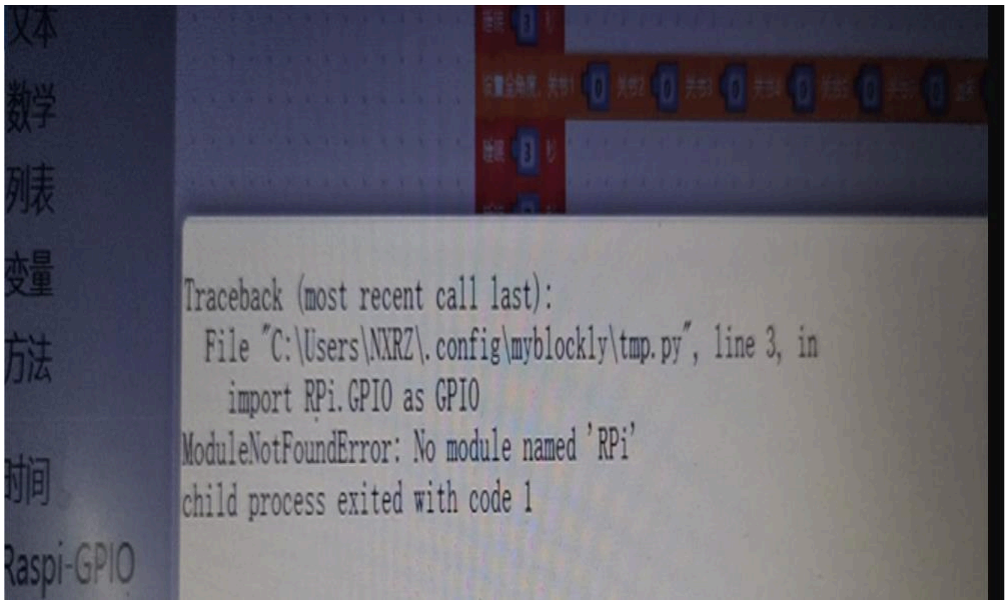
For the introduction and installation of the suction pump, please refer to **Accessories** chapter. The robot models that are compatible with the suction pump include myCobot 280, myPalletizer 260 and mechArm 270. Here, the myPalletizer 260 M5Stack robot is used as an example.

Learning content in this chapter

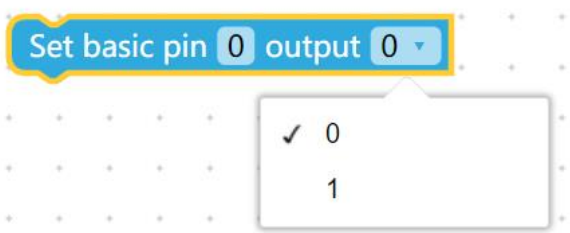
How to use myBlockly to control the suction pump connected to the myPalletizer 260 M5Stack robot

API display

Note: The M5 version and the Raspberry Pi version require different method modules to control the suction pump. The M5 version robot cannot use the Raspberry Pi interface. If the module does not match the model, the program will report an error (as shown below).



- Method module **1** (for M5 version): `Set the bottom pin number status`



- Applicable scope: myCobot 280 series, myPalletizer 260 series and mechArm 270 series
- Parameter introduction:

This module has two parameters that can be adjusted:

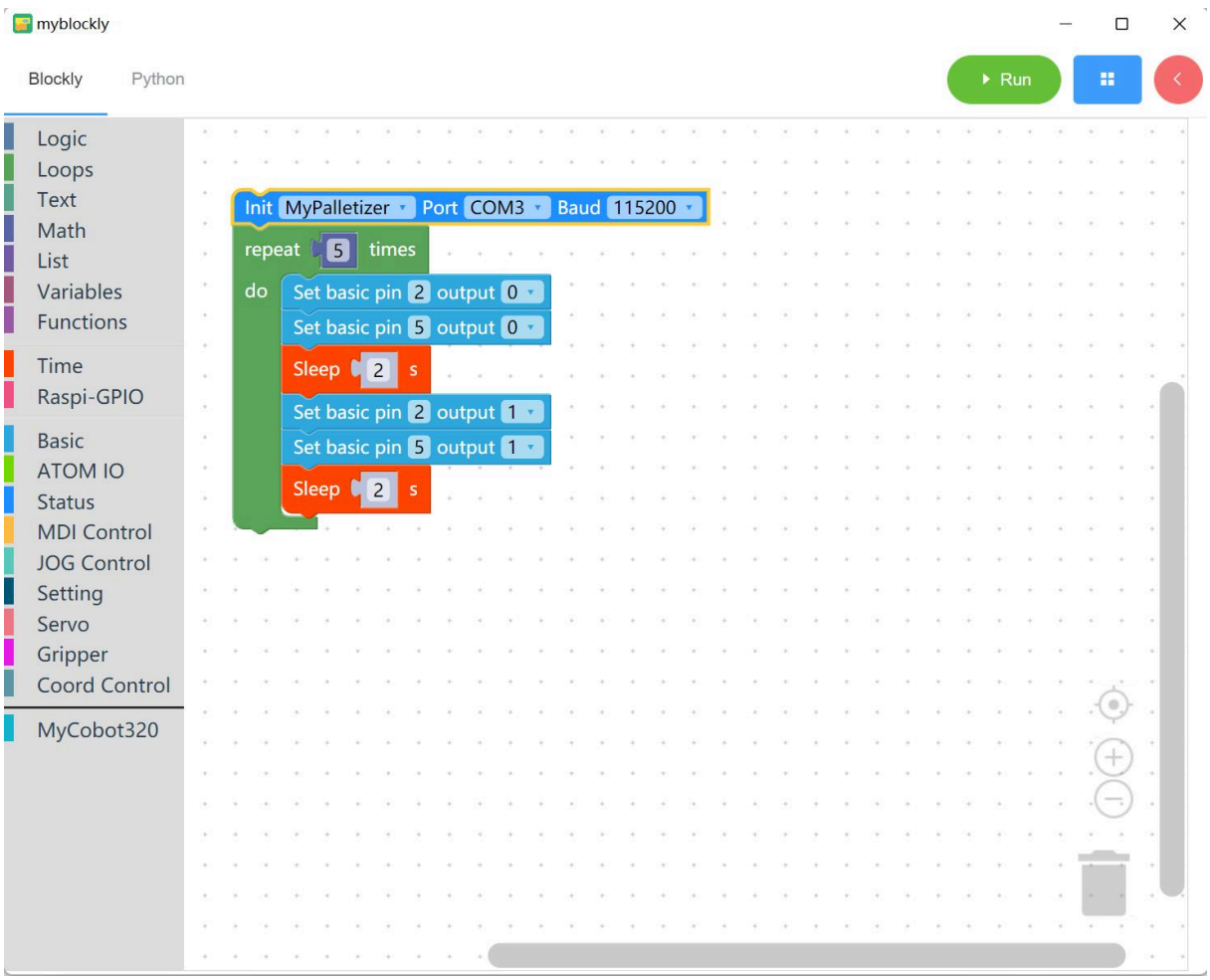
- Bottom pin number parameter: the specific pin number at the bottom of the device (only the numeric part is taken)
- Running state parameter: 0 means set to running state, 1 means stop state
- Purpose: Set the working state of the bottom pin number
- Method module **2** (for M5 version): `Get bottom pin number`

- Applicable scope: myCobot 280 series, myPalletizer 260 series and mechArm 270 series M5 version
- Parameter introduction:
- Bottom pin number parameter: the specific pin number at the bottom of the device (only the numeric part is taken)
- Purpose: Get the working state of the bottom pin number

Simple demonstration

Vertical suction pump V1.0

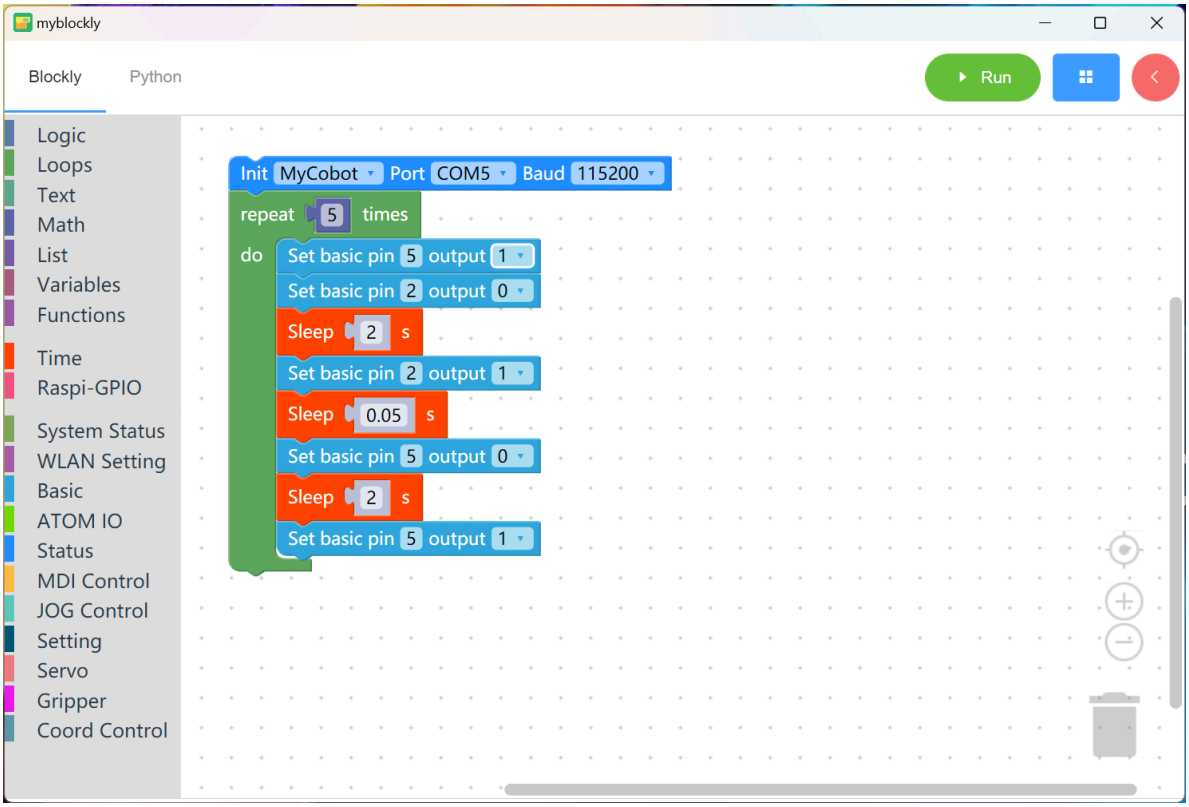
- The graphic code is as follows: (for M5 version)



- Implementation content: The suction pump vibrates and starts working. The suction pump sucks up the object, puts it down after two seconds, and repeats the previous action after another two seconds until the program runs to the end.

Vertical Suction Pump V2.0

- Graphic code is as follows: (for M5 version)
- Pin 5/2 controls the solenoid valve and the air release valve respectively



- Implementation content: First close the solenoid valve and open the air release valve to prepare for starting the suction pump; after two seconds, close the air release valve. After 0.05 seconds, open the solenoid valve, the suction pump vibrates and starts working. The suction pump picks up the object and puts it down after two seconds. Close the air release valve and repeat the previous actions until the program ends.

Gripper test

Before you start

M5Stack series: Make sure the robot arm is connected to the computer (for details, please refer to myBlockly chapter.

Others: Make sure the machine is normal

To use the gripper test function, myblockly needs to be updated to v3.3.5

Learning content in this chapter

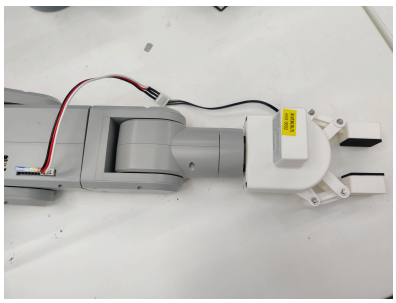
How to use myBlockly to quickly test whether the gripper is normal.

Currently, the gripper test function is only compatible with the following models: myCobot 280 series, mecharm 270 series, myPalletizer 260 series, myArm 300 Pi.

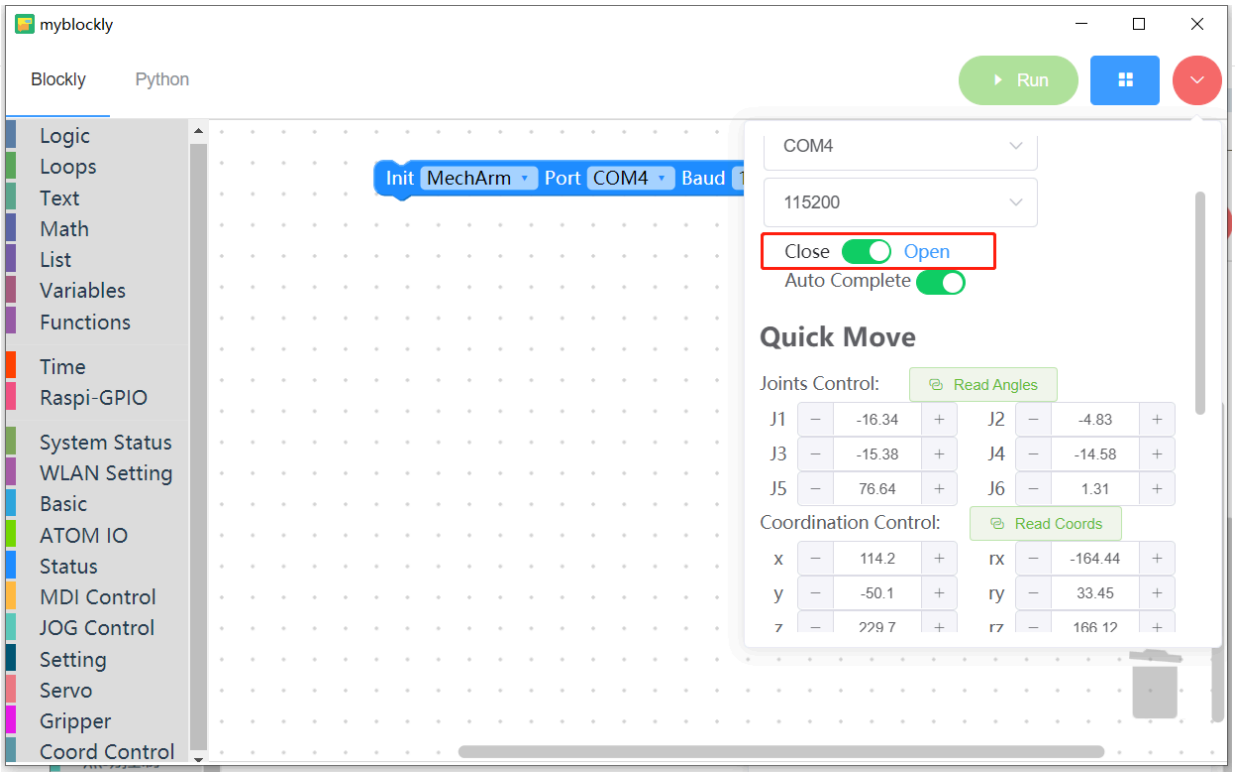
Gripper includes adaptive gripper, electric gripper and pneumatic gripper. Different grippers are compatible with different robot arm models. For details, please refer to **Accessories** chapter.

Here, mecharm 270 M5 and adaptive gripper are used as an example.

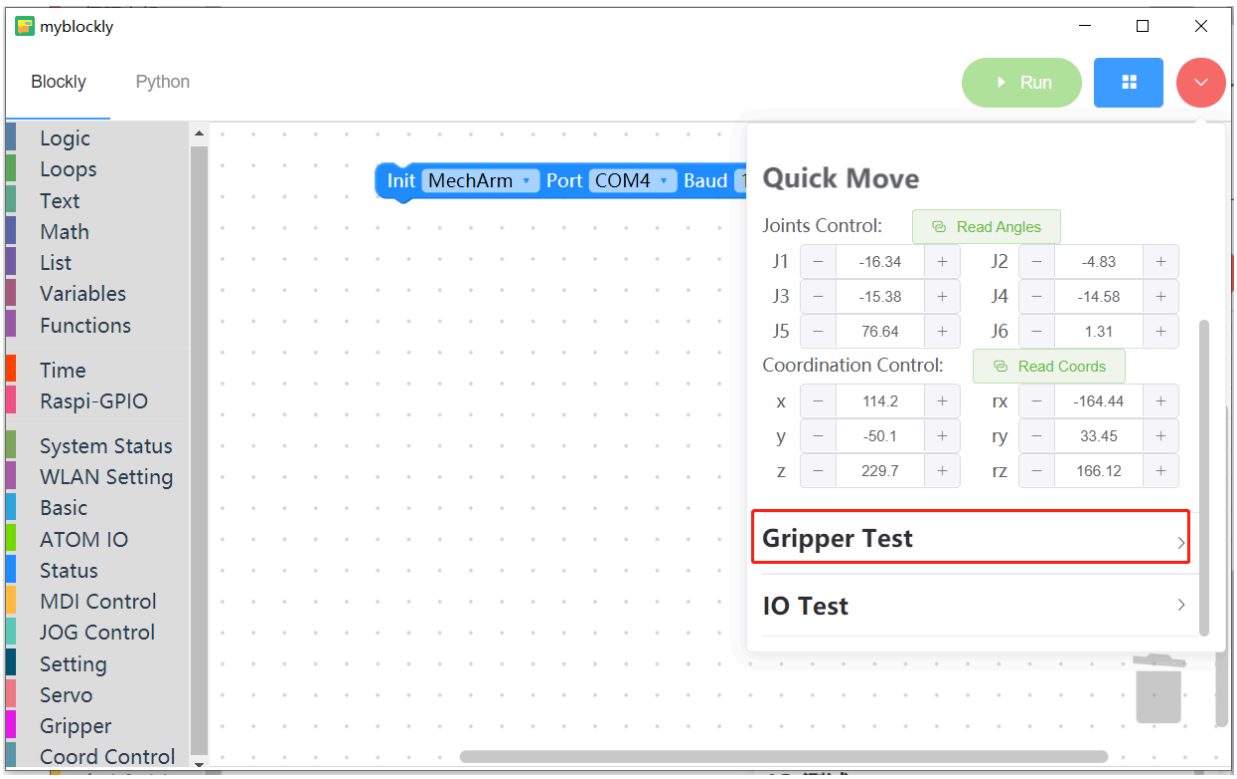
First install the gripper on the machine



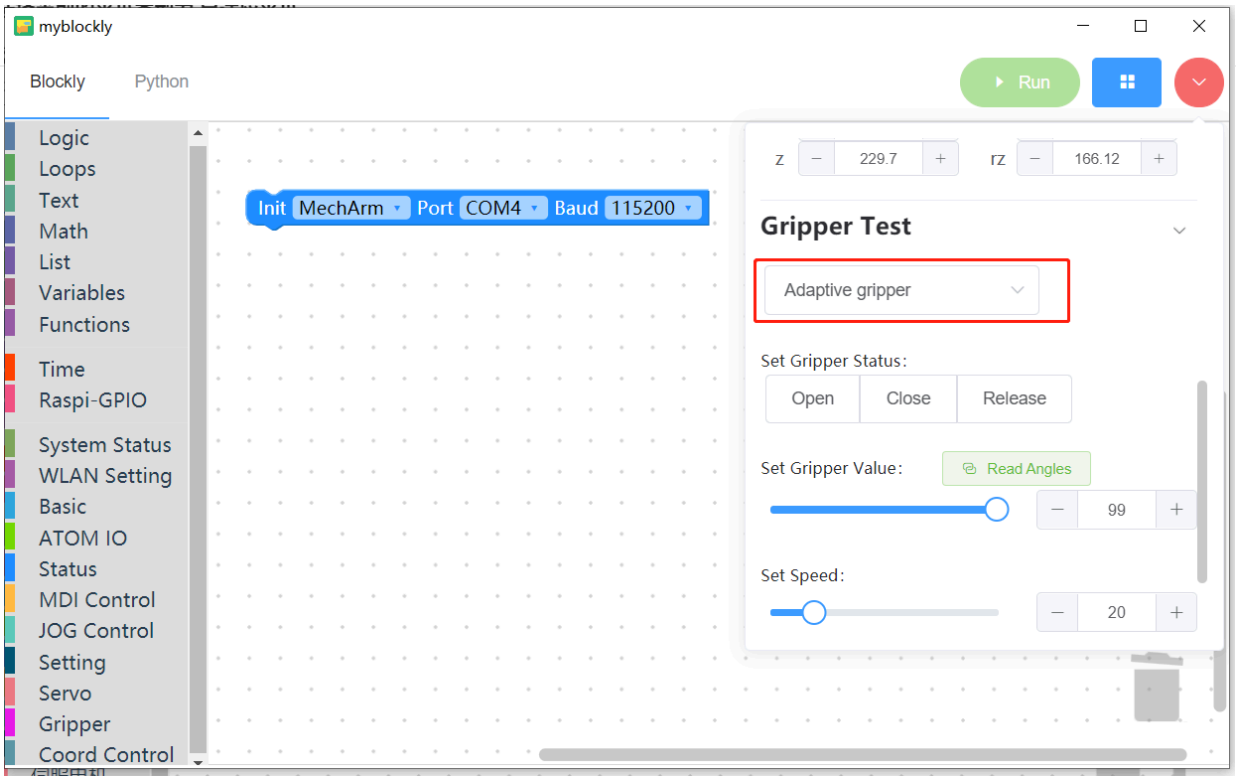
myblockly connects to the machine serial port



Open the gripper test



Select the current gripper type as Adaptive Girpper



Then you can try the following operations:

- Set the gripper state: open, closed, released. Pay attention to the movement of the gripper.
- Click the Read Angle button to get the current gripper value.
- You can fine-tune the gripper value.
- You can set the gripper's moving speed.

> Tips: When the gripper type is Dexterous Hand, you cannot set the gripper value, you can only set its status.

IO test

Preparation before starting

M5Stack series: Make sure the robot arm is connected to the computer (for details, please refer to myBlockly chapter.

Others: Make sure the machine is normal

To use the IO test function, myblockly needs to be updated to v3.3.5

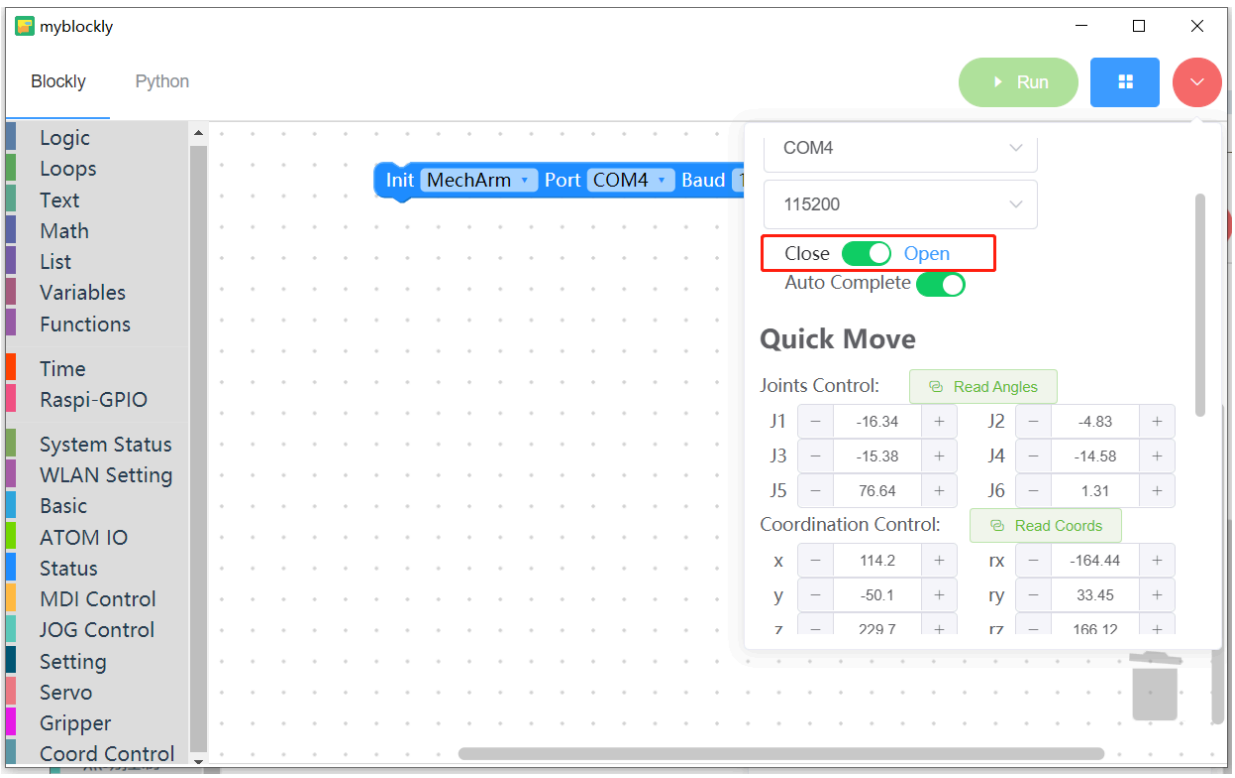
Learning content in this chapter

How to use myBlockly to quickly test whether io is normal.

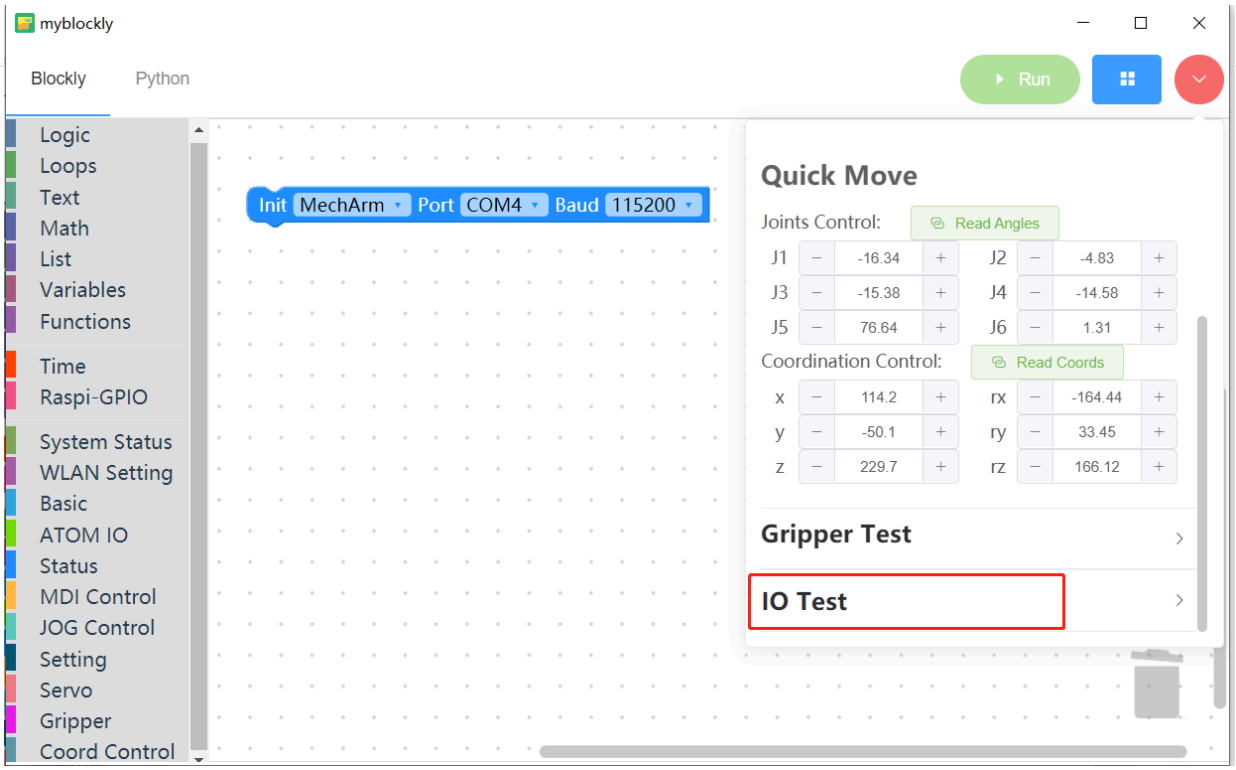
Currently, the gripper test function is only compatible with the following models: myCobot 280 series, mecharm 270 series, myPalletizer 260 series, myArm 300 Pi.

Here, take mecharm 270 M5 as an example.

myblockly connects to the machine serial port

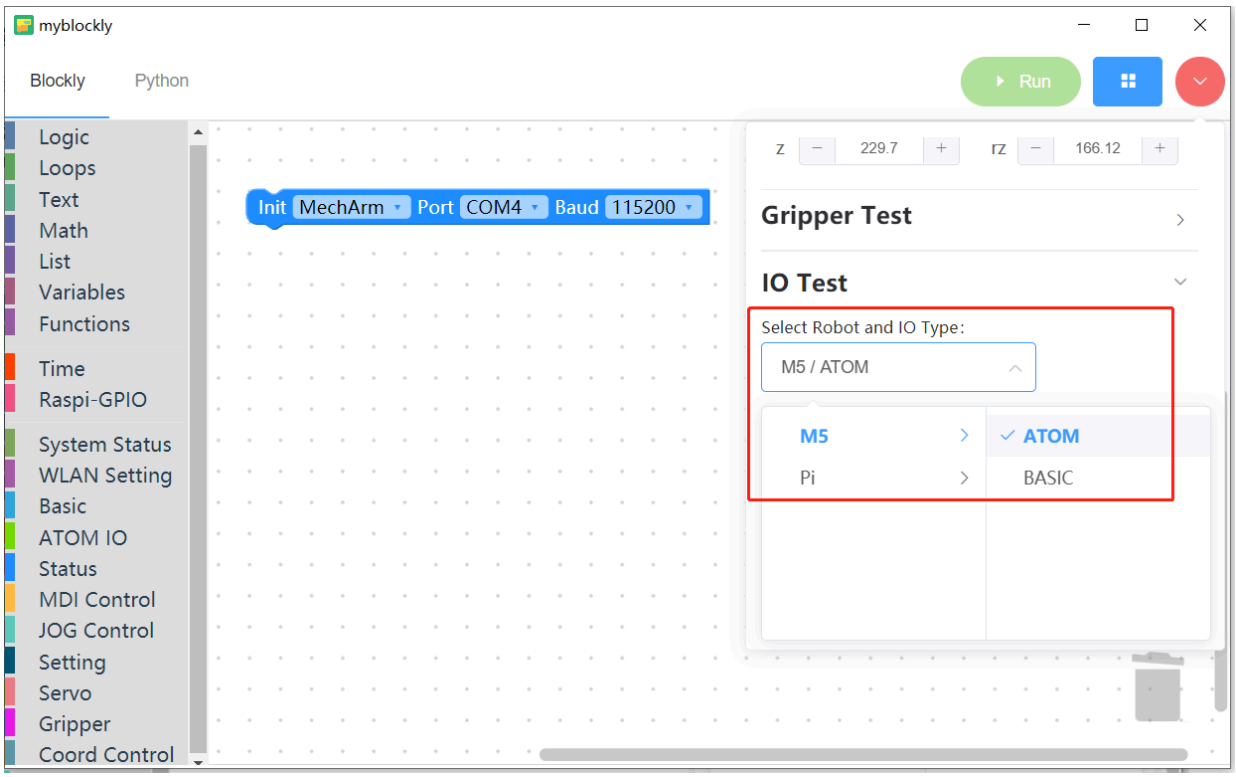


Open IO test



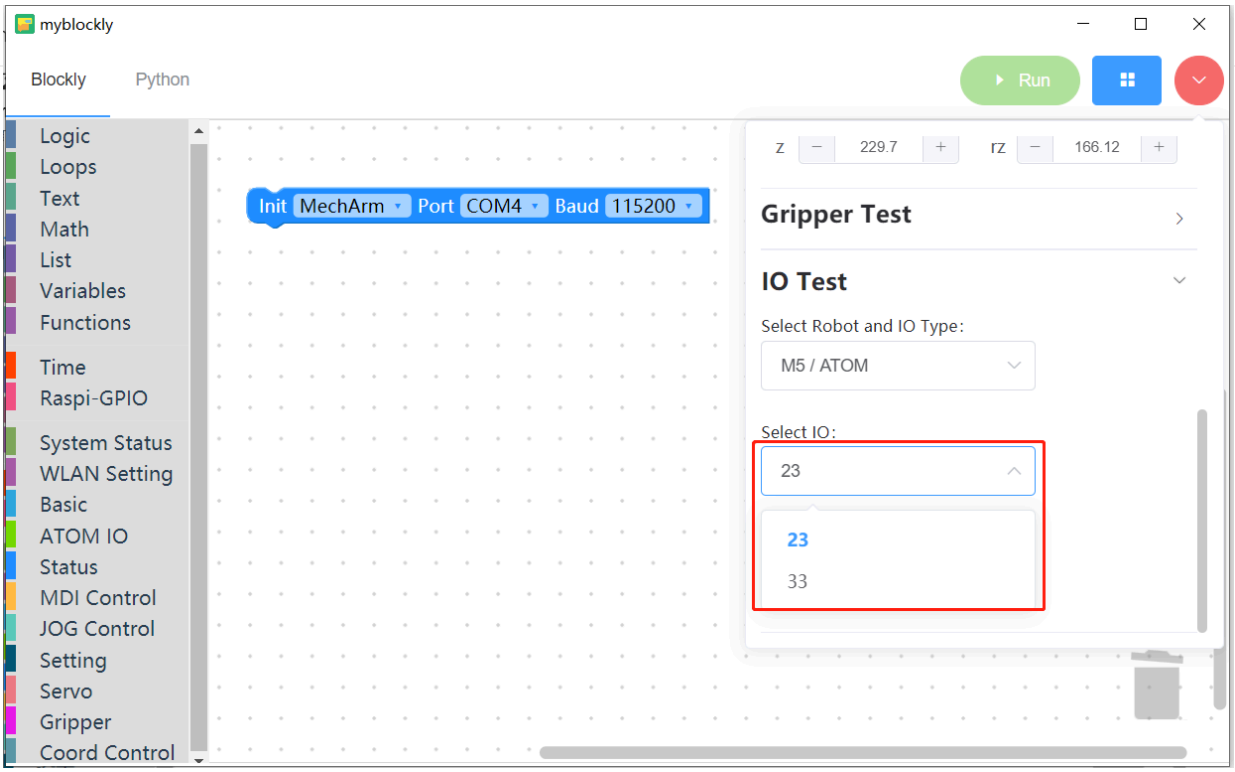
Select IO type

Our current model is M5, so select M5 type. You can choose ATOM and BASIC in the M5 category. Here we choose ATOM



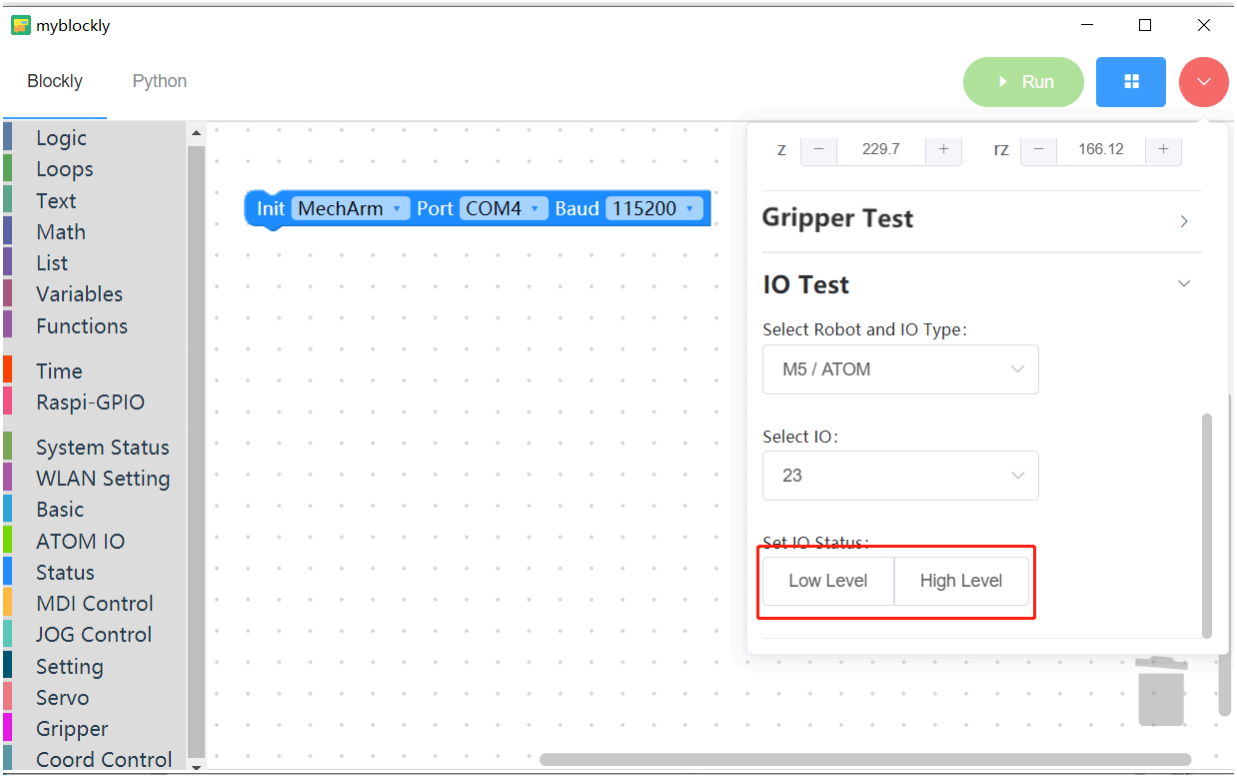
Select ATOM IO

meacharm 270 M5 Atom IO ports are currently only open 23 and 33

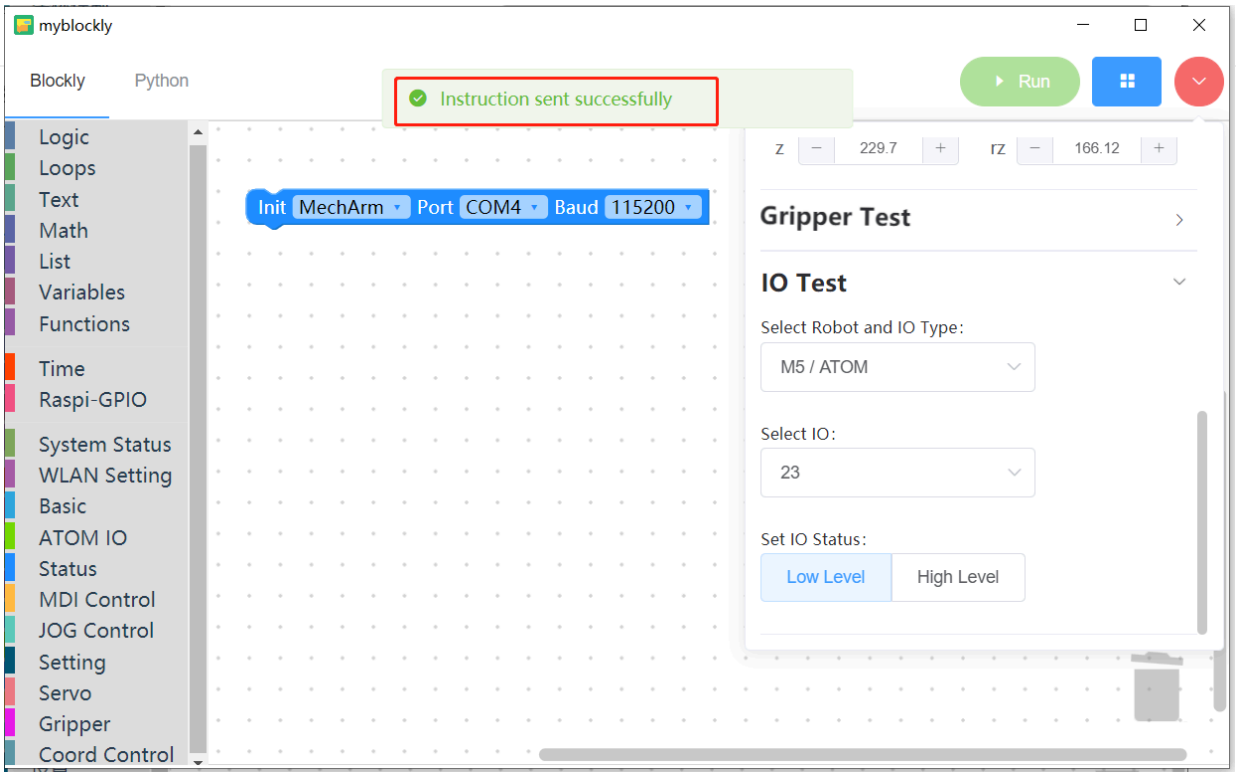


Operate IO status

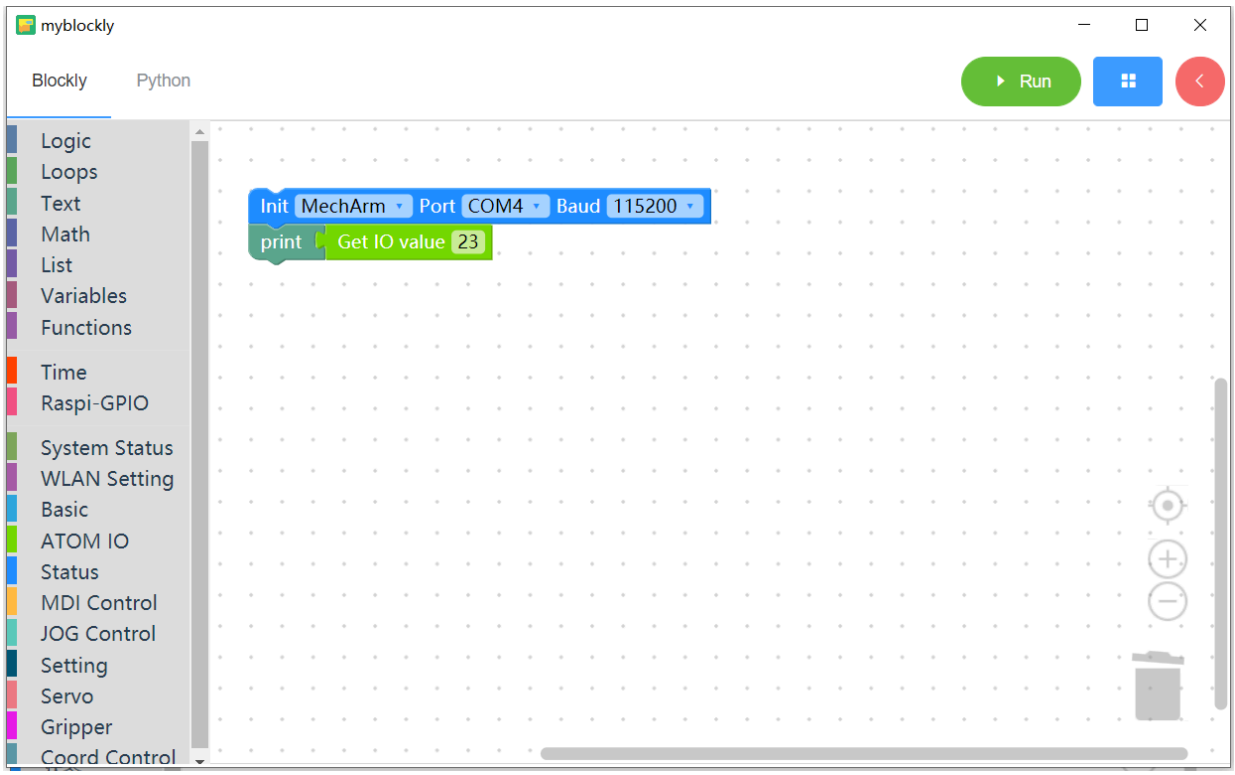
You can click the `Low Level` `High Level` buttons to change the current selection io port status



Set high and low levels and send the command successfully



After changing the io status, you can read the Atom io high and low levels through the building block to check whether it is successful

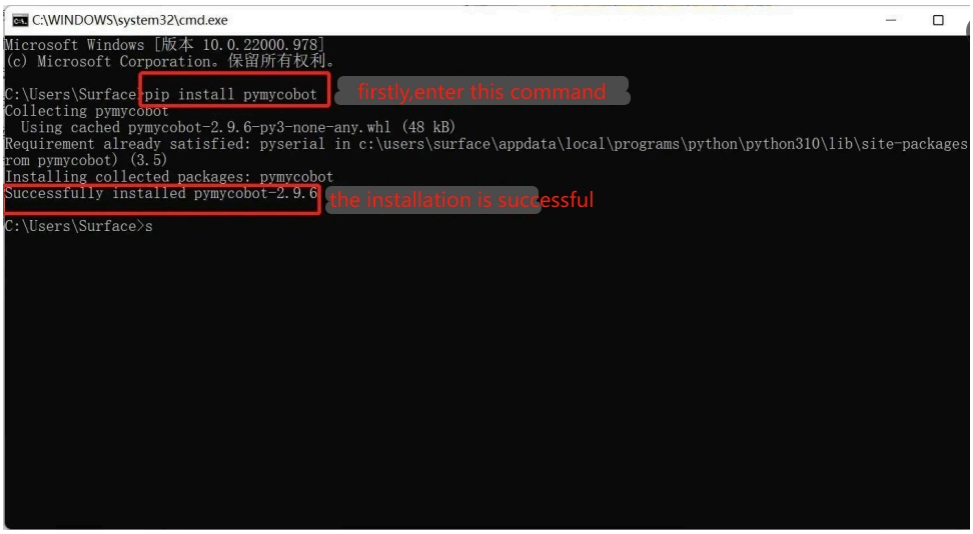


Q&A

This chapter lists common problems in using myBlockly to control the robot arm for reference.

Q1: myBlockly reports an error `ModuleNotFoundError: No module named 'pymycobot'` when running

A: This is because the pymycobot library is not installed when setting up the Python environment. To install the pymycobot library, open the terminal (Win key + R key), enter: `pip install pymycobot --upgrade --user`, and press Enter to display Successfully installed pymycobot.



Q2: The robot arm is unresponsive due to the lack of a `sleep` method module

A: The program that operates the robot arm movement takes time to complete, so a `sleep` module needs to be connected after an action to give the robot arm time to move before the next movement (the required time depends on the situation, and the robot arm is set by default to run myBlockly with a minimum sleep time of no less than 0.5s), otherwise the robot arm will not be able to achieve the desired movement.

Q3: The `Run` button in the upper right corner cannot be clicked, and it is gray-green.

A: The new version of myBlockly has added the function of detecting the serial communication of the robot arm. If the robot arm is currently connected to the computer, you need to check:

(1) Is there a background program occupying the robot arm's serial port?

(2) Is the toolbar under the red arrow on the right closed? If it is open, you need to manually close it.

Q4: Why do I get a lot of errors after running the program?

A: Before running the program, you need to confirm a few points:

(1) Please make sure that your robot arm's serial port number and baud rate are correct.

How to check the serial port number:

- In Windows, find the device manager and check the port.

If the port (COM and LPT) shows USB-Enhanced-SERIAL CH9102, it is a CP34X chip.

If the port (COM and LPT) shows Silicon Labs CP210x USB to UART Bridge, it is a CP210X chip. The ports with these two names are the serial port numbers of your robot arm.

- In Linux, open the terminal and enter ls/dev/tty* and press Enter. The serial port number of the robot arm is displayed. AMA0 or USB0 is the serial port number of your robot arm.

- Open the terminal on Mac, enter cd /dev/ and press Enter, then ls -al tty to find it, for example /dev/tty.usbserial-10.

(2) Please make sure the baud rate is correct. The baud rates of M5, myCobot 320 Pi-2020, myCobot 320 Pi-2022, myCobot 280 Jetson nano, and myCobot 280 Arudino are all 115200. The baud rates of myCobot 280 Pi, myPalletizer 260 Pi, mecahrm 270 Pi, myBuddy 280, Pro 600, etc. are all 1000000.

(3) Please make sure that the model, serial port number, and baud rate in the blue box are consistent with those in the small toolbar on the right, and match the robot arm.

Q5: Error MyCobot.*int*() takes 2 positional arguments but 3 were given.

A: This error will appear in the old version of myBlockly because the versions of myBlockly and pymycobot do not match. Just update the versions of myBlockly and pymycobot driver library.

Q6: The result of running the program shows child process exited with code 1 A: This is not an error. All programs have finished running and returned the binary number 1. It means that everything has been successfully completed.

C++

Using C++ language, you can freely develop (coordinate control, angle control, io control, gripper control, etc.) through the C++ dynamic library developed by our company, and control some robots that our company has developed.

What is C++?

C++ is the inheritance of C language. It can perform procedural programming of C language, object-based programming with abstract data types as its characteristics, and object-oriented programming with inheritance and polymorphism as its characteristics.

C++ is good at object-oriented programming, and it can also perform procedural programming. Therefore, C++ can adapt to the scale of problems.

C++ not only has the practical characteristics of efficient computer operation, but also is committed to improving the programming quality of large-scale programs and the problem description ability of programming languages.

Applicable devices:

- myCobot 280
- myCobot 280 M5
- myCobot 280 for Arduino

- myCobot 320
- myCobot 320 M5

Prerequisites:

- **M5** series version, **M5Stack-basic** burn **miniRobot** at the bottom, select **Transponder** function, **ATOM** burn the latest version of **atomMain** at the end (factory default burned)

Programming development

Some integrated development environments (IDEs)

Visual Studio (Visual C++)

Dev C++

C++ Builder

Compiler

Ultimate++

Digital Mars

C-Free

MinGW

C++ development guide

You can use it according to the following instructions C++ develops our robot arm

1.Environment construction

2.Compile and run

3.Joint control

4.Coordinate control

5.IO control

6.Gripper control

7.API description

8.Use case

C++ Environment Setup

Confirm the development goal

MycobotCpp is an interface program for serial communication with mycobot. It calls the mycobot library developed by our company, which contains simple use cases. If you want to freely develop with c++ and control the robot developed by our company, then it is your choice.

Supported robot models: **myCobot 280-M5, myCobot 320-M5**

Software required to run MycobotCpp: vs2019, qt5.12.10, vsaddin (qt plug-in).

Windows environment configuration

Install vs2019

- Download:

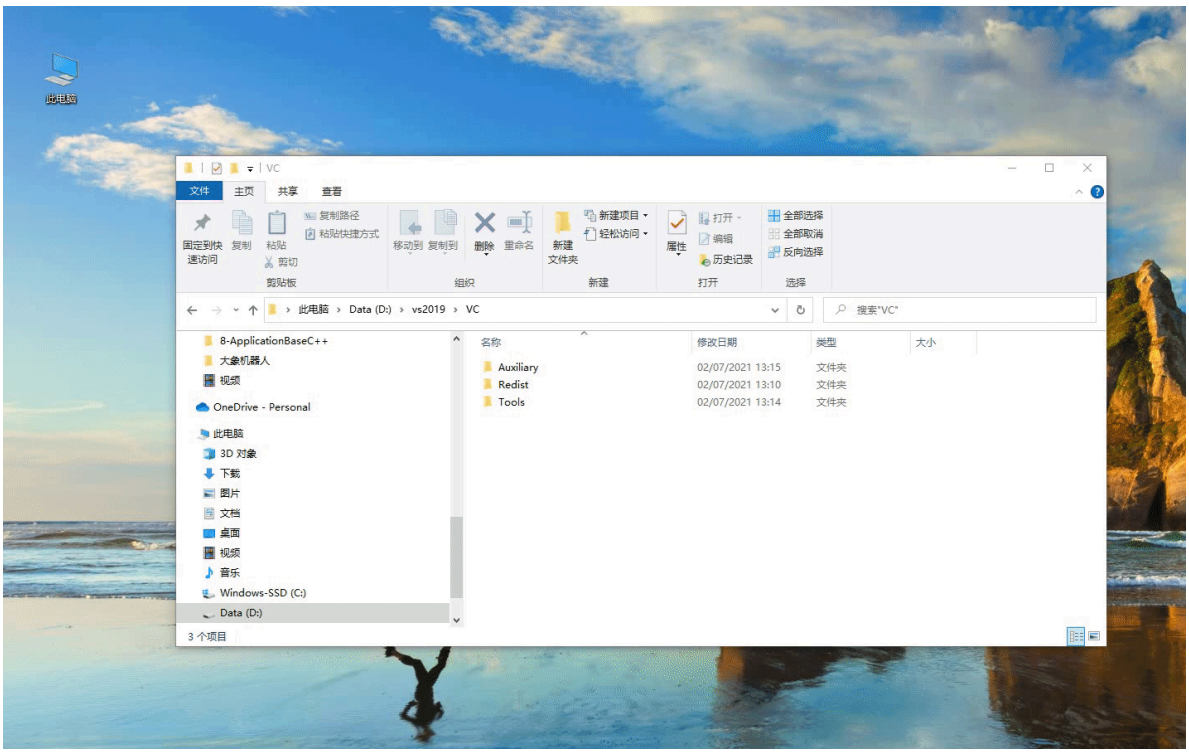
  First, download vs2019 from the official website.

- Installation:

  After the installation is complete, the interface shown in the figure below will appear. You can mainly select "Universal Windows Platform Development, Desktop Development Using C++, ASRNET and Web Development" (this is just a suggestion, you can choose according to your needs, vs2019 installation time is longer).

- Environment variable configuration:

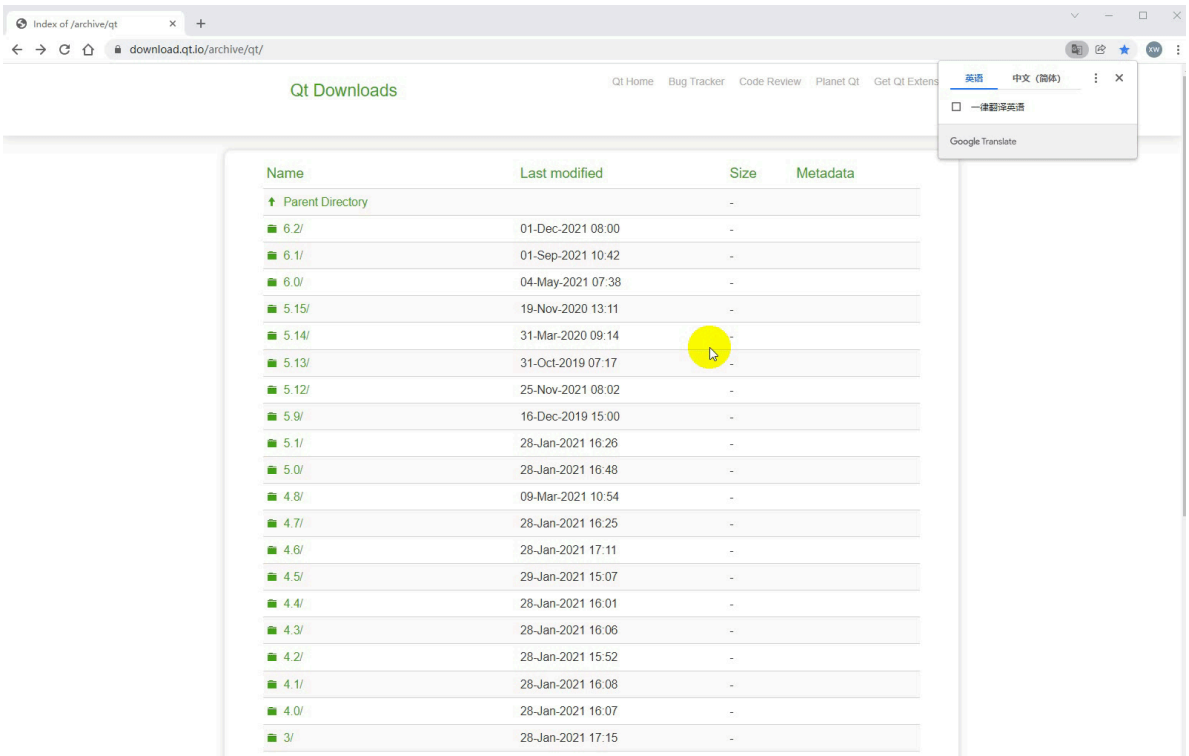
This computer--》Right click Properties--》Advanced system settings--》Environment variables--》Look at the system variables, click New--》Variable name: VCINSTALLDIR Variable value: Find the directory where Redist is located (such as: D:\vs2019\VC), as shown in the figure below:



Install qt5.12.10

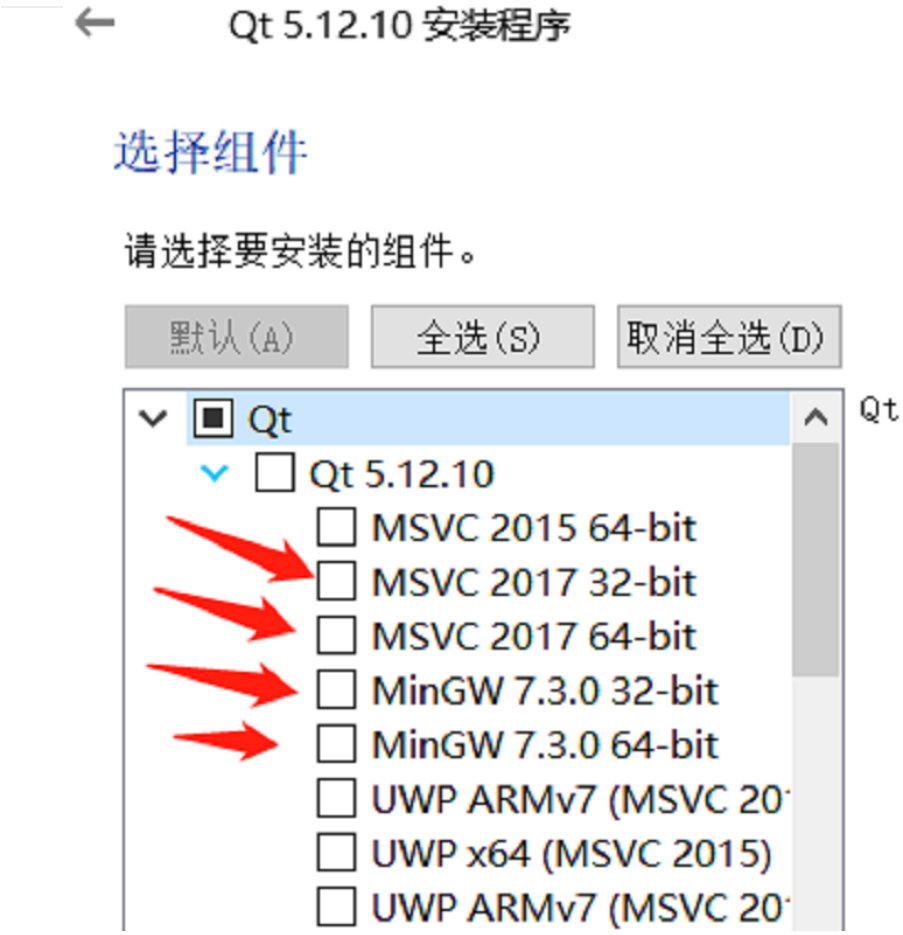
- Download:

Download qt5.12.10 and above versions are all OK. The specific operation is as shown below:



- Installation:

First log in to your qt account. If you don’t have one, register first. Next, the interface for selecting components will appear. Select MinGW and MSVC on Windows, as shown in the figure below:



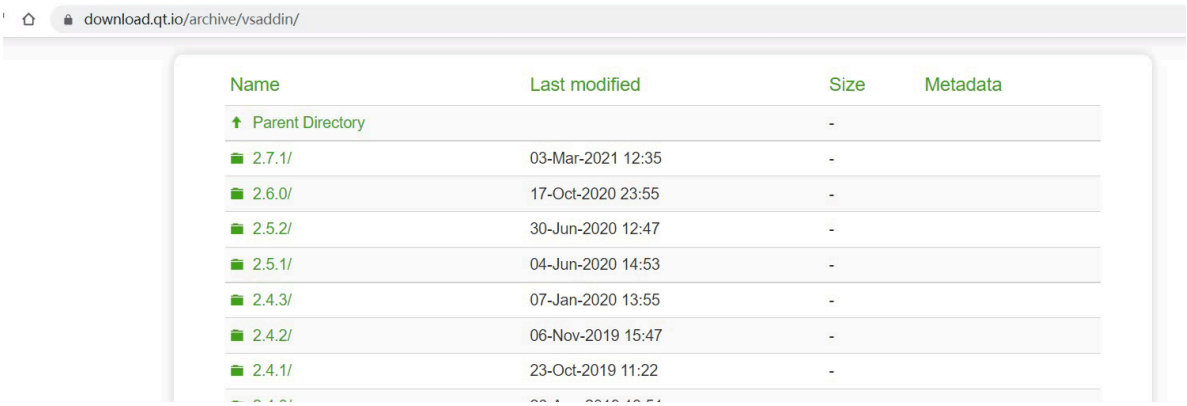
- Environment variable configuration:

  This computer--》Right-click Properties--》Advanced System Settings--》Environment Variables--》Look at the system variables, click New--》Variable name: QTDIR Variable value: The directory where msvc2017_64 is located (such as: D:\qt5.12.10\5.12.10\msvc2017_64, depending on the installation path of your computer), as shown in the figure below:

Install qt plugin vsaddin

- Download:

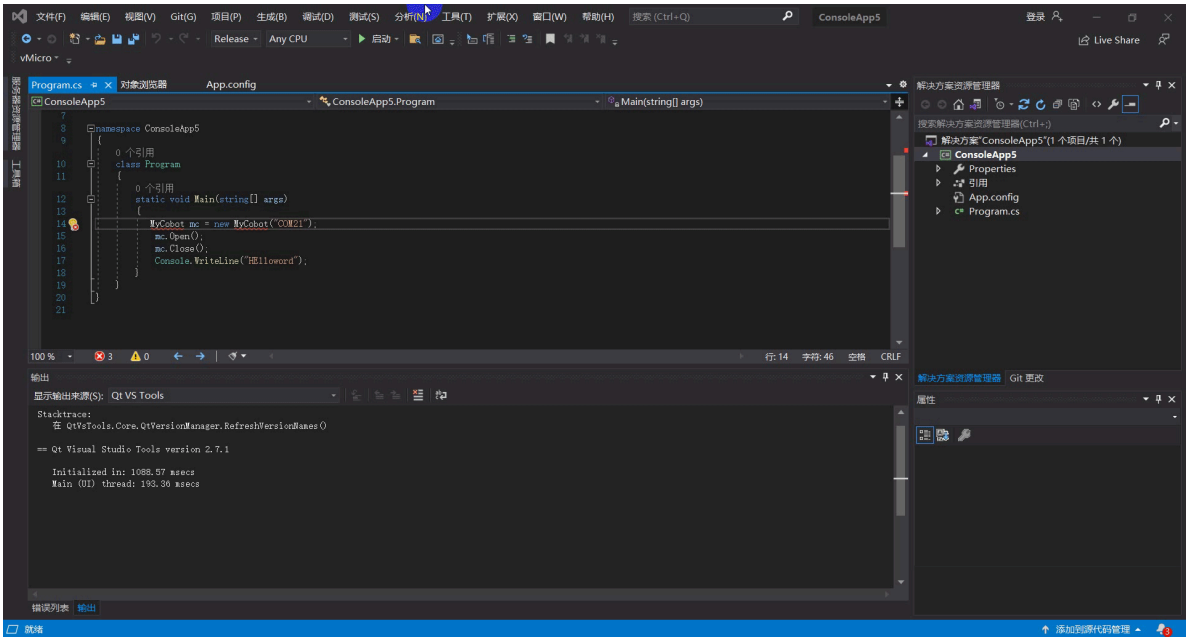
First select the vsaddin version corresponding to vs2019. The specific operation is as follows:



- Installation: Just install it directly

- Configuration:

vs2019 menu bar extension--》QT VS Tools--》QT Versions--》add new qtversion Select the path where msvc2017_64 is located (such as: D:\qt5.12.10\5.12.10\msvc2017_64), and the specific operation is as shown in the figure below:



Linux environment configuration

Install qt5.12.10

- Download:

  The download address is the same as Windows. Just select the installation package on Linux. For details, see 8.1.2.2 above.

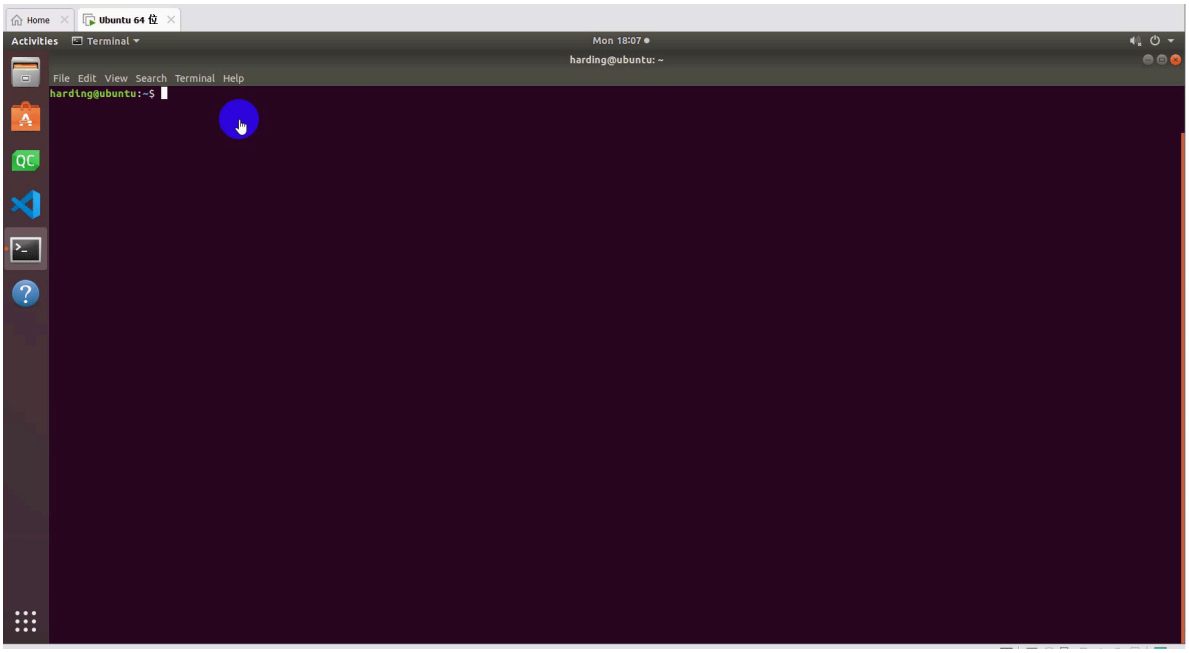
- Installation:

  Command line installation: Run./"installation package name", if there is no execution permission, add execution permission: sudo chmod +x "installation package name", and then enter the graphical interface, the same as Windows;

  Graphical interface installation: the same as Windows.

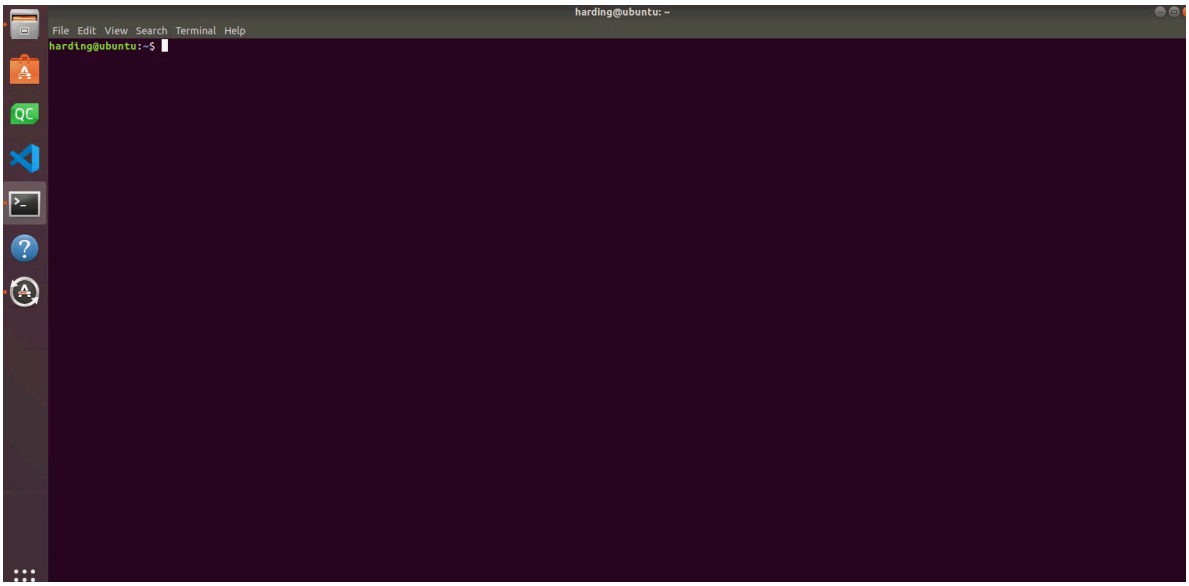
  It is recommended to install qt directly with ordinary user permissions. After successful installation, you can

execute qmake --version. The following interface will appear to indicate successful installation:



- Configuration:

Open the configuration file. Ordinary users install qt: vi ~/.bashrc, and root users install qt: vi ~/.profile. Add export QTDIR="qt directory" (such as export QTDIR=$HOME/Qt/5.12.10/gcc_64) to the configuration file, as shown in the following figure:



Compile and run myCobotCpp

Download

Source code download

Download MycobotCpp from github.

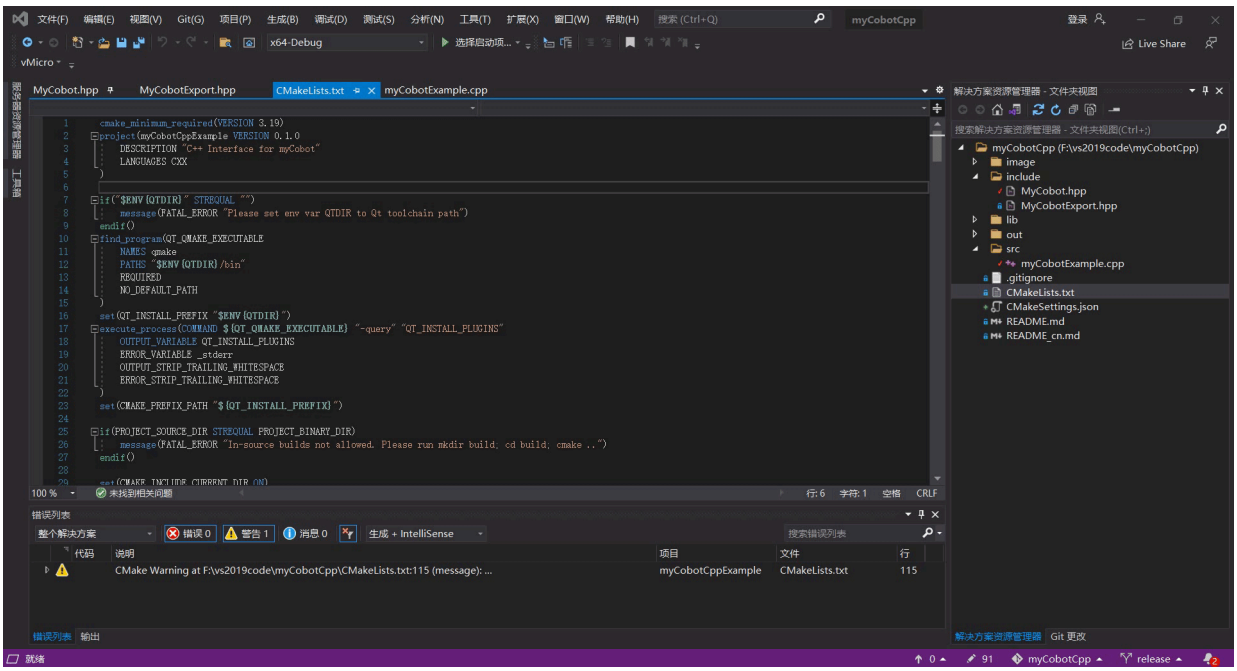
Dynamic library download

Dependency library download (Download the latest version, pay attention to select **Windows** or **Linux**, the suffix .zip is the library required for Windows, and .tar.gz is the library required for Linux)

Run under Windows

Compile

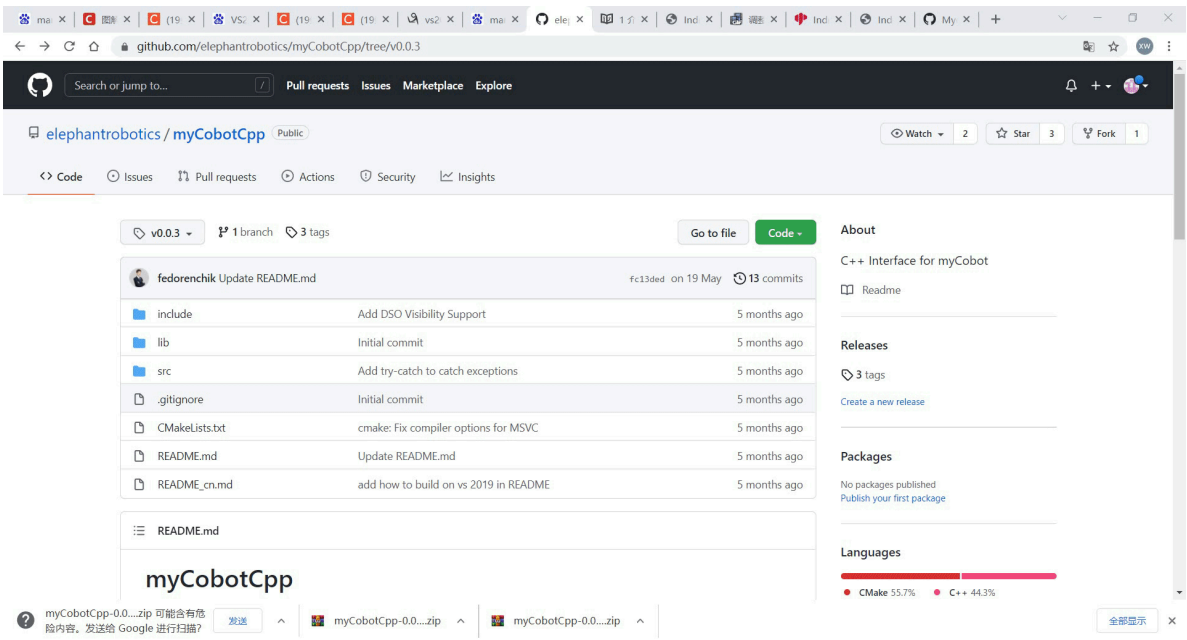
Open MycobotCpp in vs2019, select x64-Release to compile (next to the startup item, if not, click the drop-down box--》Manage Configuration to add it), and also select release in the configuration of cmake settings, and finally click Generate. Note: Be sure to select x64-Release for compilation, as shown in the figure below:



Run

- Add library files: add .lib to myCobotCpp/lib, and add .lib and .dll to the same directory as myCobotCppExample.exe, such as out/build/x64-Release/bin (.lib and .dll are in the myCobotCpp-0.0.3-windows-msvc-x86_64.zip compressed package)

- Run: Select Startup (next to the green play button, that is, next to the Run button), pull down and select myCobotCppEXample.exe (bin\myCobotCppExample.exe), and click Run, as shown in the figure below:



Common problems and solutions:

Runtime error:

- If myCobotCpp.dll is missing, put the myCobotCpp.dll previously placed in the lib directory into the directory where mycobotcppexample.exe is located

- If QT5Core.dll is missing, open qt command (search QT in the menu bar), select msvc 2017 64-bit, and execute windeployqt --release to the directory where myCobotCppExample.exe is located (such as: windeployqt --release D:\vs2019\myCobotCpp\out\build\x64-Release\bin） If the vs installation path is not found after executing the command here, please check the settings of vs environment variables

- After executing the above steps, if the qt5serialport.dll file is missing, copy this file in the qt installation directory (path such as: D:\qt5.12.10\5.12.10\msvc2017_64\bin) to the directory where myCobotCppExample.exe is located

Run under Linux

Compile and build

- mkdir build && cd build

- cmake ..

- cmake --build .

Run

- Copy all .so files to the lib directory

- Run the command line: ./bin/myCobotCppExample (here it is run in the build directory)

Run on Ubuntu20.04

Compile

- mkdir build && cd build

- cmake ..

- cmake --build .

Run

- Copy all .so files to the lib directory (note that you should unzip them after downloading. Do not unzip them in Windows and then copy them to Ubuntu. Unzip them directly in Ubuntu, such as: tar -xvf and then drag the files directly to the terminal)

- Soft link libQt5SerialPort.so.5 (in the QT installation directory, such as: /home/"username"/Qt5.12.10/5.12.10/gcc_64/lib) to mycobotcpp/build/bin (do not copy directly). The command is as follows (note that you should choose your path): ln -s /home/"Username"/Qt5.12.10/5.12.10/gcc_64/lib/libQt5SerialPort.so.5 /home/"Username"/myCobotCpp/build/bin/libQt5SerialPort.so.5

Common Problems and Solutions

- Error during compilation:

  Cannot find QTDIR. Solution: Check whether QTDIR is configured correctly, you can check it in the command line output: echo $QTDIR

- Error during runtime:

  Serial port problem: Cannot open the serial port. Solution: Modify the serial port permissions of the robot arm, you cannot directly chmod..., so you have to re-set the permissions every time you restart. Modify the file directly:

- cd /etc/udev/rules.d

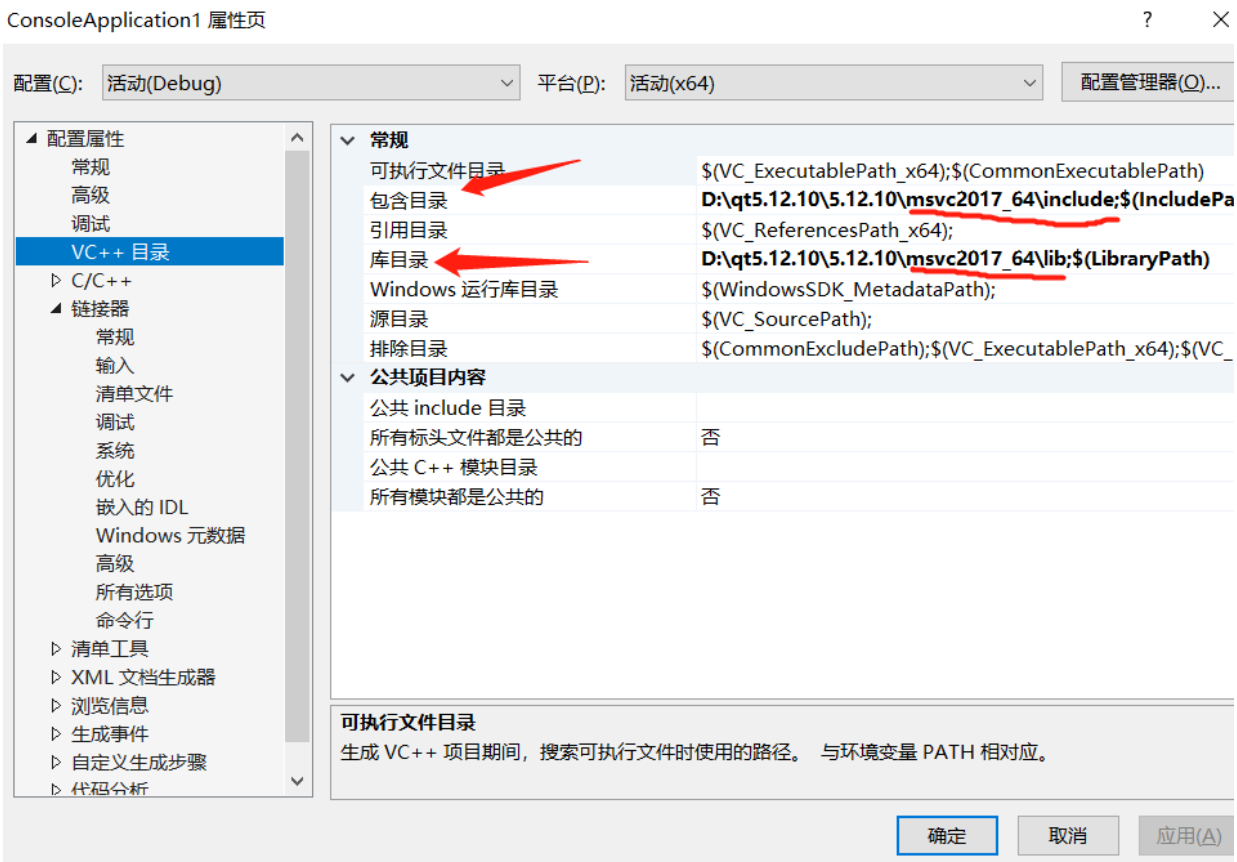
- sudo gedit 20-usb-serial.rules

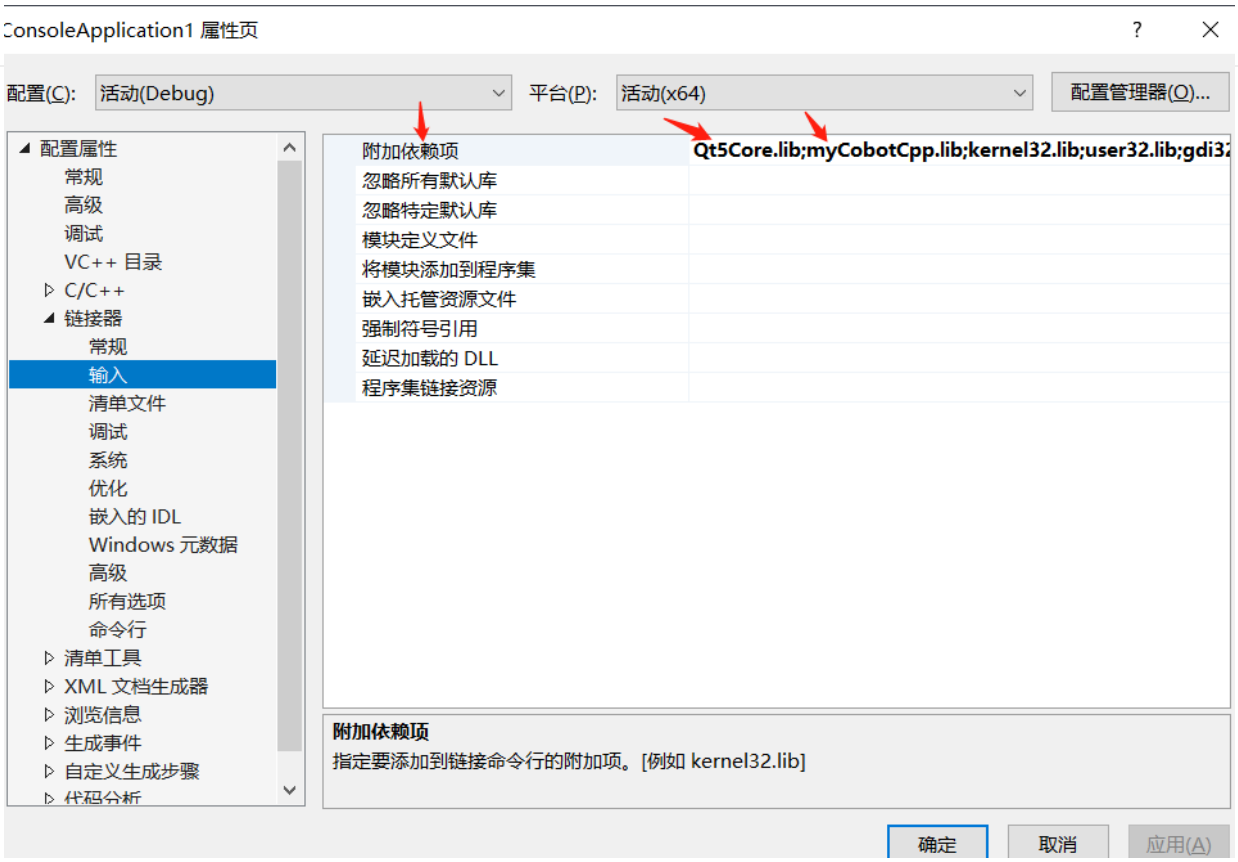
- Add to the file: KERNEL=="ttyUSB*" MODE="0777"

- File not found problem: such as being unable to open or find libQt5SerialPort.so.5. Solution: Check the above step 2

Note

If you do not use cmake to compile, such as using it directly in MFC, configure it as shown below:




ConsoleApplication1 属性页
配置(C): 活动(Debug)
平台(P): 活动(x64)
配置管理器(O)...
配置属性
常规
高级
调试
VC++ 目录
C/C++
链接器
常规
输入
清单文件
调试
系统
优化
嵌入的 IDL
Windows 元数据
高级
所有选项
命令行
清单工具
XML 文档生成器
浏览信息
生成事件
自定义生成步骤
附加依赖项
忽略所有默认库
忽略特定默认库
模块定义文件
将模块添加到程序集
嵌入托管资源文件
强制符号引用
延迟加载的 DLL
程序集链接资源
Qt5Core.lib;myCobotCpp.lib;kernel32.lib;user32.lib;gdi3
附加依赖项
指定要添加到链接命令行的附加项。[例如 kernel32.lib]
确定
取消
应用(A)

Joint control

For serial multi-joint robots, joint control is the control of the variables of each joint of the robot arm. The goal is to make each joint of the robot arm reach the target position at a certain speed.

Single joint control

Send single joint angle

WriteAngle(Joint joint, double value, int speed = DefaultSpeed)

Return value: None

Parameter description: Parameter 1: Joint number (1-6) Parameter 2: Angle (**-170°- 170°**) Parameter 3: Speed (**0-100**), default is **30**

Example:

```
mycobot::MyCobot::I().WriteAngle(mycobot::Joint::J1, 10, 30);
```

Multi-joint control

Get all joint angles

GetAngles()

Return value: Angles type

Parameter description: None

Example:

```
mycobot::Angles angles= mycobot::MyCobot::I().GetAngles();
```

Send all joint angles

WriteAngles(const Angles& angles, int speed = DefaultSpeed)

Return value: None

Parameter description: Parameter 1: All angles (std::array, angle range **-170°- 170°**) Parameter 2: Speed (**0-100**), default is 30

Example:

```
mycobot::Angles goal_angles = { 5, 5, 5, 5, 5, 5 };<br>  mycobot::MyCobot::I().WriteAngles(goal_angles, 30);<br>
```

Complete use case

```
int main(int argc, char* argv[])
try {
    QCoreApplication a(argc, argv);
    using namespace std::chrono_literals;
    if (!mycobot::MyCobot::I().IsControllerConnected()) {
        std::cerr << "Robot is not connected\n";
        exit(EXIT_FAILURE);
    }
    std::cout << "Robot is connected\n";
    mycobot::MyCobot::I().PowerOn();
    mycobot::MyCobot::I().StopRobot();
    std::cout << "Robot is moving: " << mycobot::MyCobot::I().IsMoving() << "\n";
    mycobot::Angles angles = mycobot::MyCobot::I().GetAngles();
    std::this_thread::sleep_for(200ms);
    mycobot::Coords coords = mycobot::MyCobot::I().GetCoords();
    angles = mycobot::MyCobot::I().GetAngles();
    std::cout << "[" << angles[mycobot::J1] << ", " << angles[mycobot::J2] << ", " << angles[mycobot::J3] << ", "
        << angles[mycobot::J4] << ", " << angles[mycobot::J5] << ", " << angles[mycobot::J6] << "]";
    mycobot::Angles goal_angles = { 5, 5, 5, 5, 5, 5 };
    mycobot::MyCobot::I().WriteAngles(goal_angles);
    while (!mycobot::MyCobot::I().IsInPosition(goal_angles, false)) {
        angles = mycobot::MyCobot::I().GetAngles();
        std::cout << "[" << angles[mycobot::J1] << ", " << angles[mycobot::J2] << ", "
            << angles[mycobot::J3] << ", " << angles[mycobot::J4] << ", "
            << angles[mycobot::J5] << ", " << angles[mycobot::J6] << "]" << std::flush;
        std::this_thread::sleep_for(200ms);
    }

    mycobot::MyCobot::I().JogAngle(mycobot::Joint::J1, 1, 5);
    std::this_thread::sleep_for(5000ms);
    mycobot::MyCobot::I().StopRobot();

    std::cout << "\n";
    exit(EXIT_SUCCESS);
} catch (std::error_code&) {
    std::cerr << "System error. Exiting.\n";
    exit(EXIT_FAILURE);
} catch (...) {
    std::cerr << "Unknown exception thrown. Exiting.\n";
    exit(EXIT_FAILURE);
}
```

Joint control

For serial multi-joint robots, joint control is the control of the variables of each joint of the robot arm. The goal is to make each joint of the robot arm reach the target position at a certain speed.

Single joint control

Send single joint angle

WriteAngle(Joint joint, double value, int speed = DefaultSpeed)

Return value: None

Parameter description: Parameter 1: Joint number (1-6) Parameter 2: Angle (**-170°- 170°**) Parameter 3: Speed (**0-100**), default is **30**

Example:

```
mycobot::MyCobot::I().WriteAngle(mycobot::Joint::J1, 10, 30);
```

Multi-joint control

Get all joint angles

GetAngles()

Return value: Angles type

Parameter description: None

Example:

```
mycobot::Angles angles= mycobot::MyCobot::I().GetAngles();
```

Send all joint angles

WriteAngles(const Angles& angles, int speed = DefaultSpeed)

Return value: None

Parameter description: Parameter 1: All angles (std::array, angle range **-170°- 170°**) Parameter 2: Speed (**0-100**), default is 30

Example:

```
mycobot::Angles goal_angles = { 5, 5, 5, 5, 5, 5 };<br>  mycobot::MyCobot::I().WriteAngles(goal_angles, 30);<br>
```

Complete use case

```
int main(int argc, char* argv[])
try {
QCoreApplication a(argc, argv); // Create a QCoreApplication object to support the Qt event loop

using namespace std::chrono_literals; // Import literals for time processing (such as 200ms)

// Check if the robot controller is connected
if (!mycobot::MyCobot::I().IsControllerConnected()) {
std::cerr << "Robot is not connected\n"; // If not connected, output error message
exit(EXIT_FAILURE); // Exit the program and return failure status
}

std::cout << "Robot is connected\n"; // Output successful connection information

mycobot::MyCobot::I().PowerOn(); // Power on and start the robot
mycobot::MyCobot::I().StopRobot(); // Stop all robot movements

// Check if the robot is moving and output the status
std::cout << "Robot is moving: " << mycobot::MyCobot::I().IsMoving() << "\n";

// Get the angles of each joint of the current robot
mycobot::Angles angles = mycobot::MyCobot::I().GetAngles();
std::this_thread::sleep_for(200ms); // Delay 200 milliseconds

// Get the position coordinates of the end of the current robot
mycobot::Coords coords = mycobot::MyCobot::I().GetCoords();

// Get the angles of each joint again
angles = mycobot::MyCobot::I().GetAngles();

// Output the angles of each joint
std::cout << "[" << angles[mycobot::J1] << ", " << angles[mycobot::J2] << ", "
<< angles[mycobot::J3] << ", " << angles[mycobot::J4] << ", "
<< angles[mycobot::J5] << ", " << angles[mycobot::J6] << "]";

// Define a target angle array, all joints move to 5 degrees
mycobot::Angles goal_angles = { 5, 5, 5, 5, 5, 5 };
mycobot::MyCobot::I().WriteAngles(goal_angles); // Move the robot to the target angle

// Wait for the robot to move to the target position
while (!mycobot::MyCobot::I().IsInPosition(goal_angles, false)) {
angles = mycobot::MyCobot::I().GetAngles(); // Get the current angle
std::cout << "[" << angles[mycobot::J1] << ", " << angles[mycobot::J2] << ", "
<< angles[mycobot::J3] << ", " << angles[mycobot::J4] << ", "
<< angles[mycobot::J5] << ", " << angles[mycobot::J6] << "]" << std::flush;
std::this_thread::sleep_for(200ms); // Delay 200 milliseconds for each loop
}
```

```
// Adjust the J1 joint angle, the increment is 1 degree, the speed is 5
mycobot::MyCobot::I().JogAngle(mycobot::Joint::J1, 1, 5);
std::this_thread::sleep_for(5000ms); // Delay for 5 seconds

mycobot::MyCobot::I().StopRobot(); // Stop all movements of the robot

std::cout << "\n"; // Output a newline character
exit(EXIT_SUCCESS); // Normal exit of the program

} catch (std::error_code&) {
// Capture the std::error_code exception and output the error message
std::cerr << "System error. Exiting.\n";
exit(EXIT_FAILURE); // Abnormal exit of the program
} catch (...) {
// Capture all other exceptions and output the error message
std::cerr << "Unknown exception thrown. Exiting.\n";
exit(EXIT_FAILURE); // Abnormal exit of the program
}
```

io control

There are pins on the M5Stack-basic at the bottom of the robot and the Atom at the end. You can use io control to set the high and low levels of the pins and control tools such as pumps. For the input and output pin numbers of each robot type, please see the following description table:

Description table of the input and output pins of the bottom M5Stack-basic:

Robot model	Input pin number	Output pin number
myCobot 280-M5	35, 36	2, 5, 26
myCobot 320-M5	35, 36	5, 15

Terminal Atom input and output pin description table:

Robot model	Input pin number	Output pin number
myCobot 280-M5	19, 22	23, 33
myCobot 320-M5	None	None

basic io control (m5)

Set the output io high and low levels

SetBasicOut(int pin_number, int pin_signal)

Return value: None

Parameter description: Parameter 1: Pin number (basic output pin number), Parameter 2: Status (0--low level, 1--high level)

Example:

```
mycobot::MyCobot::I().SetBasicOut(2, 1);
```

Get input io status

GetBasicIn(int pin_number)

Return value: pin status (0--low level, 1--high level)

Parameter description: pin number (basic input pin number)

Example: Set output pin 2 to high level

```
mycobot::MyCobot::I().GetBasicIn(35);
```

Atom io control

Note: **320m5 does not have atom io, so this module API is not needed**

Set the output io high and low levels

SetDigitalOut(int pin_number, int pin_signal)

Return value: None

Parameter description: Parameter 1: pin number (atom output pin number), parameter 2: state (0--low level, 1--high level)

Case:

```
mycobot::MyCobot::I().SetDigitalOut(23, 1);
```

Get input io status

GetDigitalIn(int pin_number)

Return value: pin status (0--low level, 1--high level)

Parameter description: pin number (atom input pin number)

Example:

```
mycobot::MyCobot::I().GetDigitalIn(19);
```

Complete use case

```
int main(int argc, char* argv[])
try {
QCoreApplication a(argc, argv); // Create a QCoreApplication object to support the Qt event loop

using namespace std::chrono_literals; // Introduce time unit literals (such as 200ms)

// Check if the robot controller is connected
if (!mycobot::MyCobot::I().IsControllerConnected()) {
std::cerr << "Robot is not connected\n"; // If not connected, output error message
exit(EXIT_FAILURE); // Exit the program and return failure status
}

std::cout << "Robot is connected\n"; // Output successful connection information

mycobot::MyCobot::I().PowerOn(); // Power on and start the robot
mycobot::MyCobot::I().StopRobot(); // Stop all actions of the robot

// Check if the robot is moving and output the status
std::cout << "Robot is moving: " << mycobot::MyCobot::I().IsMoving() << "\n";

// Get the angles of each joint of the current robot
mycobot::Angles angles = mycobot::MyCobot::I().GetAngles();
std::this_thread::sleep_for(200ms); // Delay 200 milliseconds

// Get the position coordinates of the end of the current robot
mycobot::Coords coords = mycobot::MyCobot::I().GetCoords();

// Get the angles of each joint again
angles = mycobot::MyCobot::I().GetAngles();

// Output the angles of each joint
std::cout << "[" << angles[mycobot::J1] << ", " << angles[mycobot::J2] << ", "
<< angles[mycobot::J3] << ", " << angles[mycobot::J4] << ", "
<< angles[mycobot::J5] << ", " << angles[mycobot::J6] << "]";

// Define a target angle array, all joints move to 5 degrees
mycobot::Angles goal_angles = { 5, 5, 5, 5, 5, 5 };
mycobot::MyCobot::I().WriteAngles(goal_angles); // Move the robot to the target angle

// Wait for the robot to move to the target position
while (!mycobot::MyCobot::I().IsInPosition(goal_angles, false)) {
angles = mycobot::MyCobot::I().GetAngles(); // Get the current angle
std::cout << "[" << angles[mycobot::J1] << ", " << angles[mycobot::J2] << ", "
<< angles[mycobot::J3] << ", " << angles[mycobot::J4] << ", "
<< angles[mycobot::J5] << ", " << angles[mycobot::J6] << "]" << std::flush;
std::this_thread::sleep_for(200ms); // Delay 200 milliseconds per loop
}
```

```
// Adjust the J1 joint angle in 1 degree increments and a speed of 5
mycobot::MyCobot::I().JogAngle(mycobot::Joint::J1, 1, 5);
std::this_thread::sleep_for(5000ms); // Delay 5 seconds

mycobot::MyCobot::I().StopRobot(); // Stop all robot movements

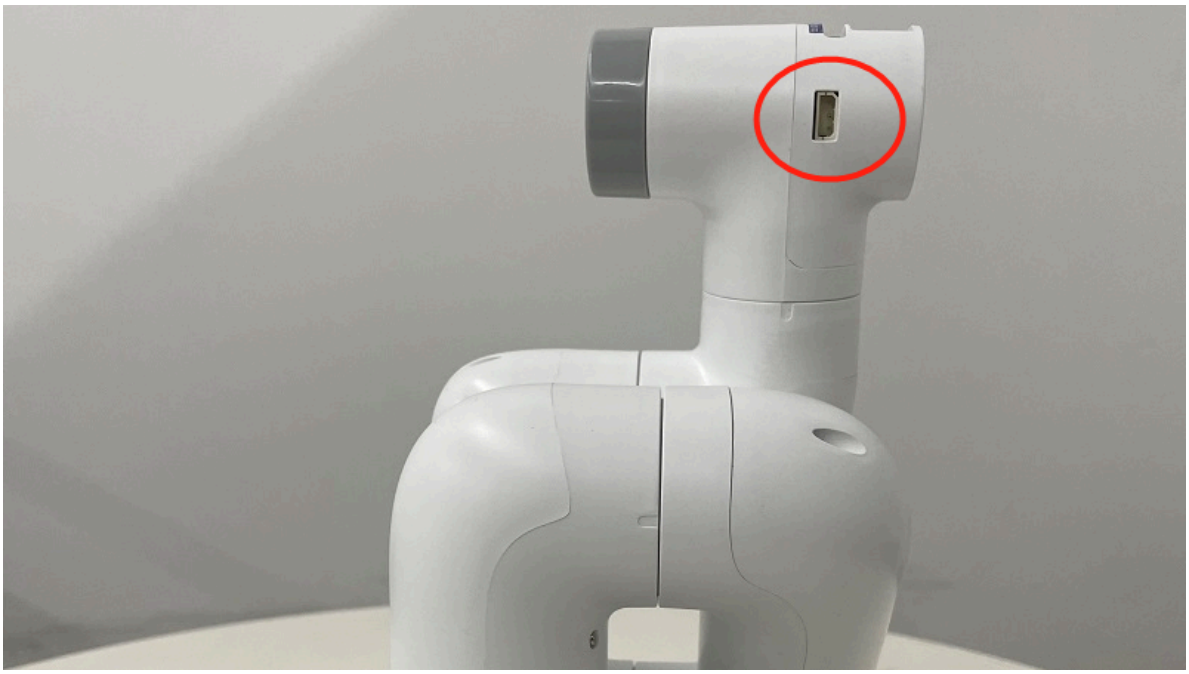
std::cout << "\n"; // Output a newline character
exit(EXIT_SUCCESS); // Normal exit

} catch (std::error_code&) {
// Capture std::error_code exception and output error message
std::cerr << "System error. Exiting.\n";
exit(EXIT_FAILURE); // Abnormal exit
} catch (...) {
// Capture all other exceptions and output error message
std::cerr << "Unknown exception thrown. Exiting.\n";
exit(EXIT_FAILURE); // Abnormal exit
}
```

Gripper control

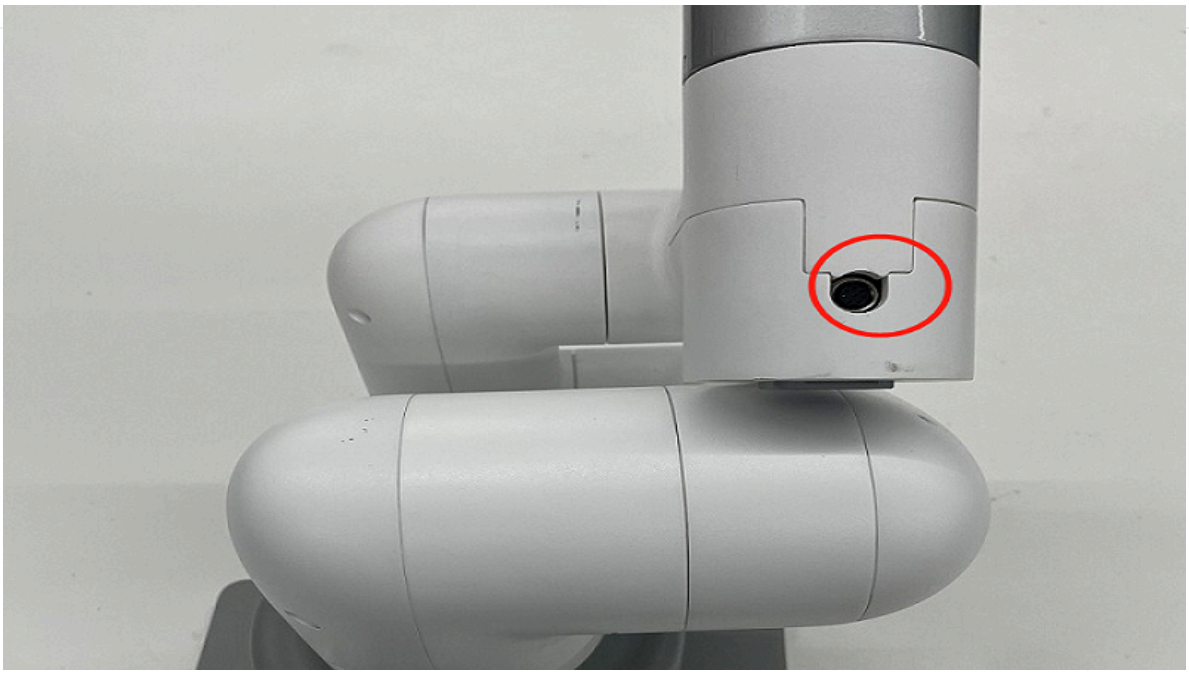
Gripper installation:

- Adaptive gripper Insert the gripper into the pins on the atom, see the following figure for details:



- The electric gripper is plugged into the interface on the top, see the picture below:

Note: **myCobot 280-m5 does not have an electric gripper, only myCobot 320-m5 has an electric gripper**.



1 Adaptive gripper control

Supported devices: myCobot280, 320 && myPalletizer 260

SetGriper(int open)

Return value: None

Parameter description: Gripper switch status (0--off, 1--on)

Case: Due to delay, the first control of the gripper may not be successful, it is recommended to send it twice

```
for (int i = 0; i < 2; i++) {<br>
    mycobot::MyCobot::I().SetGriper(1);<br>
    mycobot::MyCobot::I().SleepSecond(3);<br>
    mycobot::MyCobot::I().SetGriper(0);<br>
    mycobot::MyCobot::I().SleepSecond(3);<br>
}<br>
```

Electric gripper control

Supported devices: myCobot320

SetElectricGriper(int open)

Return value: None

Parameter description: Gripper switch status (0--off, 1--on)

Case: Due to delay, the first control of the gripper may not be successful, it is recommended to send it twice

```
for (int i = 0; i < 2; i++) {<br>
    mycobot::MyCobot::I().SetElectricGriper(1);<br>
    mycobot::MyCobot::I().SleepSecond(1);<br>
    mycobot::MyCobot::I().SetElectricGriper(0);<br>
    mycobot::MyCobot::I().SleepSecond(1);<br>
}
```

Complete use case

```
int main(int argc, char* argv[])
try {
QCoreApplication a(argc, argv);
using namespace std::chrono_literals;
if (!mycobot::MyCobot::I().IsControllerConnected()) {
    std::cerr << "Robot is not connected\n";
    exit(EXIT_FAILURE);
}
std::cout << "Robot is connected\n";
mycobot::MyCobot::I().PowerOn();

mycobot::MyCobot::I().SleepSecond(1);//You need to wait for 1S to complete the previous action.

//Set io output, 2, 5, 26 are m5 output pins
mycobot::MyCobot::I().SetBasicOut(2, 1);
mycobot::MyCobot::I().SleepSecond(1);
mycobot::MyCobot::I().SetBasicOut(5, 1);
mycobot::MyCobot::I().SleepSecond(1);
mycobot::MyCobot::I().SetBasicOut(26, 1);
mycobot::MyCobot::I().SleepSecond(1);

//M5 input pins 35 and 36 will be delayed for the first time
/*for (int i = 0; i < 2; i++) {
    std::cout << "35= " << mycobot::MyCobot::I().GetBasicIn(35) << std::endl;
    mycobot::MyCobot::I().SleepSecond(1);
    std::cout << "36= " << mycobot::MyCobot::I().GetBasicIn(36) << std::endl;
    mycobot::MyCobot::I().SleepSecond(1);
}*/

//atom output pin 23 33
/*mycobot::MyCobot::I().SetDigitalOut(23, 1);
mycobot::MyCobot::I().SleepSecond(1);
mycobot::MyCobot::I().SetDigitalOut(33, 1);
mycobot::MyCobot::I().SleepSecond(1);*/

//Atom input pin 22 19 There will be a delay for the first time
/*for (int i = 0; i < 2; i++) {
    std::cout << "22= " << mycobot::MyCobot::I().GetDigitalIn(22) << std::endl;
    mycobot::MyCobot::I().SleepSecond(1);
    std::cout << "19= " << mycobot::MyCobot::I().GetDigitalIn(19) << std::endl;
    mycobot::MyCobot::I().SleepSecond(1);
}*/

//Adaptive gripper 1--open 0--close Sent twice due to delay in the first time
for (int i = 0; i < 2; i++) {
    mycobot::MyCobot::I().SetGriper(1);
    mycobot::MyCobot::I().SleepSecond(3);
```

```
    mycobot::MyCobot::I().SetGriper(0);
    mycobot::MyCobot::I().SleepSecond(3);
}

//Electric Gripper 1-On 0-Off Sent twice due to delay in first time
/*for (int i = 0; i < 2; i++) {
    mycobot::MyCobot::I().SetElectricGriper(1);
    mycobot::MyCobot::I().SleepSecond(1);
    mycobot::MyCobot::I().SetElectricGriper(0);
    mycobot::MyCobot::I().SleepSecond(1);
}*/
/*mycobot::MyCobot::I().StopRobot();
std::cout << "Robot is moving: " << mycobot::MyCobot::I().IsMoving() << "\n";
mycobot::Angles angles = mycobot::MyCobot::I().GetAngles();
std::this_thread::sleep_for(200ms);
mycobot::Coords coords = mycobot::MyCobot::I().GetCoords();
angles = mycobot::MyCobot::I().GetAngles();
std::cout << "[" << angles[mycobot::J1] << ", " << angles[mycobot::J2] << ", " << angles[mycobot::J3] << ", "
    << angles[mycobot::J4] << ", " << angles[mycobot::J5] << ", " << angles[mycobot::J6] << "]";
mycobot::Angles goal_angles = { 1, 0, 0, 0, 0, 0 };
mycobot::MyCobot::I().WriteAngles(goal_angles,180);
while (!mycobot::MyCobot::I().IsInPosition(goal_angles, false)) {
    angles = mycobot::MyCobot::I().GetAngles();
    std::cout << "[" << angles[mycobot::J1] << ", " << angles[mycobot::J2] << ", "
        << angles[mycobot::J3] << ", " << angles[mycobot::J4] << ", "
        << angles[mycobot::J5] << ", " << angles[mycobot::J6] << "]" << std::flush;
    std::this_thread::sleep_for(200ms);
}

//mycobot::MyCobot::I().JogAngle(mycobot::Joint::J1, 1, 5);
std::this_thread::sleep_for(5000ms);
mycobot::MyCobot::I().StopRobot();*/

std::cout << "\n";
exit(EXIT_SUCCESS);
} catch (std::error_code&) {
std::cerr << "System error. Exiting.\n";
exit(EXIT_FAILURE);
} catch (...) {
std::cerr << "Unknown exception thrown. Exiting.\n";
exit(EXIT_FAILURE);
}
```

myCobot API

Please import our API library before using the following function interfaces, otherwise it will not run successfully. For downloading and importing the library, please refer to MycobotCpp compilation and running chapter

Instantiate MyCobot

1.1 **I();**

Function: Instantiate MyCobot

Return value: MyCobot type, singleton instance of myCobot object

Parameter description: None

Note: When calling the following API, you do not need to instantiate separately, just call this API

Overall status of the robot Overall Status

2.1 **PowerOn();**

Function: Power on the robot arm

Return value: None

Parameter description: None

Note: After the robot arm is powered on, you cannot move the robot arm manually

2.2 **PowerOff();**

Function: Power off the robot arm

Return value: None

Parameter description: None

Note: After the robot arm is powered on, if you want to move the robot arm manually, you can call this API

2.3 **SetFreeMoveMode(bool free_move = true);**

Function: Set free movement mode

Return value: None

Parameter description: Turn on or off free movement, true--turn on free movement, false--turn off free movement

Note: **After free movement is turned on, you can move the robot manually, and the light on the atom will turn yellow, and it will turn green when it is turned off**

2.4 **IsFreeMoveMode()**

Function: Check whether it is in free movement mode

Return value: bool type, true-free movement is turned on, false-free movement is not turned on

Parameter description: None

2.5 **IsControllerConnected();**

Function: Check whether the system is normal

Return value: None

Parameter description: bool type, return **false will not be able to control the robot**

Input program control mode MDI Mode and Robot Control (Manual Data Input)

3.1 **IsInPosition(const Coords& coords, bool is_linear = true);**

Function: Check whether the robot arm has reached the specified point (angle or coordinate)

Return value: bool type, return false--not reached the specified point, return true--reached the specified point

Parameter description: Parameter 1: all angles or coordinates Parameter 2: 0 or 1 (**coordinate is 1 (true), angle is 0 (false))**

3.2 **IsMoving();**

Function: Check whether the robot arm is moving

Return value: bool type, true--moving, false--not moving

Parameter description: None

3.3 **WriteAngle(Joint joint, double value, int speed = DefaultSpeed)**

Function: Send single joint angle

Return value: None

Parameter description: Parameter 1: joint number (1-6) Parameter 2: angle (**-170°- 170°**) Parameter 3: speed (**0-100**), default is **30**

3.4 **GetAngles()**

Function: Get all joint angles

Return value: Angles type

Parameter description: None

3.5 **WriteAngles(const Angles& angles, int speed = DefaultSpeed)**

Function: Send all joint angles

Return value: None

Parameter description: Parameter 1: All angles (std::array, angle range **-170°- 170°**) Parameter 2: Speed (**0-100**), default is 30

3.6 **WriteCoord(Axis axis, double value, int speed = DefaultSpeed)**

Function: Send single parameter coordinates

Return value: None

Parameter description: Parameter 1: Coordinate number (Axis enumeration type, int: 1-6 (X-RZ)), Parameter 2: Coordinate (**X, Y, Z** value range **-300-300.00** unit mm **RX, RY, RZ**, value range **-180-180**), Parameter 3: Speed (**0-100**), default is **30**

3.7 **GetCoords()**

Function: Get all coordinates

Return value: Coords type

Parameter description: None

3.8 **WriteCoords(const Coords& coords, int speed = DefaultSpeed)**

Function: Send all coordinates

Return value: None

Parameter description: Parameter 1: Coordinates (**X, Y, Z** value range **-300-300.00** unit mm **RX, RY, RZ**, value range **-180-180**), Parameter 2: Speed (**0-100**), default is 30

3.9 **StopRobot()**

Function: Stop the robot arm When the robot arm is moving, you can call this API to stop the robot arm from moving

Return value: None

Parameter description: None

Running auxiliary information Running Status and Settings

4.1 **GetSpeed()**

Function: Get the speed of the robot arm movement

Return value: int type, robot arm movement speed (**0-100**)

Parameter description: None

4.2 **SetSpeed(int percentage)**

Function: Set the speed of the robot arm movement

Return value: None

Parameter description: Robot arm movement speed (**0-100**)

4.3 **GetJointMin(Joint joint)**

Function: Read the minimum angle of the joint

Return value: double type, minimum angle (the minimum angle that the joint can run to)

Parameter description: Joint number (1-6)

4.4 **GetJointMax(Joint joint);**

Function: Read the maximum angle of the joint

Return value: double type, maximum angle (the maximum angle that the joint can run to)

Parameter description: Joint number (1-6)

4.5 **SleepSecond(unsigned time)**

Function: Wait Return value: None

Parameter description: The time unit is **seconds**

JOG operation and operation JOG mode and operation

5.1 **JogCoord(Axis axis, int direction, int speed = DefaultSpeed)**

Function: Make the robot arm move in the direction of the coordinate axis

Return value: None

Parameter description: Parameter 1: Coordinate number (**1-6, x y z rx ry rz**), parameter 2: direction (**1--positive direction, 0--negative direction**), parameter 3: speed (**default is 30, range: 0-100**)

Note: **This API will make the robot arm move in the positive and negative directions of the coordinate axis all the time, and will stop moving after reaching the limit or calling JogStop in the middle**

5.2 **JogAngle(Joint joint, int direction, int speed = DefaultSpeed)**

Function: Make a joint move until Jogstop or reach the limit

Return value: None

Parameter description: Parameter 1: joint number (**1-6**), parameter 2: direction (**1--positive direction, 0--negative direction**), parameter 3: speed (**default is 30, range: 0-100**)

Note: **This API will make the robot arm joint move in the positive and negative directions all the time, and will stop moving after reaching the limit or calling JogStop in the middle**

5.3 **JogCoordAbsolute(Axis axis, double value, int speed = DefaultSpeed)**

Function: Move a coordinate axis to a given coordinate

Return value: None

Parameter description: Parameter 1: Coordinate number (**1-6, x y z rx ry rz**), Parameter 2: Coordinate (X, Y, Z value range -300-300.00 unit mm RX, RY, RZ, value range **-180-180**), Parameter 3: Speed (**Default 30, range: 0-100**)

5.4 **JogAngleAbsolute(Joint joint, double value, int speed = DefaultSpeed)**

Function: Make a joint move to a given angle

Return value: None

Parameter description: Parameter 1: Joint number (**1-6**), Parameter 2: Angle (**Range: -170-170**), Parameter 3: Speed (**Default 30, Range 0-100**)

5.5 **JogCoordIncrement(Axis axis, double increment, int speed = DefaultSpeed)**

Function: Make a coordinate move to the set coordinate increment

Return value: None

Parameter description: Parameter 1: Coordinate number (**1-6, x y z rx ry rz**), parameter 2: coordinate increment value, parameter 3: speed (**default 30, range: 0-100**)

Note: **The robot performs stepping motion: for example, the current x-axis coordinate is 100, the increment value is 50, and after the motion, the x-axis coordinate will be 150**

5.6 **JogAngleIncrement(Joint joint, double increment, int speed = DefaultSpeed)**

Function: Make a joint move with a set angle increment

Return value: None

Parameter description: Parameter 1: joint number (**1-6**), parameter 2: joint increment value, speed (**default 30, range: 0-100**)

Note: **The robot performs stepping motion: for example, the current joint 1 coordinate is -100, the increment value is 50, and after the motion, the joint 1 will be 50**

Atom terminal IO control Atom IO Control

6.1 **SetDigitalOut(int pin_number, int pin_signal)**

Function: Set output io high and low levels

Return value: None

Parameter description: Parameter 1: Pin number (atom output pin number), Parameter 2: Status (0--low level, 1--high level)

6.2 **GetDigitalIn(int pin_number)**

Function: Get input io status

Return value: Pin status (0--low level, 1--high level)

Parameter description: Pin number (atom input pin number)

6.3 **SetGriper(int open)**

Function: Control adaptive gripper

Return value: None

Parameter description: Gripper switch status (0--off, 1--on)

6.4 **SetElectricGriper(int open)**

Function: Control electric gripper

Return value: None

Parameter description: Gripper switch status (0--off, 1--on)

Base M5Stack-basicIO Control M5Stack-basic IO Control

7.1 **SetBasicOut(int pin_number, int pin_signal)**

Function: Set output io high and low levels

Return value: None

Parameter description: Parameter 1: Pin number (basic output pin number), Parameter 2: Status (0--low level, 1--high level)

7.2 **GetBasicIn(int pin_number)**

Function: Get input io status

Return value: Pin status (0--low level, 1--high level)

Parameter description: Pin number (basic input pin number)

Use case

This case will first set the three **output pins of m5 to high level**, and then let the **robot move to the zero point**. The program ends after the robot moves to the zero point.

The myCobotExample.cpp in the project is a use case. You can modify it based on your needs:

```
int main(int argc, char* argv[])
try {
QCoreApplication a(argc, argv);
using namespace std::chrono_literals;
if (!mycobot::MyCobot::I().IsControllerConnected()) {
    std::cerr << "Robot is not connected\n";
    exit(EXIT_FAILURE);
}
std::cout << "Robot is connected\n";
mycobot::MyCobot::I().PowerOn();

mycobot::MyCobot::I().SleepSecond(1);//You need to wait for 1S to complete the previous action.

//Set io output, 2, 5, 26 are m5 output pins
mycobot::MyCobot::I().SetBasicOut(2, 1);
mycobot::MyCobot::I().SleepSecond(1);
mycobot::MyCobot::I().SetBasicOut(5, 1);
mycobot::MyCobot::I().SleepSecond(1);
mycobot::MyCobot::I().SetBasicOut(26, 1);
mycobot::MyCobot::I().SleepSecond(1);

//M5 input pins 35 and 36 will be delayed for the first time
/*for (int i = 0; i < 2; i++) {
    std::cout << "35= " << mycobot::MyCobot::I().GetBasicIn(35) << std::endl;
    mycobot::MyCobot::I().SleepSecond(1);
    std::cout << "36= " << mycobot::MyCobot::I().GetBasicIn(36) << std::endl;
    mycobot::MyCobot::I().SleepSecond(1);
}*/

//atom output pin 23 33
/*mycobot::MyCobot::I().SetDigitalOut(23, 1);
mycobot::MyCobot::I().SleepSecond(1);
mycobot::MyCobot::I().SetDigitalOut(33, 1);
mycobot::MyCobot::I().SleepSecond(1);*/

//Atom input pin 22 19 There will be a delay for the first time
/*for (int i = 0; i < 2; i++) {
    std::cout << "22= " << mycobot::MyCobot::I().GetDigitalIn(22) << std::endl;
    mycobot::MyCobot::I().SleepSecond(1);
    std::cout << "19= " << mycobot::MyCobot::I().GetDigitalIn(19) << std::endl;
    mycobot::MyCobot::I().SleepSecond(1);
}*/

//Adaptive gripper 1--open 0--close Sent twice due to delay in the first time
/*for (int i = 0; i < 2; i++) {
    mycobot::MyCobot::I().SetGriper(1);
    mycobot::MyCobot::I().SleepSecond(3);
    mycobot::MyCobot::I().SetGriper(0);
    mycobot::MyCobot::I().SleepSecond(3);
}*/
```

```
//Electric Gripper 1-On 0-Off Sent twice due to delay in first time
/*for (int i = 0; i < 2; i++) {
    mycobot::MyCobot::I().SetElectricGriper(1);
    mycobot::MyCobot::I().SleepSecond(1);
    mycobot::MyCobot::I().SetElectricGriper(0);
    mycobot::MyCobot::I().SleepSecond(1);
}*/
mycobot::MyCobot::I().StopRobot();
std::cout << "Robot is moving: " << mycobot::MyCobot::I().IsMoving() << "\n";
mycobot::Angles angles = mycobot::MyCobot::I().GetAngles();
std::this_thread::sleep_for(200ms);
mycobot::Coords coords = mycobot::MyCobot::I().GetCoords();
angles = mycobot::MyCobot::I().GetAngles();
std::cout << "[" << angles[mycobot::J1] << ", " << angles[mycobot::J2] << ", " << angles[mycobot::J3] << ", "
    << angles[mycobot::J4] << ", " << angles[mycobot::J5] << ", " << angles[mycobot::J6] << "]";
mycobot::Angles goal_angles = { 1, 0, 0, 0, 0, 0 };
mycobot::MyCobot::I().WriteAngles(goal_angles,180);
while (!mycobot::MyCobot::I().IsInPosition(goal_angles, false)) {
    angles = mycobot::MyCobot::I().GetAngles();
    std::cout << "[" << angles[mycobot::J1] << ", " << angles[mycobot::J2] << ", "
        << angles[mycobot::J3] << ", " << angles[mycobot::J4] << ", "
        << angles[mycobot::J5] << ", " << angles[mycobot::J6] << "]" << std::flush;
    std::this_thread::sleep_for(200ms);
}

//mycobot::MyCobot::I().JogAngle(mycobot::Joint::J1, 1, 5);
std::this_thread::sleep_for(5000ms);
mycobot::MyCobot::I().StopRobot();

std::cout << "\n";
exit(EXIT_SUCCESS);
} catch (std::error_code&) {
std::cerr << "System error. Exiting.\n";
exit(EXIT_FAILURE);
} catch (...) {
std::cerr << "Unknown exception thrown. Exiting.\n";
exit(EXIT_FAILURE);
}
```

C#

Using c# language, you can freely develop (coordinate control, angle control, io control, gripper control, etc.) through the c# dynamic library provided by our company, and control some robots that our company has developed.

Supported robot models: **myCobot280, 320 and myPalletizer 260**.

What is C#?

C# is an object-oriented programming language derived from C and C++ released by Microsoft, and a high-level programming language that runs on .NET Framework and .NET Core (completely open source, cross-platform).

C# is significantly different from Java. It borrows a feature from Delphi and is directly integrated with COM (Component Object Model), and it is the protagonist of Microsoft's .NET windows network framework.

C# allows C++ programmers to develop programs efficiently, and because it can call native functions written in C/C++, it will never lose the original powerful functions of C/C++. Because of this inheritance relationship, C# and C/C++ have great similarities, and developers familiar with similar languages can quickly switch to C#.

Applicable devices:

- myCobot 280
- myCobot 280 M5
- myCobot 280 for Arduino

- myCobot 320
- myCobot 320 M5

Prerequisites:

- **M5** series version, **M5Stack-basic** burn **miniRobot** at the bottom, select **Transponder** function, **ATOM** burn the latest version of **atomMain** at the end (factory default is burned)

Programming development

Some integrated development environments (IDEs)

Visual Studio (Visual C#)

MonoDevelop

C# development guide

You can use it according to the following instructions C# develops our robot arm 1.Environment construction

2.Compile and run

3.Joint control

4.Coordinate control

5.IO control

6.Gripper control

7.API description

8.Use case

C# Environment Setup

Confirm the development goal

Mycobot.csharp is a program for serial communication with the robot, which contains simple use cases. If you want to use C# for free development and control the robot developed by our company, then it is your choice.

Supported robot models: **myCobot280, 320 and myPalletizer 260**.

Recommended software for running Mycobot.csharp: vs2019 (Windows development), MonoDevelop (development on Raspberry Pi robot arm).

Windows environment configuration

Install vs2019

Download:

First, download vs2019 from the official website.

Installation:

After the installation is complete, the interface shown in the figure below will appear. Just select **.NET Desktop Development** (this is just a suggestion, you can choose according to your needs, vs2019 installation takes a long time).


工作负荷
单个组件
语言包
安装位置
Web 和云 (4)
ASP.NET 和 Web 开发
使用 ASP.NET Core、ASP.NET、HTML/JavaScript 和包括 Docker 支持的容器生成 Web 应用程序。
Azure 开发
用于使用 .NET 和 .NET Framework 开发云应用和创建资源的 Azure SDK、工具和项目。还包含用于实现应用程序容...
Python 开发
对 Python 进行编辑、调试、交互式开发和源代码管理。
Node.js 开发
使用 Node.js (一个由异步事件驱动的 JavaScript 运行时)生成可缩放的网络应用程序。
桌面应用和移动应用 (5)
.NET 桌面开发
将 C#、Visual Basic 和 F# 与 .NET 和 .NET Framework 一起使用，生成 WPF、Windows 窗体和控制台应用程序。
使用 C++ 的桌面开发
使用所选工具(包括 MSVC、Clang、CMake 或 MSBuild)生成适用于 Windows 的现代 C++ 应用。
通用 Windows 平台开发
使用 C#、VB、或 C++ (可选)为通用 Windows 平台创建应用程序。
使用 .NET 的移动开发
使用 Xamarin 对 iOS、Android 或 Windows 生成跨平台应用程序。
位置
D:\vs2019
继续操作即表示你同意所选 Visual Studio 版本的许可证。我们还提供通过 Visual Studio 下载其他软件的功能。此软件单独进行许可，如第三方公告或其随附的许可证中所述。继续即表示你同意这些许可证。

Compile and run the Mycobot.csharp case

Download

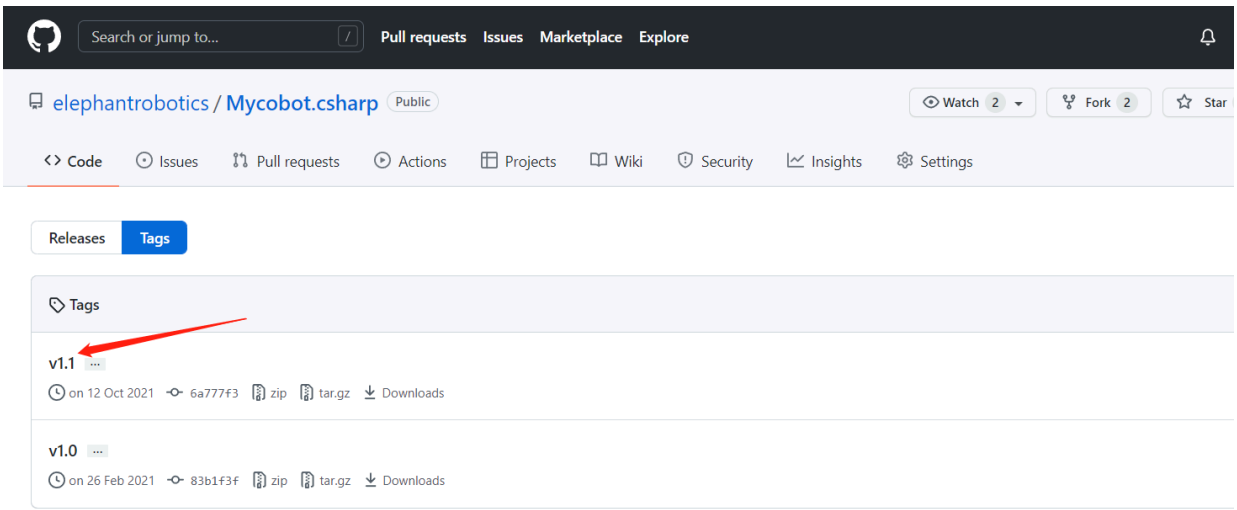
Source code download

Download Mycobot.csharp from github.

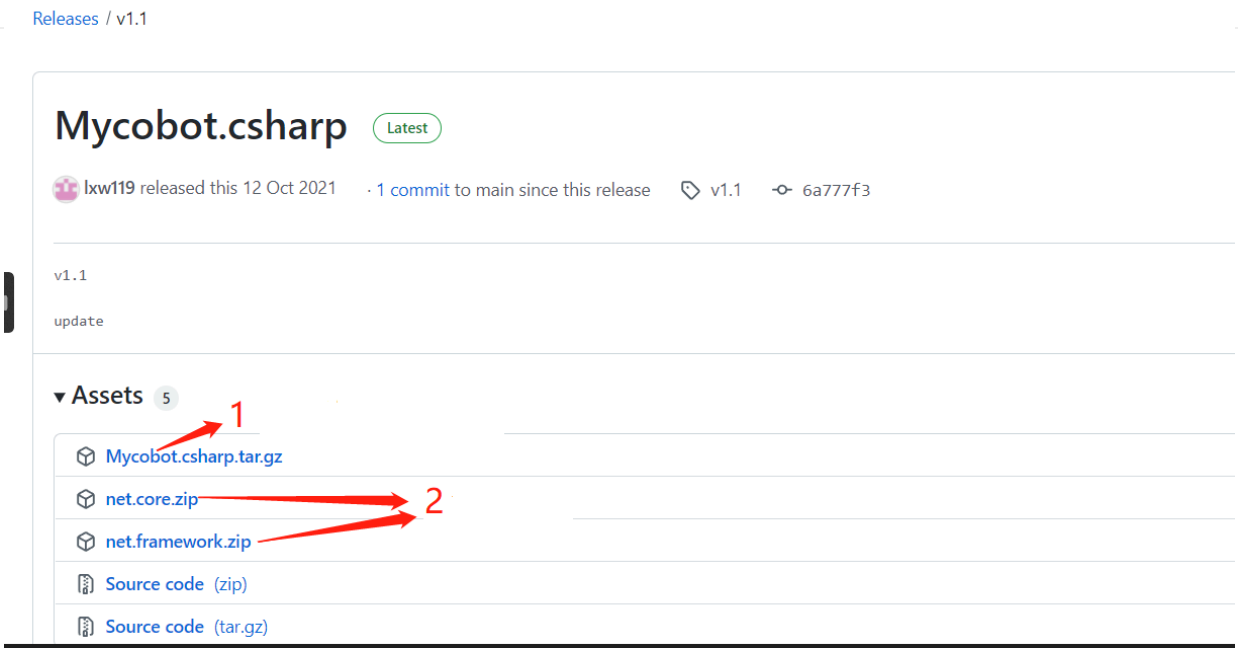
Download dynamic library

To run the example, you need to use this dynamic library, which encapsulates the API for controlling the robot arm:

Select the latest version, as shown in the figure below:



The dynamic library is divided into Windows (Windows is divided into .net and .net framework. For how to distinguish, please see the following running under Windows) and Raspberry Pi system versions, as shown in the figure below:



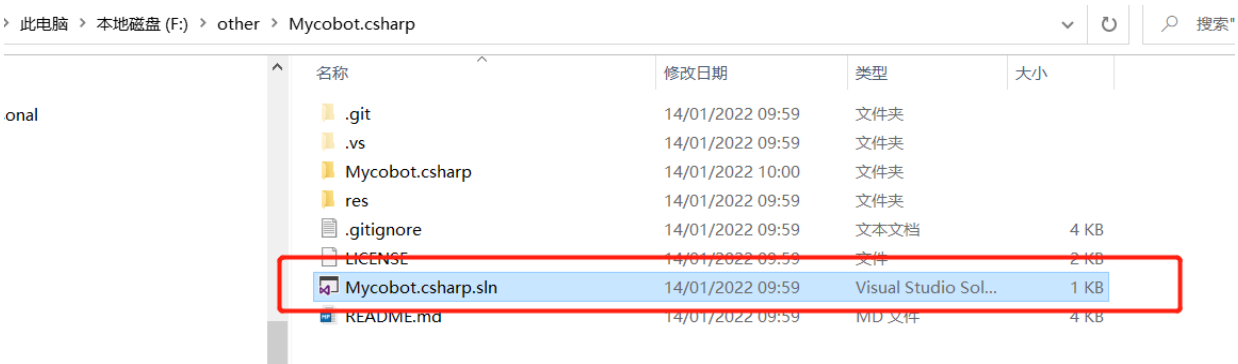
1 Applicable to Raspberry Pi Robotic Arm System

2 Applicable to Windows System

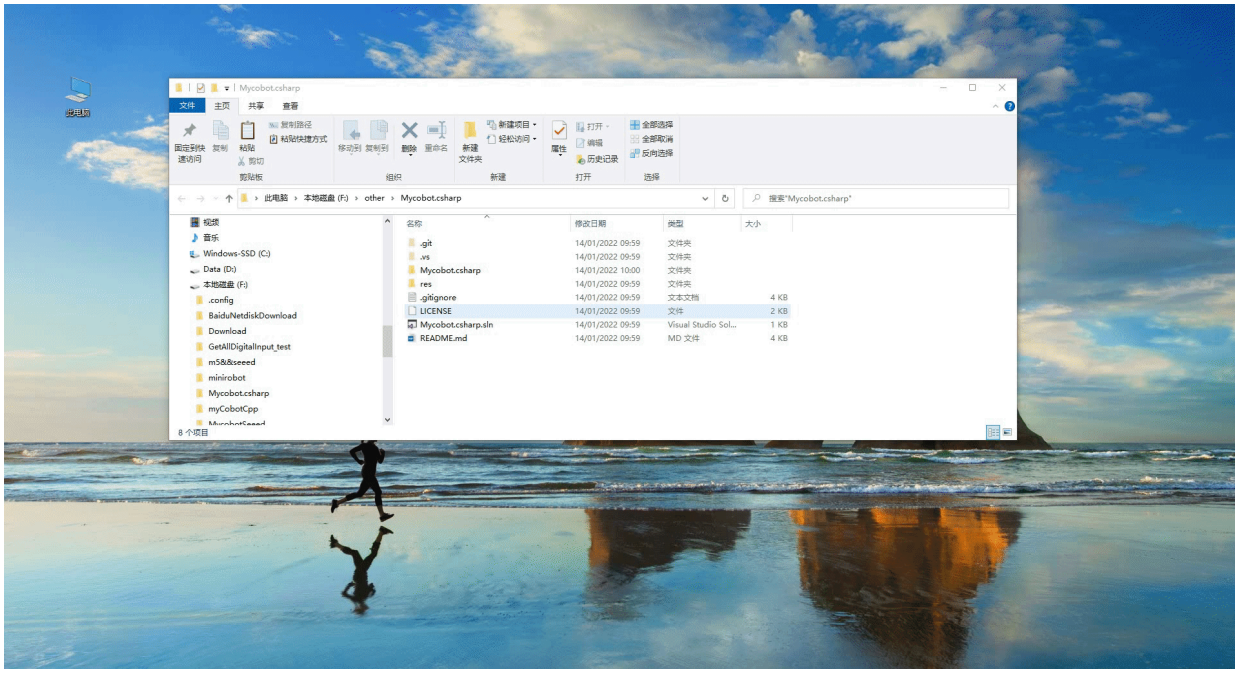
Running under Windows

Run the Mycobot.csharp example downloaded from github directly:

Double-click to open Mycobot.csharp.sln (make sure that vs2019 is installed on the computer. If not, please see 9.1 Environment Building)

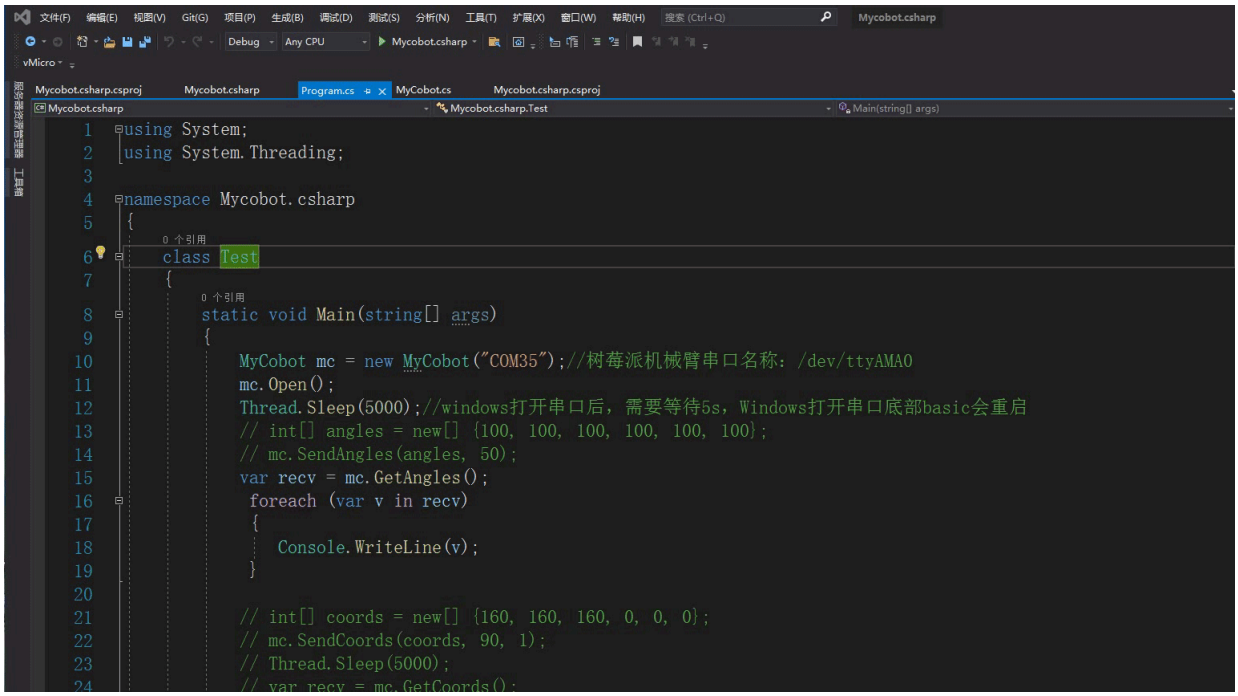


Compile and run the project, check the serial port number of the robot arm, if it is inconsistent with the example, please modify the serial port number, see the following figure for details:



Call the Mycobot.csharp dynamic library in your own project:

Check the target framework of the project, and then download the corresponding dynamic library. If your project's target framework is .net core, download **net core/Mycobot.csharp.dll**, if the target framework is .net framework, download **net framework/Mycobot.csharp.dll**)

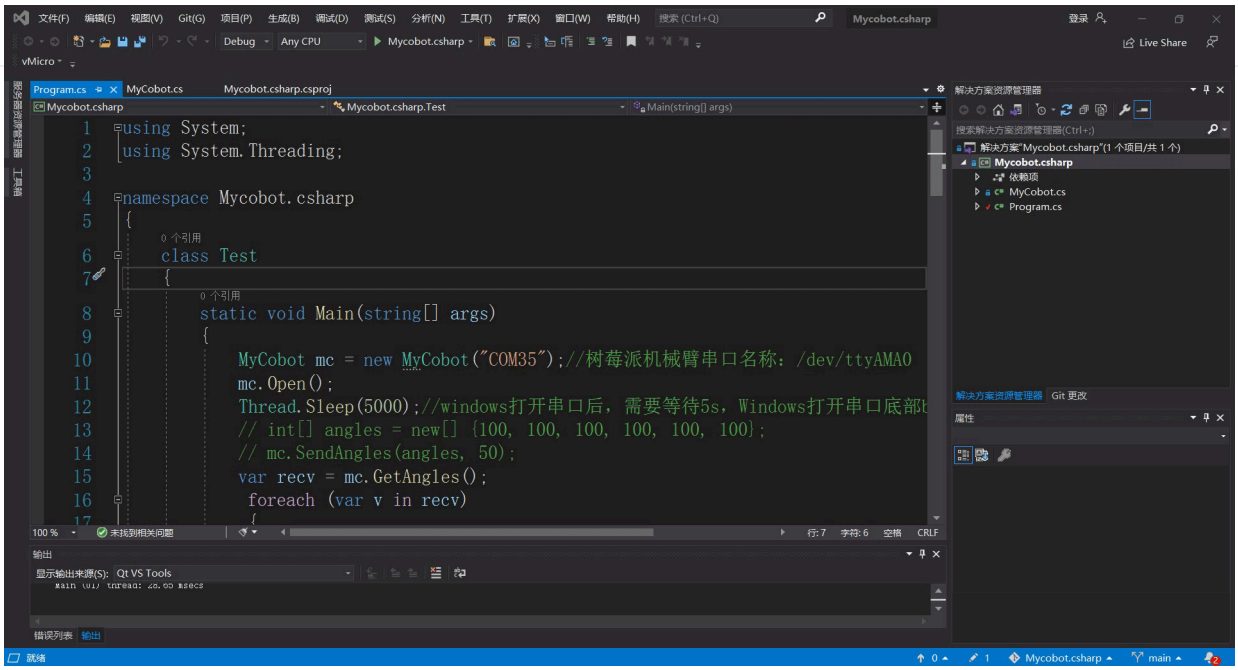


```
using System;
using System.Threading;

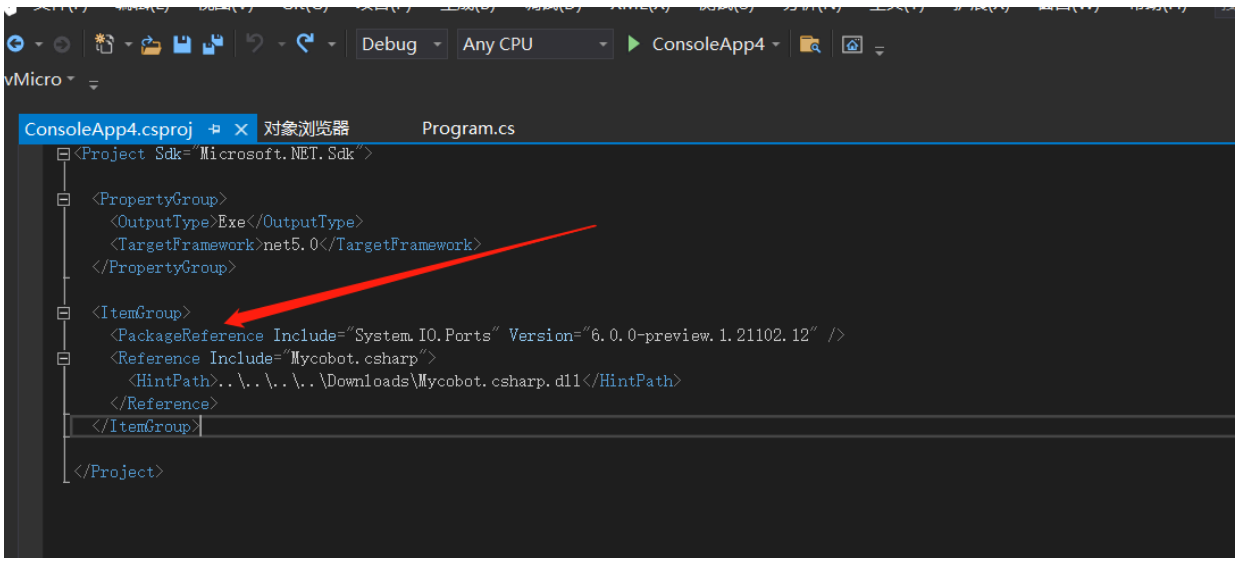
namespace Mycobot.csharp
{
    0 个引用
    class Test
    {
        0 个引用
        static void Main(string[] args)
        {
            MyCobot mc = new MyCobot("COM35");//树莓派机械臂串口名称: /dev/ttyAMA0
            mc.Open();
            Thread.Sleep(5000);//windows打开串口后，需要等待5s，Windows打开串口底部basic会重启
            // int[] angles = new[] {100, 100, 100, 100, 100, 100};
            // mc.SendAngles(angles, 50);
            var recv = mc.GetAngles();
             foreach (var v in recv)
             {
                 Console.WriteLine(v);
             }

            // int[] coords = new[] {160, 160, 160, 0, 0, 0};
            // mc.SendCoords(coords, 90, 1);
            // Thread.Sleep(5000);
            // var recv = mc.GetCoords();
```

Import **Mycobot.csharp.dll** into the project

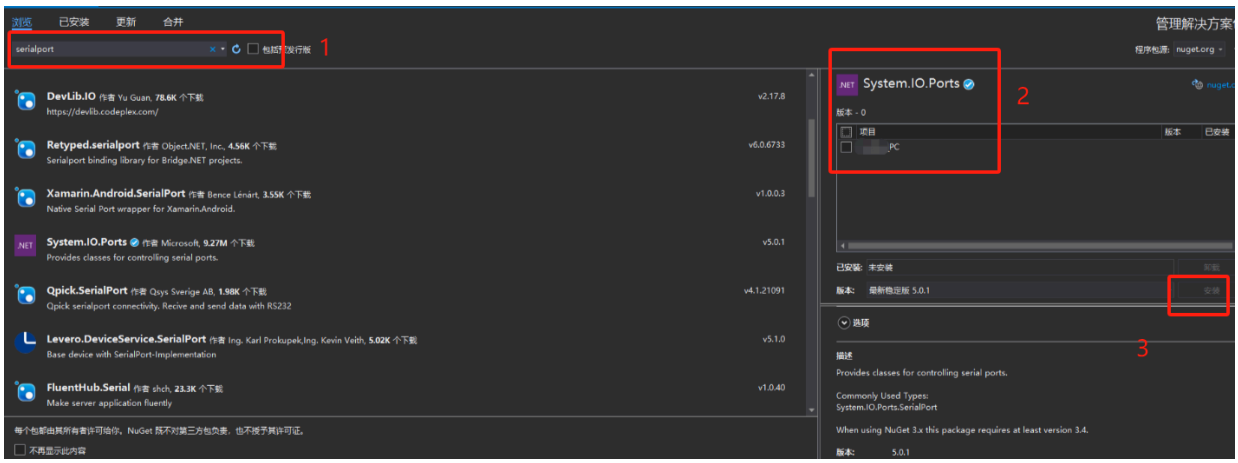


Add **system.io.ports** to .csproj(Project name, the file is located in the project directory), please see the picture below for details:



```
    </PropertyGroup>
    <PropertyGroup Condition=" '$(Configuration)|$(Platform)' == 'Release|AnyCPU' ">
      <PlatformTarget>AnyCPU</PlatformTarget>
      <DebugType>pdbonly</DebugType>
      <Optimize>true</Optimize>
      <OutputPath>bin\Release\</OutputPath>
      <DefineConstants>TRACE</DefineConstants>
      <ErrorReport>prompt</ErrorReport>
      <WarningLevel>4</WarningLevel>
    </PropertyGroup>
    <ItemGroup>
      <PackageReference Include="System.IO.Ports" Version="6.0.0-preview.1.21102.12" />
      <Reference Include="Mycobot.csharp">
        <HintPath>..\..\Mycobot.csharp\Mycobot.csharp\bin\Release\Mycobot.csharp.dll</HintPath>
      </Reference>
      <Reference Include="System" />
      <Reference Include="System.Core" />
      <Reference Include="System.Xml.Linq" />
      <Reference Include="System.Data.DataSetExtensions" />
      <Reference Include="Microsoft.CSharp" />
      <Reference Include="System.Data" />
      <Reference Include="System.Net.Http" />
      <Reference Include="System.Xml" />
    </ItemGroup>
    <ItemGroup>
      <Compile Include="Program.cs" />
      <Compile Include="Properties\AssemblyInfo.cs" />
    </ItemGroup>
```

In versions before vs2019, you can use SerialPort by using System.IO.Ports. If an error is displayed: Failed to find the corresponding type name in the namespace, you need to configure the corresponding dll for the project, as follows: Tools -> Nuget Package Manager (N) -> Manage Nuget Packages for Solutions (N) -> Browse, search for the corresponding dll (such as SerialPort) in the left search bar, check the project to be added on the right, and click Download and Install.



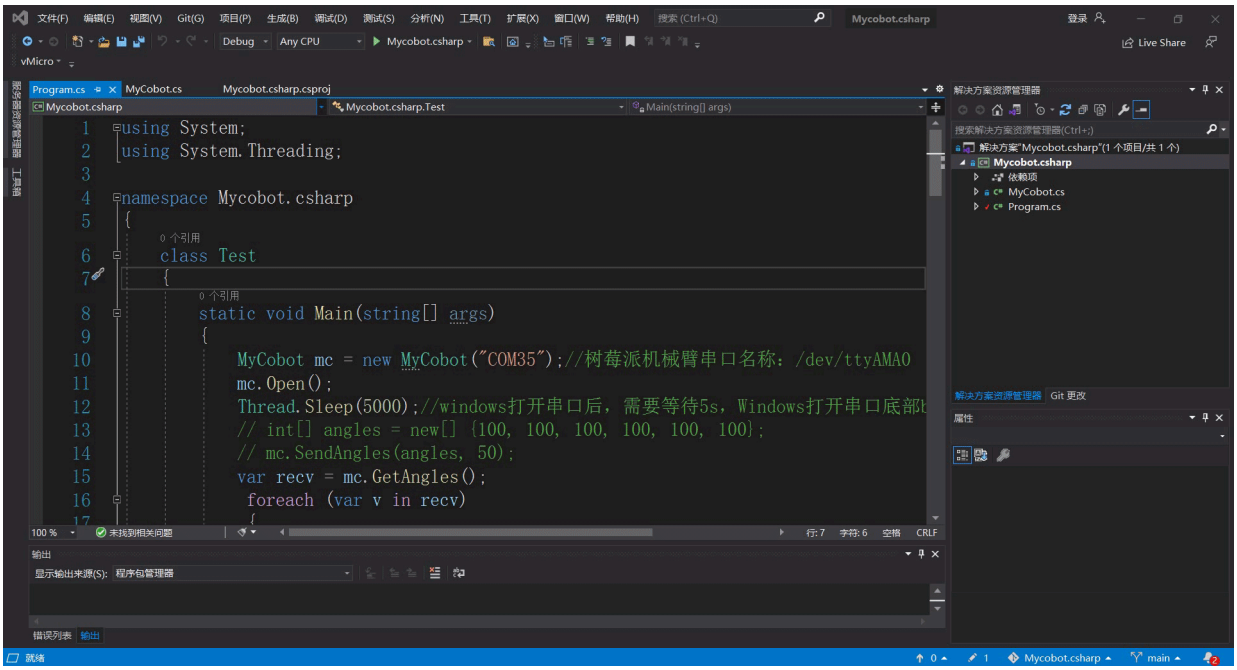
For the usage of library functions, please refer to the Mycobot API section, the use case section, and the subsequent separate usage sections on joints, coordinates, etc.

Problems

Problems you may encounter during use:

Problem 1: System.Runtime, Version=5.0.0.0, Culture=neutral, PublicKeyToken=b03f5f7f11d50a3a' or one of its dependencies...

Solution: **Update your sdk**(if .net core,update to 5.0 and choose,if .net framework update to 4.0 and choose 4.7.2), see the following animation:



Problem 2: System.IO.FileNotFoundException: "Could not load file or assembly 'System.IO.Ports, Version=6.0.0.0, Culture=neutral, PublicKeyToken=cc7b13ffcd2ddd51'.

Solution: See Add system.io.ports to .csproj (project name, located in the project directory) section above.

Joint control

For serial multi-joint robots, joint control is the control of the variables of each joint of the robot arm. The goal is to make each joint of the robot arm reach the target position at a certain speed.

Single joint control

Send single joint angle

SendOneAngle(int jointNo, int angle, int speed)

Return value: None

Parameter description: Parameter 1: joint number (**1 - 6**), Parameter 2: angle (range: **-170°- 170°**), Parameter 3: speed (**0-100**)

Example:

```
mc.SendOneAngle(1, 100,70);
```

Multi-joint control

Get all joint angles

GetAngles()

Return value: Returns int type array, int[], length: 6

Parameter description: None

Example:

```
var recv = mc.GetAngles();
```

Send all joint angles

SendAngles(int[] angles, int speed)

Return value: None

Parameter description: Parameter 1: All joint angles (range: **-170°- 170°**), Parameter 2: Speed (**0-100**)

Example:

int[] angles = new[] {100, 100, 100, 100, 100, 100}; mc.SendAngles(angles ,30);

Complete use case

The program.cs in the project is a complete use case program, which can be modified as needed.

```
using System; // Introduce the System namespace to provide basic classes and methods, such as Console and Thread

namespace Mycobot.csharp // Define a namespace for organizing code
{
 class Test // Define a class named Test
  {
static void Main(string[] args) // Main entry point of the program
     {
MyCobot mc = new MyCobot("/dev/ttyUSB0"); // Create a MyCobot instance, assuming that "/dev/ttyUSB0" is the serial port fo
mc.Open(); // Open the connection with the robot

// The following lines of code are commented out, they demonstrate how to send an array of angles, wait for a while, recei
// int[] angles = new[] {100, 100, 100, 100, 100, 100}; // Create an array of 6 angles
// mc.SendAngles(angles, 50); // Send angle array and speed to the robot
// Thread.Sleep(5000); // Wait 5000 milliseconds (5 seconds)
// var recv = mc.GetAngles(); // Receive current angle
// foreach (var v in recv) // Traverse and print received angles
// {
// Console.WriteLine(v);
// }

// The following lines of code are also commented out, they demonstrate how to send a coordinate array, wait for a while,
// int[] coords = new[] {160, 160, 160, 0, 0, 0}; // Create a coordinate array containing position and direction
// mc.SendCoords(coords, 90, 1); // Send coordinates and speed to the robot
// Thread.Sleep(5000); // Wait 5000 milliseconds (5 seconds)
// var recv = mc.GetCoords(); // Receive current coordinates
// foreach (var v in recv) // Traverse and print received coordinates
// {
// Console.WriteLine(v);
// }

mc.SendOneAngle(1, 100, 70); // Send the angle of a single joint (assuming it is the first joint), set the angle to 100 an

// byte[] setColor = {0xfe, 0xfe, 0x05, 0x6a, 0xff, 0x00, 0x00, 0xfa}; // This line of code is also commented out, it may
mc.Close(); // Close the connection with the robot
  }
 }
}
```

Coordinate control

Coordinate control is to make the robot move to a specified point with a specified posture, which is divided into x, y, z, rx, ry, rz. X, Y, Z represent the position of the robot head in space (the coordinate system is a rectangular coordinate system), and rx, ry, rz represent the posture of the robot head at that point (the coordinate system is an Euler coordinate system).

Single parameter coordinates

Send single parameter coordinates

SendOneCoord(int coord, int value, int speed)

Return value: None

Parameter description: Parameter 1: Coordinate number (1-6 (**x, y, z, rx, ry, rz**)), Parameter 2: Coordinate (**X, Y, Z value range -300-300.00 unit mm RX, RY, RZ, value range** -180-180), Parameter 3: Speed (0-100)

Example:

```
mc.SendOneCoord(1, 160,30);
```

Multi-parameter coordinates

Get all coordinates

GetCoords()

Return value: Returns int type array, int[], length: 6

Parameter description: None

Example:

```
var recv = mc.GetCoords();
```

Send multi-parameter coordinates

SendCoords(int[] coords, int speed, int mode)

Return value: None

Parameter description: Parameter 1: All coordinates (**X, Y, Z value range -300-300.00 unit mm RX, RY, RZ, value range -180-180**), Parameter 2: Speed (0-100), Parameter 3: Mode (0 - angular, 1 - linear)

Example:

int[] coords = new[] {160, 160, 160, 0, 0, 0};

mc.SendCoords(coords ,30);

Complete Use Case

The program.cs in the project is a complete use case program, which can be modified as needed.

using System;

```
using System; // Introduce the System namespace, which contains the basic classes and functions commonly used in C# progra

namespace Mycobot.csharp // Define a namespace Mycobot.csharp to organize related classes
{
class Test // Define a class named Test, which is the main body of the program
{
static void Main(string[] args) // The Main method is the entry point of the program, static means it can be called withou
{
MyCobot mc = new MyCobot("/dev/ttyUSB0"); // Create an instance of the MyCobot class mc, "/dev/ttyUSB0" is the serial port
mc.Open(); // Call the Open method of the mc instance to open the connection with the robot

// The following lines of code are commented out, they demonstrate how to set a set of joint angles, wait for a response,
// int[] angles = new[] {100, 100, 100, 100, 100, 100}; // Create an array of 6 joint angles
// mc.SendAngles(angles, 50); // Call the SendAngles method to send the angle array and speed parameters to the robot
// Thread.Sleep(5000); // Pause the program for 5 seconds and wait for the robot to respond
// var recv = mc.GetAngles(); // Call the GetAngles method to get the current angle from the robot
// foreach (var v in recv) // Traverse the received angle array
// {
// Console.WriteLine(v); // Print each angle to the console
// }

// The following lines of code are also commented out, they demonstrate how to set the coordinates, wait for a response, a
// int[] coords = new[] {160, 160, 160, 0, 0, 0}; // Create a coordinate array containing position and direction
// mc.SendCoords(coords, 90, 1); // Call the SendCoords method to send the coordinate array, speed and accuracy parameters
// Thread.Sleep(5000); // Pause the program for 5 seconds and wait for the robot to respond
// var recv = mc.GetCoords(); // Call the GetCoords method to get the current coordinates from the robot
// foreach (var v in recv) // Traverse the received coordinate array
// {
// Console.WriteLine(v); // Print each coordinate to the console
// }

mc.SendOneAngle(1, 100, 70); // Call the SendOneAngle method to set the angle of the first joint to 100 and the speed to 7

// byte[] setColor = {0xfe, 0xfe, 0x05, 0x6a, 0xff, 0x00, 0x00, 0xfa}; // This line of code is commented out, probably use
mc.Close(); // Call the Close method to close the connection with the robot
}
}
}
```

io control

There are pins on the Basic at the bottom of the robot and the Atom at the end. You can use io control to set the high and low levels of the pins and control tools such as pumps (the pin number can be found on the pin labels attached to the Basic and Atom pins, and the input and output are shared).

M5Stack-basic io control (m5)

Set the output io high and low levels

SetBasicOut(byte pin_number, byte pin_signal)

Return value: None

Parameter description: Parameter 1: Pin number (basic output pin number), Parameter 2: State (0--low level, 1--high level)

Case:

mc.SetBasicOut(2, 1); Thread.Sleep(100); mc.SetBasicOut(5, 1); Thread.Sleep(100);

Get input io status

GetBasicIn(byte pin_number)

Return value: pin status (0--low level, 1--high level)

Parameter description: pin number (basic input pin number)

Example: Set output pin 2 to high level

Console.WriteLine(mc.GetBasicIn(35)); Thread.Sleep(100); Console.WriteLine(mc.GetBasicIn(36)); Thread.Sleep(100);

Atom io control

Note: **320m5 does not have atom io, so this module API is not needed**

Set the output io high and low levels

SetDigitalOut(byte pin_number, byte pin_signal)

Return value: None

Parameter description: Parameter 1: pin number (atom output pin number), parameter 2: state (0--low level, 1--high level)

Case:

```
mc.SetDigitalOut(23, 0);
Thread.Sleep(100);
mc.SetDigitalOut(33, 0);
Thread.Sleep(100);
```

Get input io status

GetDigitalIn(byte pin_number)

Return value: pin status (0--low level, 1--high level)

Parameter description: pin number (atom input pin number)

Example:

```
Console.WriteLine(mc.GetDigitalIn(19));
Thread.Sleep(100);
Console.WriteLine(mc.GetDigitalIn(22));
Thread.Sleep(100);
```

Complete use case

```
using System;
using System.Threading;

namespace Mycobot.csharp
{
    class Test
    {
        static void Main(string[] args)
        {
            MyCobot mc = new MyCobot("COM57");//Raspberry Pi Robotic Arm Serial Port Name: /dev/ttyAMA0
            mc.Open();
            Thread.Sleep(5000);//After Windows opens the serial port, you need to wait for 5 seconds, and the basic button


            //set basic output io
            /*mc.SetBasicOut(2, 1);
            Thread.Sleep(100);
            mc.SetBasicOut(5, 1);
            Thread.Sleep(100);
            mc.SetBasicOut(26, 1);
            Thread.Sleep(100);*/

            //get basic input io
            Console.WriteLine(mc.GetBasicIn(35));
            Thread.Sleep(100);
            Console.WriteLine(mc.GetBasicIn(36));
            Thread.Sleep(100);

            //set atom output io
            /*mc.SetDigitalOut(23, 0);
            Thread.Sleep(100);
            mc.SetDigitalOut(33, 0);
            Thread.Sleep(100);*/

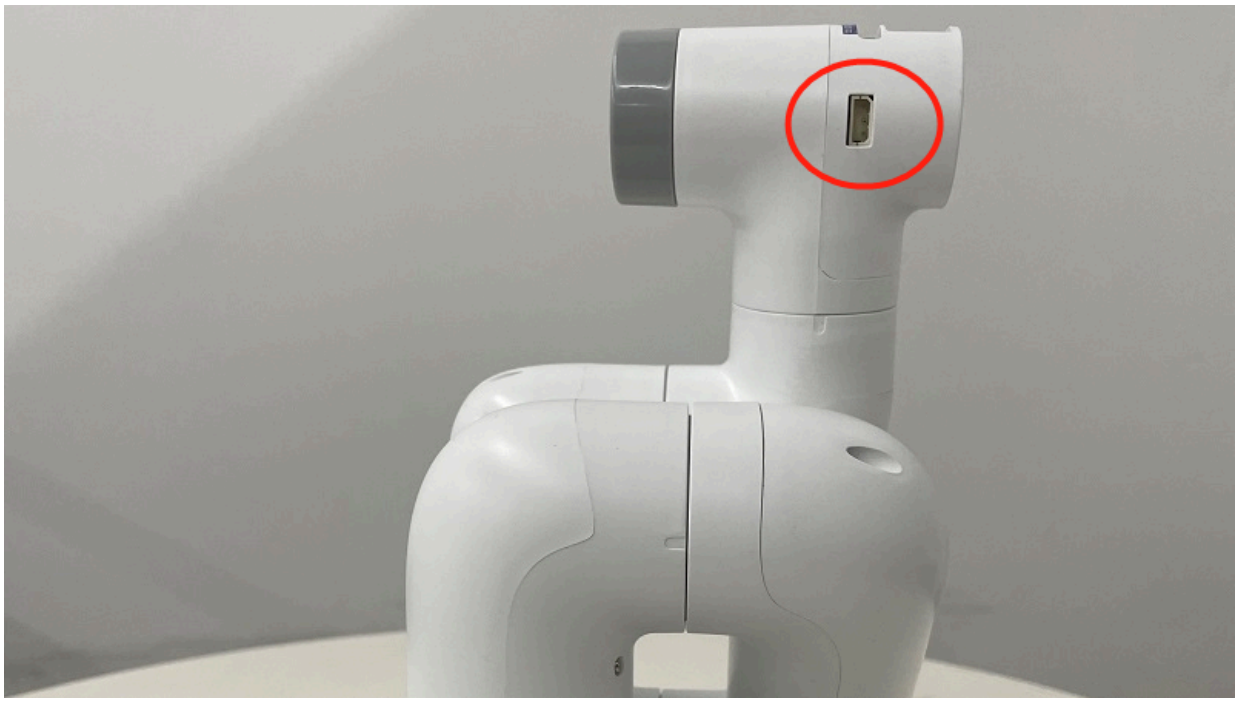
            //get m5 input io
            /*Console.WriteLine(mc.GetDigitalIn(19));
            Thread.Sleep(100);
            Console.WriteLine(mc.GetDigitalIn(22));
            Thread.Sleep(100);*/

            mc.Close();
        }
    }
}
```

Gripper control

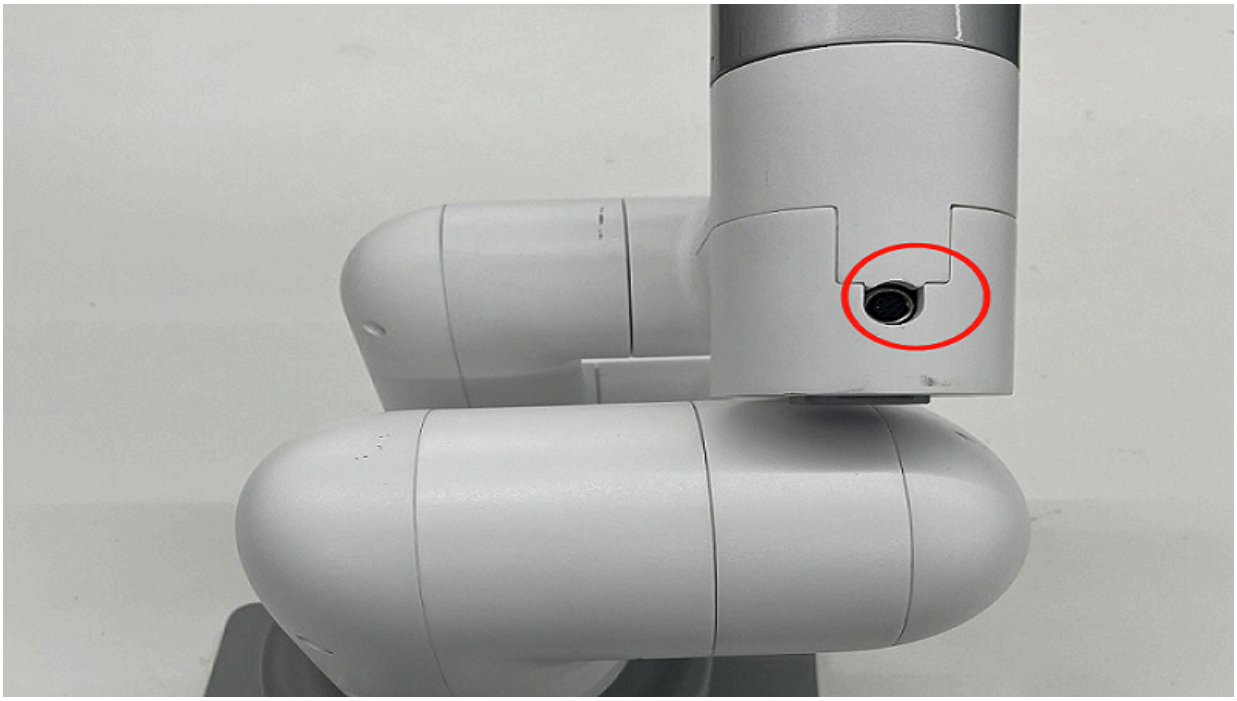
Gripper installation:

The adaptive gripper inserts the gripper into the pins on the atom, see the following figure for details:



The electric gripper is plugged into the 485 interface on the top, see the following figure for details:

Note: **myCobot280 and myPalletizer 260 do not have electric grippers, only myCobot320 has electric grippers**.



Adaptive gripper control

Supported devices: myCobot280, 320 && myPalletizer 260

1.1 **setGripperValue(byte angle, byte speed)**

Return value: None

Parameter description: Parameter 1: Gripper opening and closing angle (0-100, 0--closed, 100-open maximum angle), Parameter 2: Gripper opening and closing speed (0-100)

Case:

```
mc.setGripperValue(0, 10);
Thread.Sleep(3000);
mc.setGripperValue(50, 100);
Thread.Sleep(3000);
```

1.2 **getGripperValue()**

Return value: int type, returns the gripper angle (0--closed, 100-open maximum angle)

Parameter description: None

Case:

```
Console.WriteLine(mc.getGripperValue());
```

Electric Gripper Control

Supported devices: myCobot320

2.1 **setEletricGripper(int state)**

Return value: None

Parameter description: Gripper switch state (0--off, 1--on)

Example:

```
mc.setEletricGripper(0);
```

Complete use case

```
using System;
using System.Threading;

namespace Mycobot.csharp
{
    class Test
    {
        static void Main(string[] args)
        {
            MyCobot mc = new MyCobot("COM57");//Raspberry Pi robotic arm serial port name: /dev/ttyAMA0
            mc.Open();
            Thread.Sleep(5000);//After Windows opens the serial port, you need to wait for 5 seconds, and the basic button

            //set gripper open or close 0--close 100-open max 0-100
            mc.setGripperValue(0, 10);
            Thread.Sleep(3000);
            mc.setGripperValue(50, 100);
            Thread.Sleep(3000);

            //set electric gripper
            mc.setEletricGripper(0);
            Thread.Sleep(100);
            mc.setEletricGripper(1);
            Thread.Sleep(100);

            //get gripper state 0--close 1--open
            Console.WriteLine(mc.getGripperValue());
            mc.Close();
        }
    }
}
```

myCobot API

Please import our API library before using the following function interfaces, otherwise it will not run successfully. For downloading and importing the library, please refer to the Mycobot.csharp case compilation and running section.

Prerequisites for controlling the robot arm

1.1 **MyCobot(string port, int baud=115200)**

Function: Instantiate MyCobot

Return value: None

Parameter description: Parameter 1: Serial port number ("COM*" on Windows (such as COM30) Parameter 2: Baud rate (default is 115200)*

*Note: *If you want to call the following API, you need to instantiate it first*

1.2 **Open()**

Function: Open the serial port

Return value: None

Parameter description: None

Note: **To communicate with the robot arm, you need to open the serial port first**

1.3 **Close()**

Function: Close the serial port

Return value: None

Parameter description: None

Note: **At the end of the program, it is best to close the serial port**

Overall operation status of the robot Overall Status

2.1 **PowerOn();**

Function: Power on the robot

Return value: None

Parameter description: None

Note: **After the robot is powered on, it will not be possible to move the robot manually<**

2.2 **PowerOff()**

Function: Power off the robot

Return value: None

Parameter description: None

Note: **After the robot is powered on, if you want to move the robot manually, you can use this api to power off the robot**

Input program control mode MDI Mode and Robot Control (Manual Data Input)

3.1 **SendOneAngle(int jointNo, int angle, int speed)**

Function: Send single joint angle

Return value: None

Parameter description: Parameter 1: joint number (**1 - 6**), Parameter 2: angle (range: **-170°- 170°**), parameter 3: speed (**0-100**)

3.2 **GetAngles()**

Function: Get all joint angles

Return value: Return int type array, int[], length: 6

Parameter description: None

3.3 **SendAngles(int[] angles, int speed)**

Function description: Send all joint angles

Return value: None

Parameter description: Parameter 1: All joint angles (range: **-170°- 170°**), Parameter 2: Speed (**0-100**)

3.4 **GetCoords()**

Function: Get all coordinates

Return value: Return int type array, int[], length: 6

Parameter description: None

3.5 **SendCoords(int[] coords, int speed, int mode)**

Function: Send multi-parameter coordinates

Return value: None

Parameter description: Parameter 1: All coordinates (X, Y, Z value range -300-300.00 unit mm RX, RY, RZ, value range **-180-180**), Parameter 2: Speed (**0-100**), Parameter 3: Mode (**0 - angular, 1 - linear**)

3.6 **SendOneCoord(int coord, int value, int speed)**

Function: Send single parameter coordinates

Return value: None

Parameter description: Parameter 1: Coordinate number (1-6(**x, y, z, rx, ry, rz**)), Parameter 2: Coordinate (X, Y, Z value range -300-300.00 unit mm RX, RY, RZ, value range **-180-180**), Parameter 3: Speed (**0-100**)

Atom terminal IO control Atom IO Control

4.1 **SetDigitalOut(byte pin_number, byte pin_signal)**

Function: Set output io high and low levels

Return value: None

Parameter description: Parameter 1: Pin number (atom output pin number), Parameter 2: Status (0--low level, 1--high level)

4.2 **GetDigitalIn(byte pin_number)**

Function: Get input io status

Return value: Pin status (0--low level, 1--high level)

Parameter description: Pin number (atom input pin number)

4.3 **setGripperValue(byte angle, byte speed)**

Function: Control adaptive gripper

Return value: None

Parameter description: Parameter 1: Gripper opening and closing angle (0-100, 0--closed, 100-open maximum angle), Parameter 2: Gripper opening and closing speed (0-100)

4.4 **SetElectricGriper(byte open)**

Function: Control electric gripper

Return value: None

Parameter description: Gripper switch status (0--off, 1--on)

4.5 **getGripperValue()**

Function: Get adaptive gripper angle

Return value: int type, return gripper angle (0--closed, 100-open maximum angle)

Parameter description: None

M5Stack-basicIO Control M5Stack-basic IO Control

5.1 **SetBasicOut(byte pin_number, byte pin_signal)**

Function: Set output io high and low levels

Return value: None

Parameter description: Parameter 1: pin number (basic output pin number), parameter 2: state (0--low level, 1--high level)

5.2 **GetBasicIn(byte pin_number)**

Function: Get input io state

Return value: pin state (0--low level, 1--high level)

Parameter description: pin number (basic input pin number)

Use Case

This case will first **get the current angles of all joints**, then **return joint 1 to zero**, and finally **get the values of two input pins on basic**.

The program.cs in the project is a complete use case program, which can be modified as needed:

```
using System;
using System.Threading;

namespace Mycobot.csharp
{
class Test
{
static void Main(string[] args)
{
MyCobot mc = new MyCobot("COM57"); //Raspberry Pi robot serial port name: /dev/ttyAMA0
mc.Open();
Thread.Sleep(5000); //After Windows opens the serial port, you need to wait for 5 seconds. The basic at the bottom of Wind
// int[] angles = new[] {100, 100, 100, 100, 100, 100};
// mc.SendAngles(angles, 50);
var recv = mc.GetAngles();
foreach (var v in recv)
{
Console.WriteLine(v);
}

// int[] coords = new[] {160, 160, 160, 0, 0, 0};
    // mc.SendCoords(coords, 90, 1);
    // Thread.Sleep(5000);
    // var recv = mc.GetCoords();
    // foreach (var v in recv)
    // {
    // Console.WriteLine(v);
    // }
   mc.SendOneAngle(1,0, 70); 00);
    /*var angle = new int[6]; angle = mc.GetAngles();
    foreach (var v in angle) Console.WriteLine(v);
    // byte[] setColor = {0xfe, 0xfe, 0x05, 0x6a, 0xff, 0x00, 0x00, 0xfa};*/
    //set basic output io
    /*mc.SetBasicOut(2, 1);
    Thread.Sleep(100);
    mc.SetBasicOut(5, 1);
    Thread.Sleep(100);
    mc.SetBasicOut(26, 1);
    Thread.Sleep(100);*/
    //get basic input io Console.WriteLine(mc.GetBasicIn(35));
    Thread.Sleep (100);          Console.WriteLine(mc.GetBasicIn(36)); Thread.Sleep(100);
    //set atom output io
    /*mc.SetDigitalOut(23, 0);
    Thread.Sleep(100);
    mc.SetDigitalOut(33, 0);
    Thread.Sleep(100);*/
    //get m5 input io
    /*Console.WriteLine(mc.GetDigitalIn(19));
    Thread.Sleep(100);
    Console.WriteLine(mc.GetDigitalIn(22));
```

```
    Thread.Sleep(100);*/
    //set gripper open or close 0--close 100-open max 0-100
    /*mc.setGripperValue(0, 10);
    (3000);
    mc.setGripperValue(50, 100);
    Thread.Sleep(3000);*/
    //get gripper state 0--close 1--open /*Console.WriteLine(mc.getGripperValue());*/ mc.Close();
   }
 }
}
```

Arduino

What is Arduino?

Arduino is an easy-to-use, easy-to-use open source electronic prototyping platform, which includes hardware (various development boards that meet Arduino specifications) and software (Arduino IDE and related development kits). The hardware part (or development board) consists of a microcontroller (MCU), flash memory (Flash) and a set of general input/output interfaces (GPIO), etc. You can think of it as a microcomputer motherboard. The software part mainly consists of the PC-side Arduino IDE and related board support packages (BSP) and rich third-party function libraries. Users can easily download the BSP and required function libraries related to the development board you have through Arduino IDE to write your program.

What can MyCobotBasic library do?

MyCobotBasic library is an open source robot control library developed by our company. It can only be used with robots developed by our company. With this library, you can control our robots through Bluetooth, WiFi, serial ports, etc., and it also supports external sensors, IIC communication, LED lights and other functions. You can DIY different application scenarios according to your needs, or refer to the MiniRobot sample code or angle, coordinate, gripper and other control cases we provide. The MiniRobot sample code contains control-related content such as Bluetooth, WiFi, drag teaching, and distance sensors.

Applicable devices:

- myCobot 280
- myCobot 280 M5

Prerequisites:

- **M5** series version, **M5Stack-basic** burn **miniRobot** at the bottom, select **Transponder** function, **ATOM** burn the latest version of **atomMain** at the end (factory default burned)

Arduino development guide

You can use it according to the following instructions Arduino develops our robotic arm

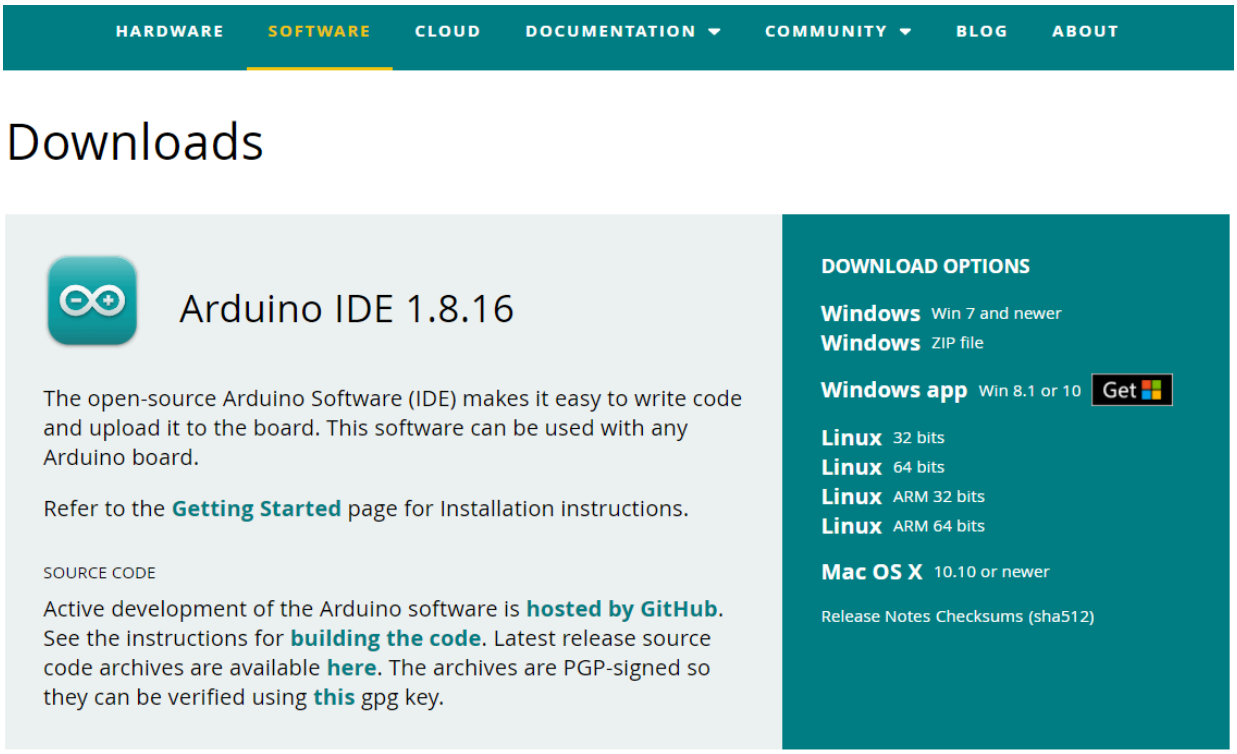
1. Environment setup

2. Simple use

3. API description

Arduino environment setup

Arduino IDE download



Download **Arduino IDE** You can click **Arduino official website** to download and install the version corresponding to the computer system.

- Windows X64
- Mac OS X
- Linux ARM 64

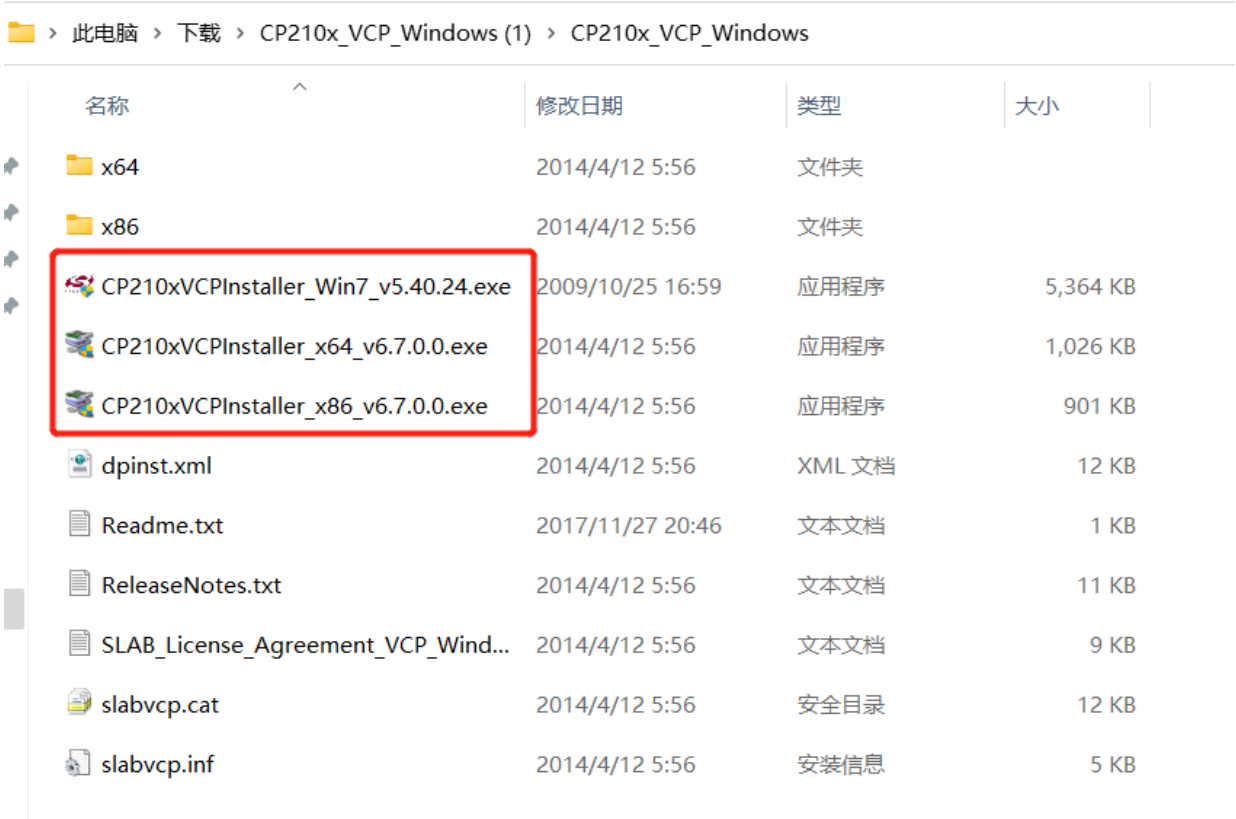
Install the driver

Before burning the program, users of M5Core host (including BASIC/GRAY/M5GO/FIRE/FACES)/ **microcontroller devices** please click the button below to download the corresponding **CP210X** driver package according to your operating system. After decompressing the package, select the installation package corresponding to the operating system bit number to install.

For **Mac OS**, before installing, make sure **System Preferences-->Security & Privacy-->General** and allow **CP2104** drivers to be downloaded from the App Store and approved developers

- Windows10
- MacOS
- Linux

After unzipping the compressed package, select the corresponding installation package according to the **operating system** of the computer for installation (select x64 or x86 for win10 and win11).

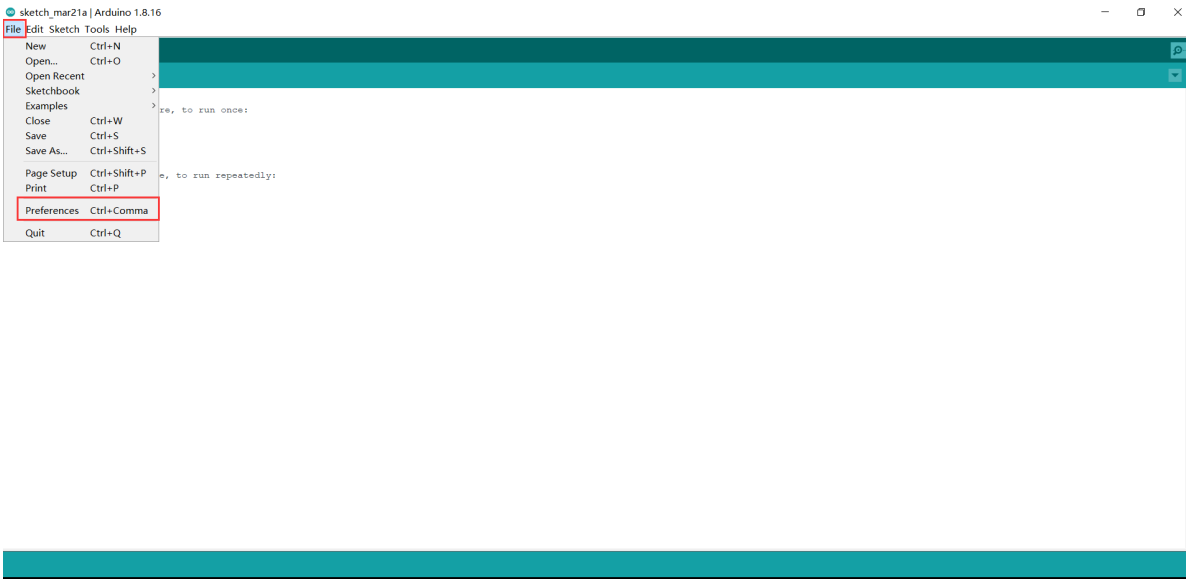


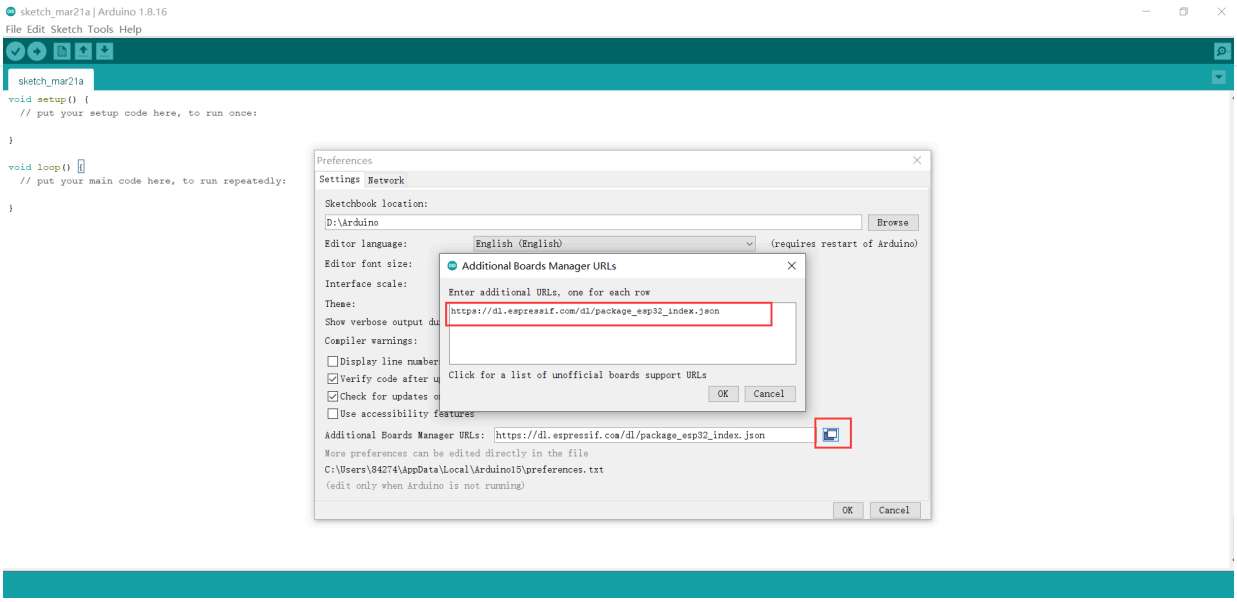
CP34X

- Windows10
- MacOS

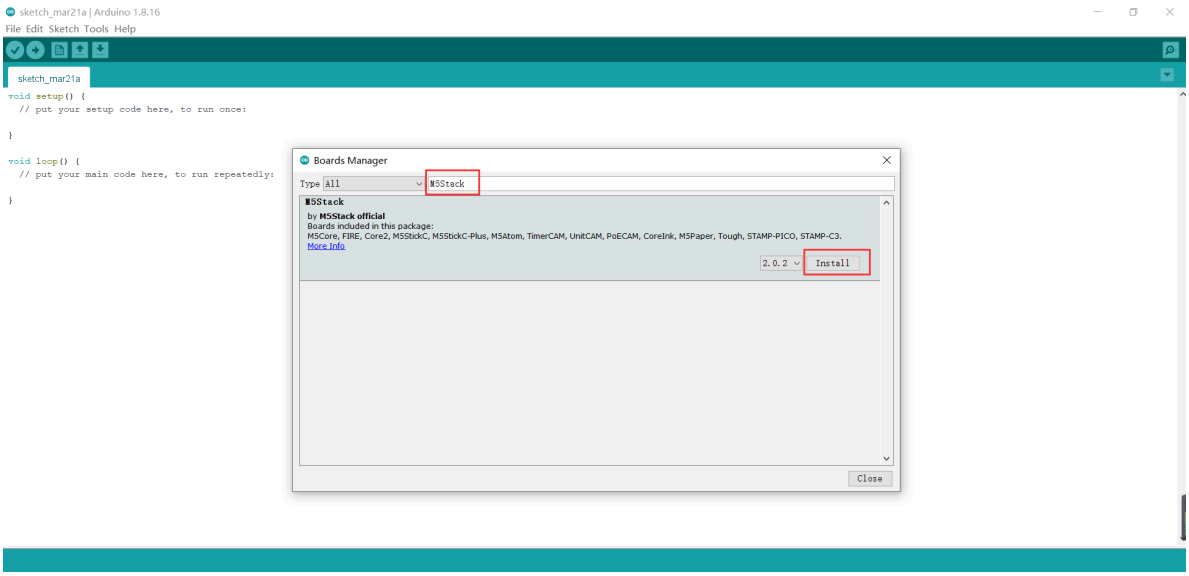
Add development board

- Open Arduino IDE, select **File --> Preferences --> Settings**, add the URL below to the additional development board manager https://m5stack.oss-cn-shenzhen.aliyuncs.com/resource/arduino/package_m5stack_index.json

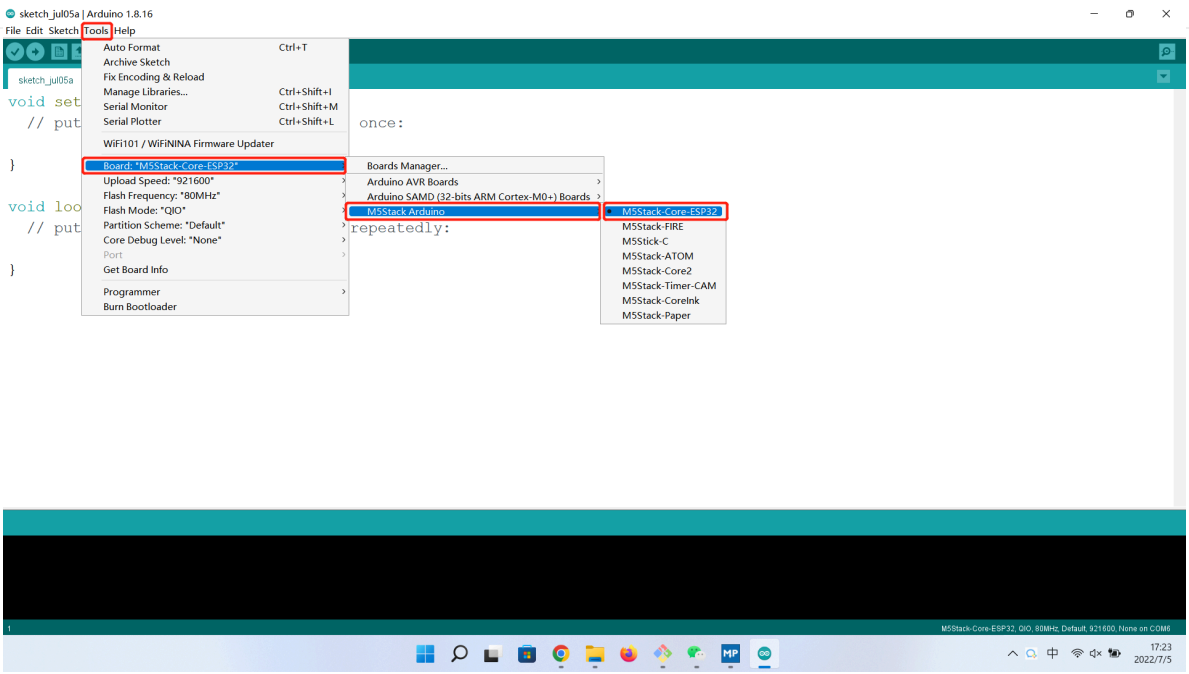




- After adding, select **Tools --> Development Edition --> Development Board Manager**, enter and search **M5Stack** in the new pop-up dialog box, and click Install (if the search fails, you can try restarting the **Arduino** program; if an error occurs during downloading, click Install again), as shown below:



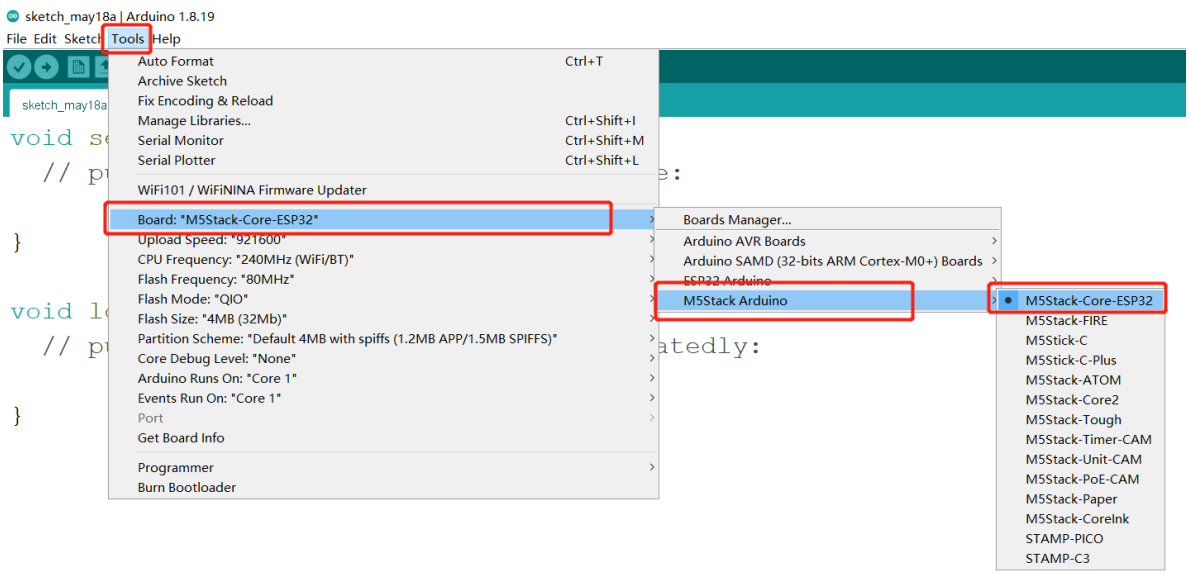
- After adding, select **Tools --> Development Board** , check if it is successful, as shown below:



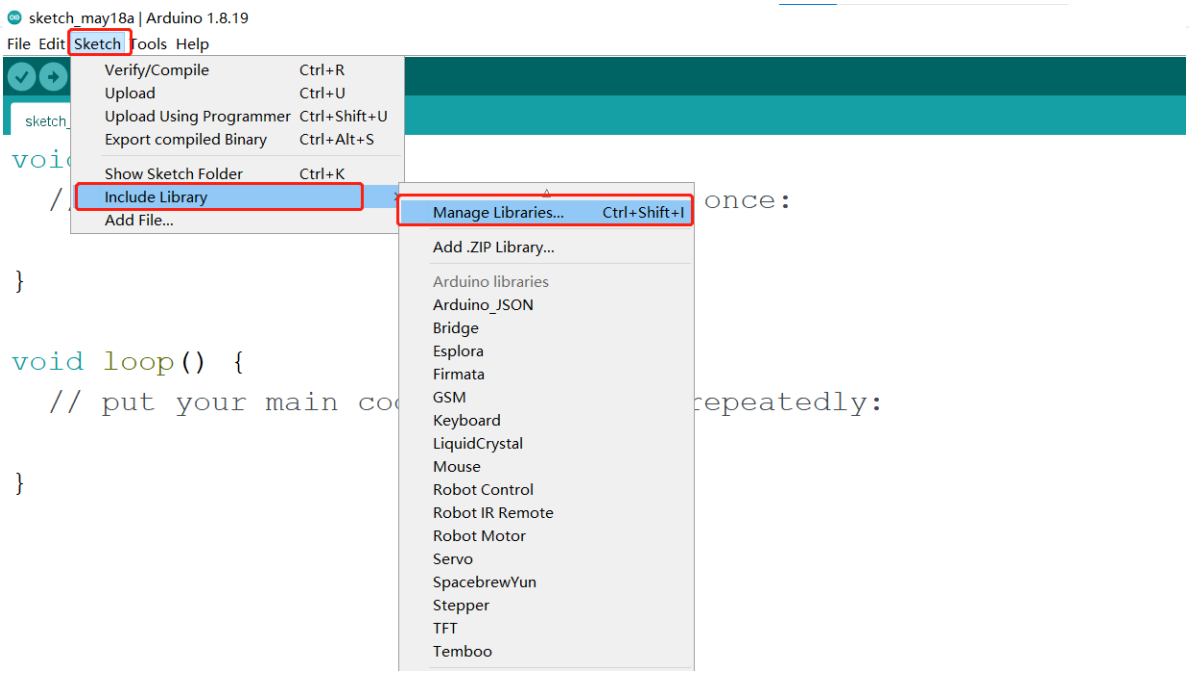
Add related libraries

4.1 Install M5Stack library

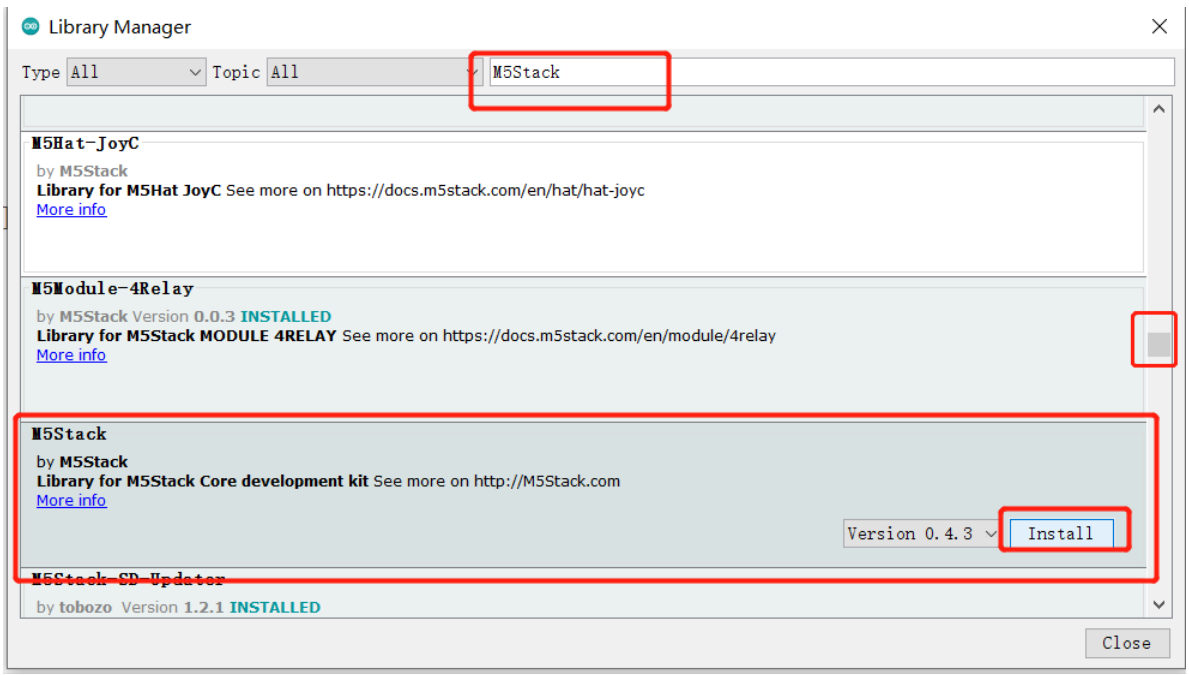
1. Tools --> Development Board --> M5Stack Arduino Select **M5Stack-Core-ESP32**, as shown below:



2. Project --> Load Library --> Manage Library Enter **M5Stack** in the search box, as shown in the following figure:



3. Click Install after finding it, scroll down, **M5Stack** is at the back, and you can see the location of the drop-down slider in the picture, as shown in the following figure:

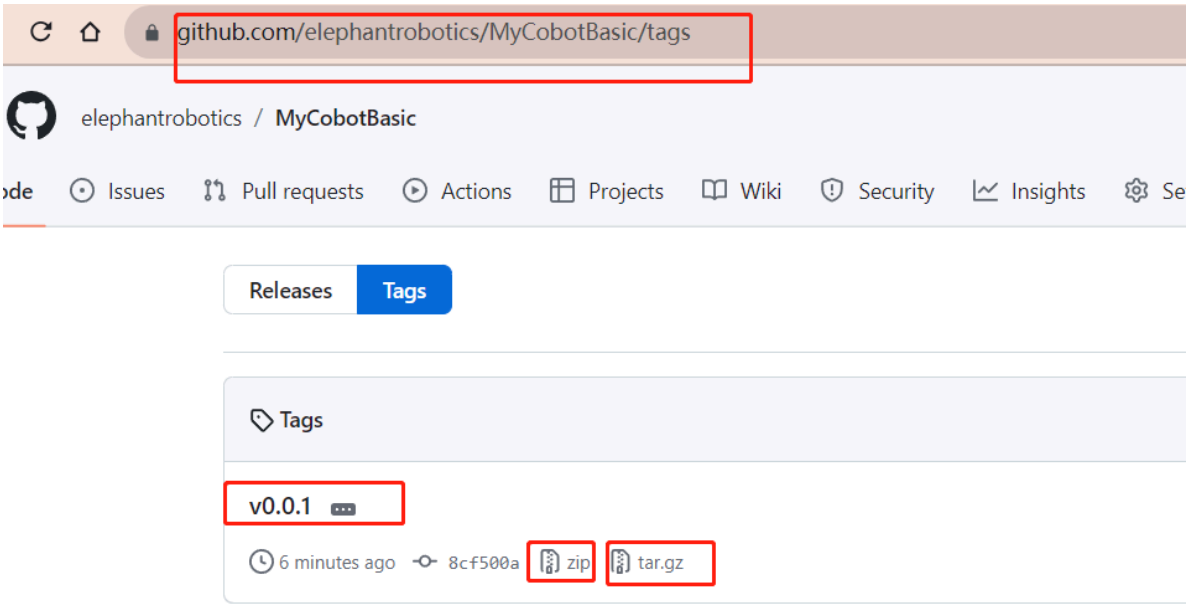


4.2 Install MyCobotBasic library

Note: Please download the latest library, the first version is v0.0.1.

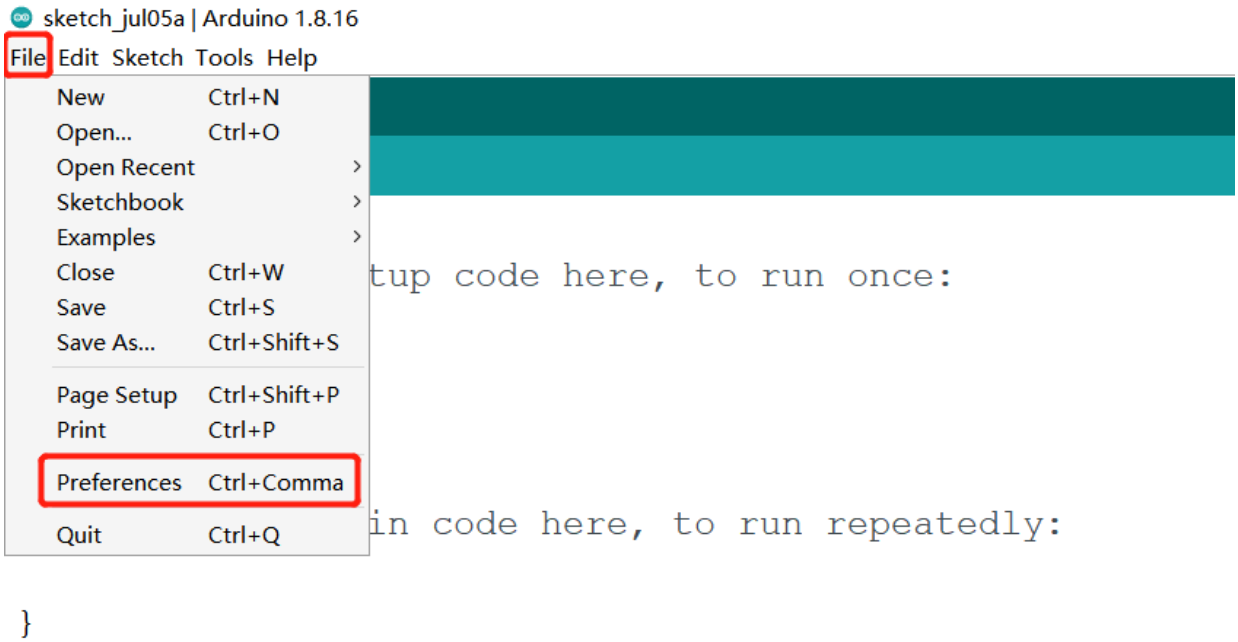
- Click to download related dependency libraries

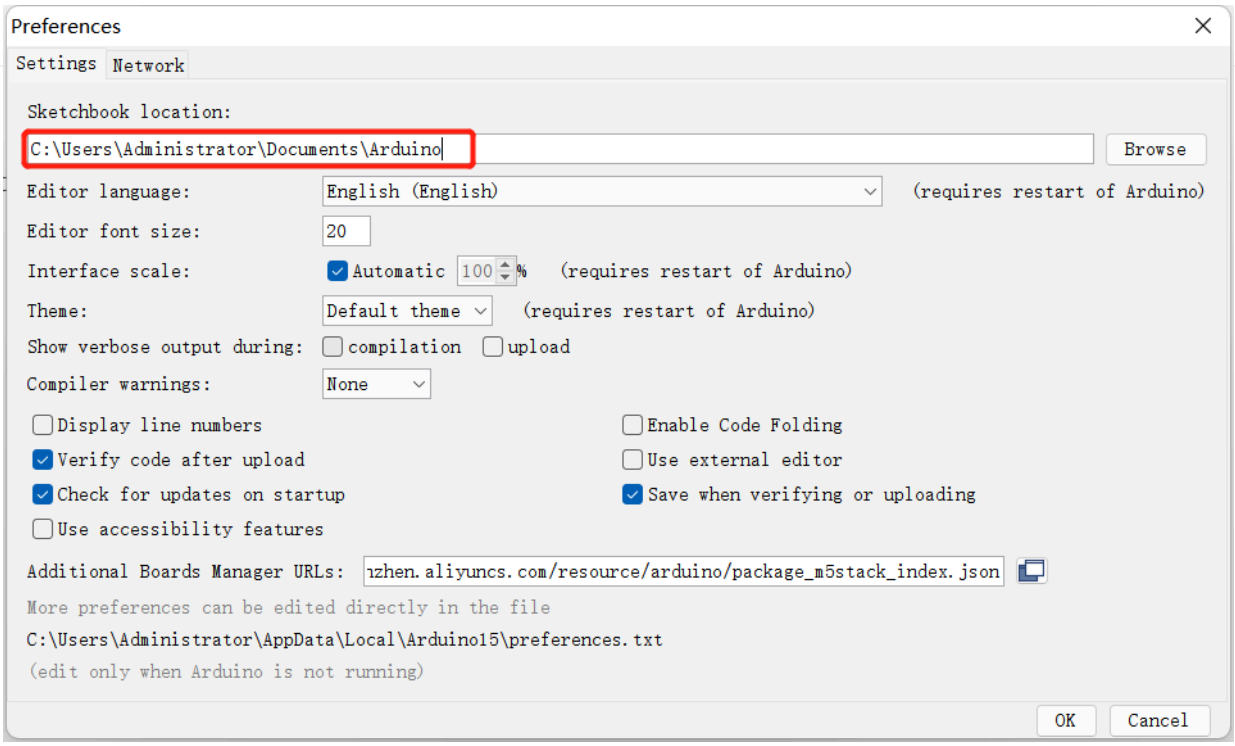
- **MycobotBasic**(After importing the Mycobot280-Arduino model, you can refer to 10.3-arduinolib_use for use). Please see the figure below for details. .zip is suitable for Windows system, and .tar.gz is suitable for Linux system:

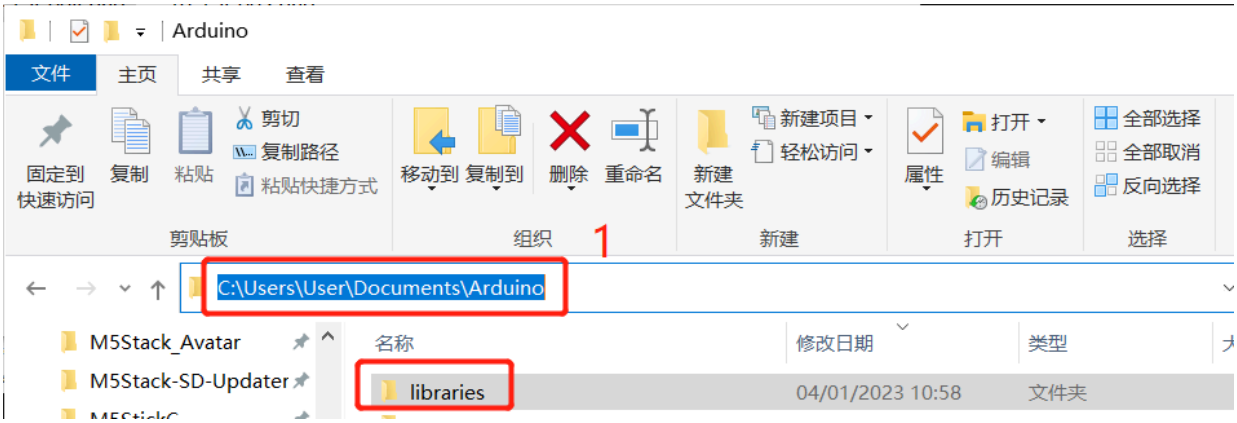


- Dependent library installation instructions

First check the location of the Arduino project folder. You can view it by clicking File --> Preferences (you can copy the path to the hard disk path to find the libraries folder)

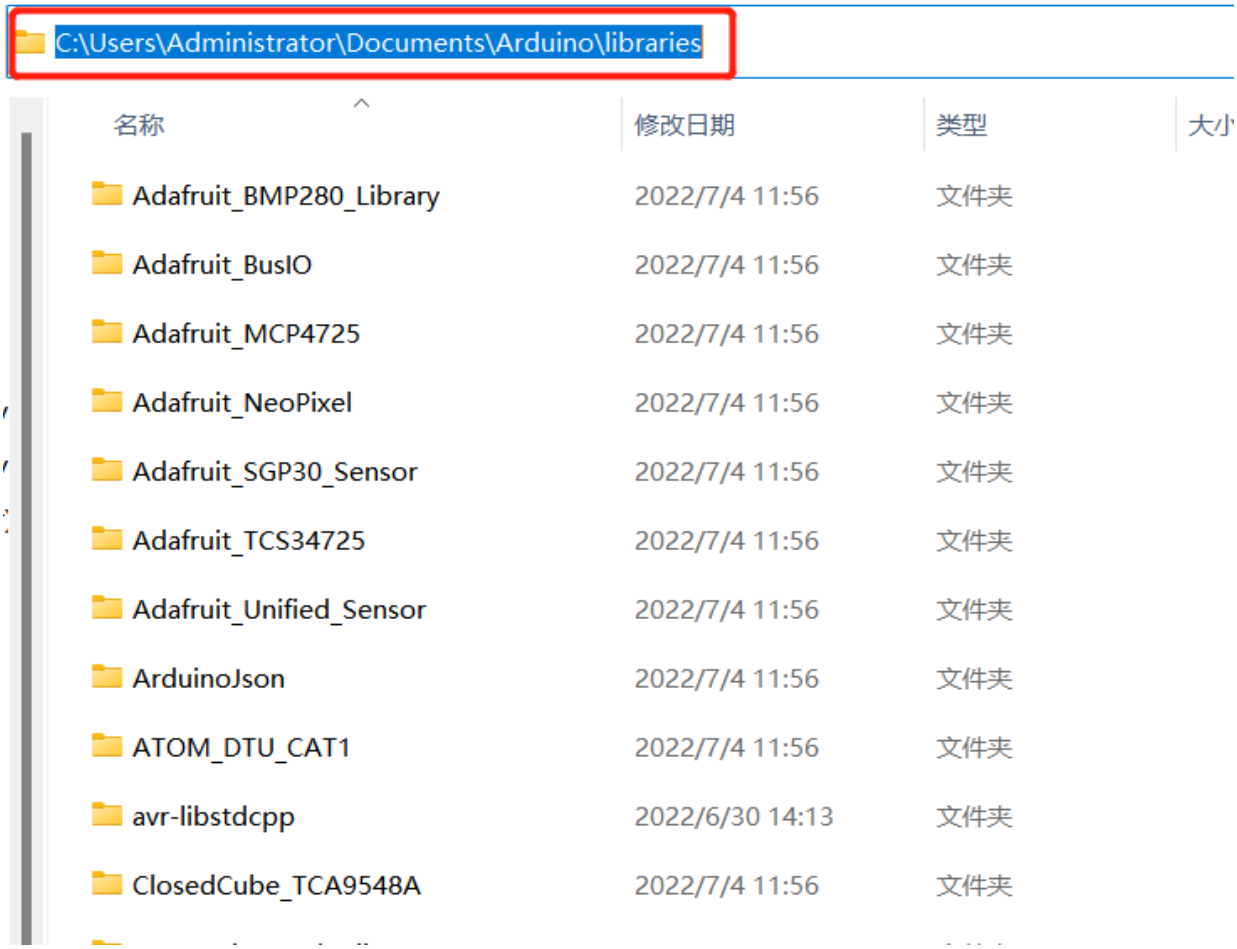






1 Copy the path here and press enter to find the libraries folder

Unzip to the corresponding folder **libraries** directory. If you are using **Arduino**, please do not overwrite, just add it to the existing **Library**.



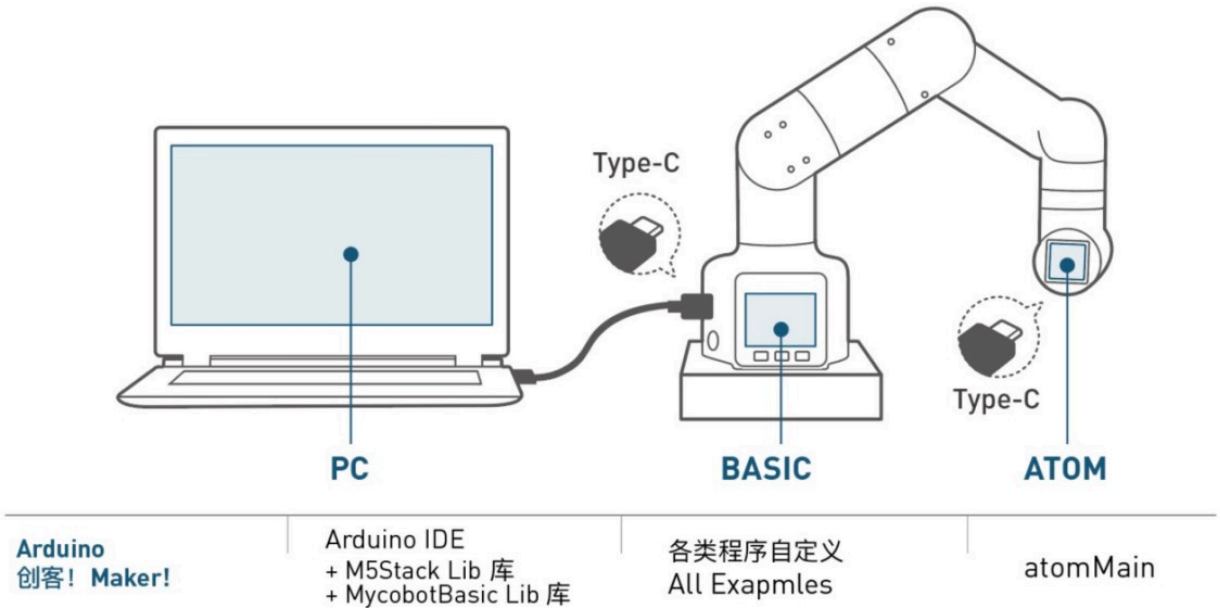
At this point, congratulations, you have built the **Arduino** related development environment.

Note: For Arduino environment configuration and case compilation, you can watch our video on Bilibili (https://www.bilibili.com/video/BV1Vi4y1c7DQ/).

Simple use of Arduino

Connect the device

Take **myCobot 280-M5** as an example, use the Tyep-C data cable to connect the M5Stack-basic on the base of the robot arm to the PC.



Firmware requirements

- ATOM: Use **MyStudio** to burn the latest version of AtomMain
- Basic: No requirements

Check the link

Open the computer device manager to check if there is any device. If the device is not detected, please change the USB cable. If it is not available, please install and click to download **CP210X driver**. After downloading, unzip and install the required driver version to use it.

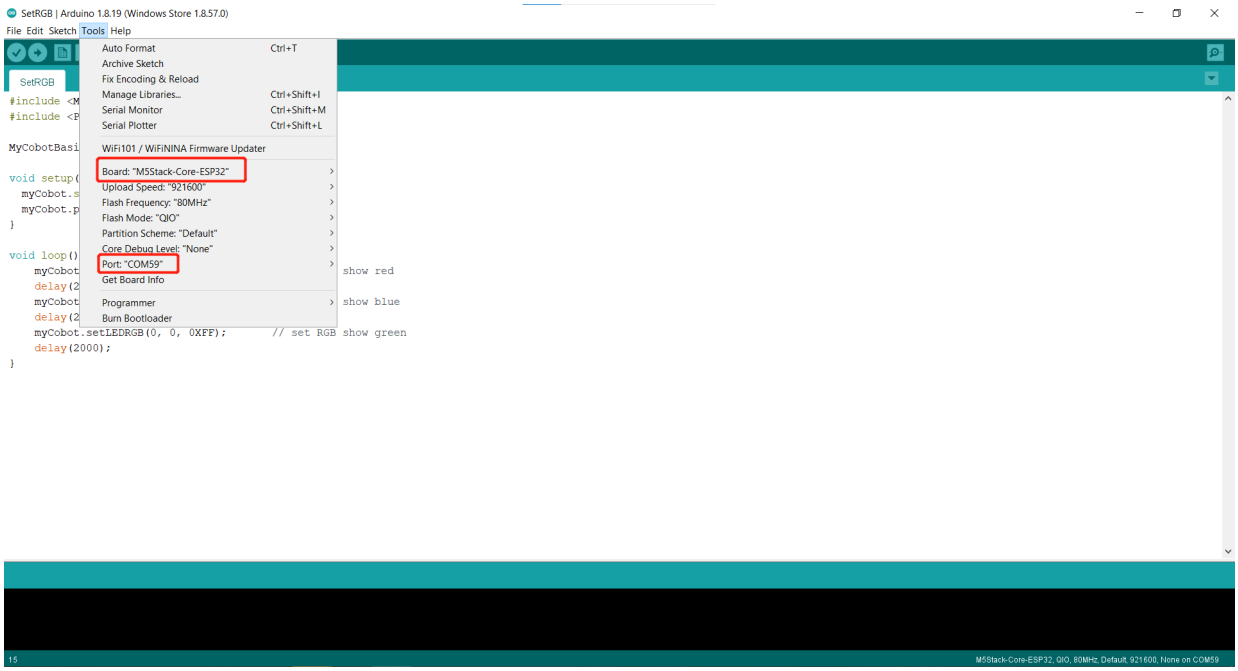
Open **Arduino IDE --> Tools --> Port** to check if there is a device. If the device is not detected, please change the USB cable to test, or check whether the driver is installed successfully.

Start development

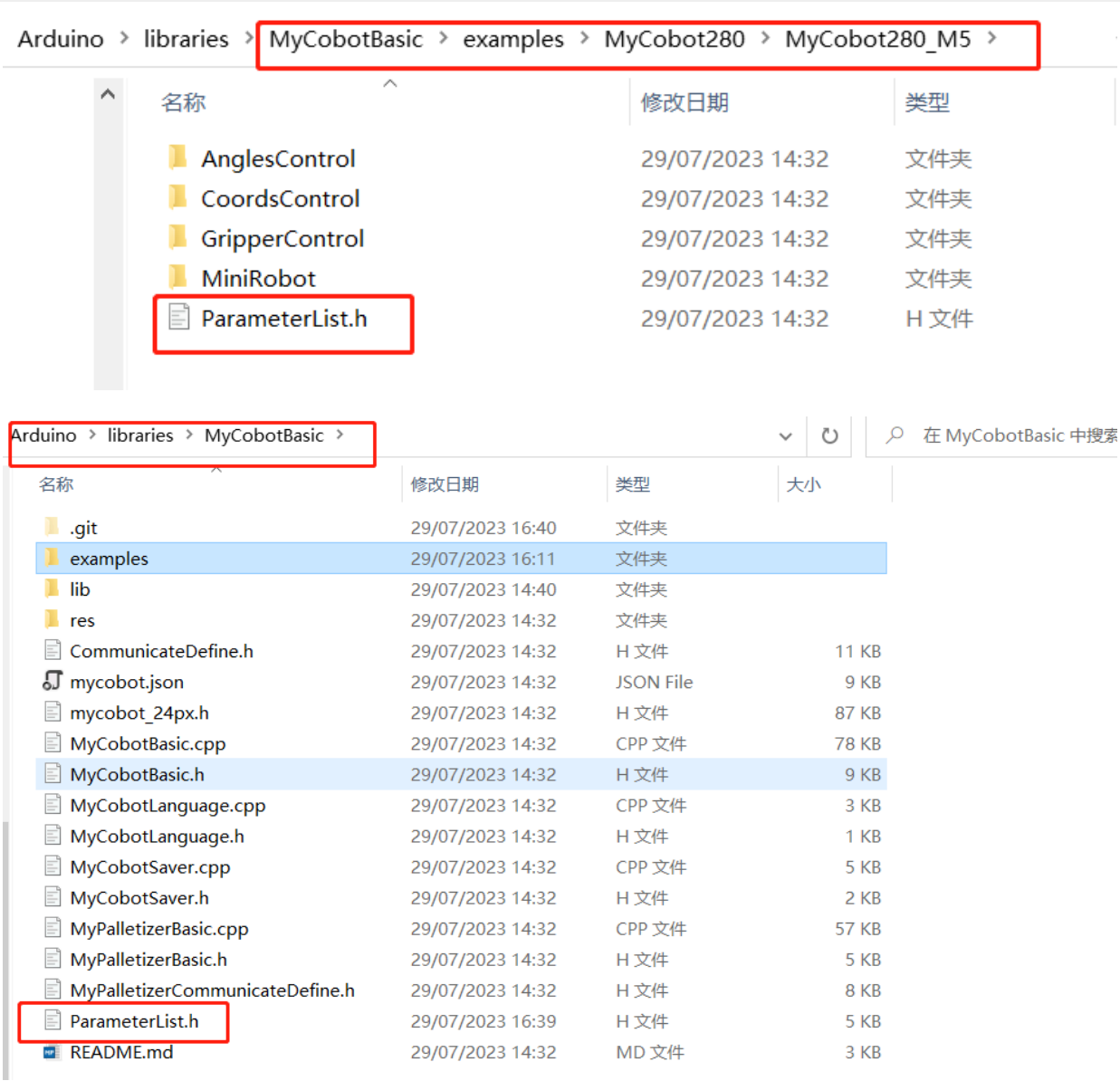
Take burning an official demo as an example. Open **Arduino IDE --> File --> Examples --> MyCobotBasic** to see all project examples (if you don't see the example, you can restart Arduino). Choose to burn a simple demo, for example **--> MyCobot280--> MyCobot280-M5--> AnglesControl**.

Open AnglesControl.ino from the example file

Note: Select the development board as **M5Stack-Core-ESP32** and the corresponding **COM port**.



If you are using myCobot280-M5, **please use ParameterList.h in the MyCobot280-M5 folder to replace ParameterList.h in the MyCobotBasic folder**. Please see the following figure for details:



Note: When using different models, please use the "ParameterList.h" file in the respective case directory to replace the "MyCobotBasic\ParameterList.h" file

Click upload and wait for the progress bar in the lower right corner to finish running

AnglesControl | Arduino 1.8.16

文件 编辑 项目 工具 帮助

AnglesControl

```
#include <MyCobotBasic.h>

MyCobotBasic myCobot;
Angles angles = {0, 0, 0, 0, 0, 0};

void setup()
{
    myCobot.setup(); //This api is required
    delay(100);
    myCobot.powerOn();//robot poweron
    delay(100);
}

void loop()
{
    myCobot.writeAngle((Joint)1, 100, 30); //Single joint control, J1 to 100°,speed 30
    delay(200); //Once in place, proceed to the next step
    myCobot.writeAngles(angles, 50); //All joints to zero, speed 50
    delay(5000);
}
```

正在编译项目...

Wait until the lower right corner shows that the upload is successful, and the program has been downloaded

AnglesControl | Arduino 1.8.16

文件 编辑 项目 工具 帮助

AnglesControl

```
#include <MyCobotBasic.h>

MyCobotBasic myCobot;
Angles angles = {0, 0, 0, 0, 0, 0};

void setup()
{
    myCobot.setup(); //This api is required
    delay(100);
    myCobot.powerOn();//robot poweron
    delay(100);
}

void loop()
{
    myCobot.writeAngle((Joint)1, 100, 30); //Single joint control, J1 to 100°,speed 30
    delay(200); //Once in place, proceed to the next step
    myCobot.writeAngles(angles, 50); //All joints to zero, speed 50
    delay(5000);
}
```

上传成功.

```
Wrote 3072 bytes (128 compressed) at 0x00008000 in 0.0 seconds (effective 1536.0 kbit/s)...
Hash of data verified.

Leaving...
Hard resetting via RTS pin...
```

At this time, we can see the **robot** start working.

For the interface and driver of **basic buttons and screen**, please refer to the following documents:

Button: https://docs.m5stack.com/en/api/core/button

Screen: https://docs.m5stack.com/en/api/core/lcd

5. Introduction to some cases

Currently, different models have angle, coordinate, and gripper control. MyCobot320 supports adaptive gripper and electric gripper control.

miniRobot:

MyCobot280, 320m5, mechArm270-M5 use cases can perform zero calibration, drag teaching, communication, etc. (on this basis, use RoboFlow, python, myblockly, etc. to control the robot arm), information acquisition (obtain the servo atom connection status, and basic, atom firmware versions).

Note: For Arduino environment configuration and case compilation, please refer to the relevant chapters of gitbook and the video on Bilibili https://space.bilibili.com/2126215657/channel/seriesdetail?sid=619809.

Case code explanation:

The sample code in the **AnglesControl** folder is used to control the angle of the robot arm. The code includes the functions of initialization, power-on, controlling the angle of a single joint, and controlling all joints to return to the initial position. The following is a detailed comment of the code

```
#include <MyCobotBasic.h> // Import the MyCobotBasic library to control the MyCobot robot

MyCobotBasic myCobot; // Declare and instantiate a MyCobotBasic object to call the robot control method
Angles angles = {0, 0, 0, 0, 0, 0}; // Define an Angles variable and initialize the angles of the six joints to 0

void setup()
{
myCobot.setup(); // Initialize the basic settings such as the communication interface of the robot, which is required to s
delay(100); // Delay 100 milliseconds to ensure that the initialization is complete
myCobot.powerOn(); // Power on the robot so that it can respond to control commands
delay(100); // Delay another 100 milliseconds to ensure that the robot is fully started
}

void loop()
{
myCobot.writeAngle((Joint)1, 100, 30); // Control the first joint (J1) to move to 100°, set the speed to 30
delay(200); // Delay 200 milliseconds, wait for the joint to move to the specified angle before executing the next step
myCobot.writeAngles(angles, 50); // Move all joints to the angle specified in angles (here is 0°), set the speed to 50
delay(5000); // Delay 5000 milliseconds, let the robot arm remain still for a while after all joints return to the initial
}
```

The sample code in the **CoordsControl** folder is used to control the coordinates of the robot arm. The code includes robot arm initialization, power-on, and robot arm movement according to the specified coordinates. The following is a detailed comment on the code.

```
#include <MyCobotBasic.h> // Import the MyCobotBasic library to control the MyCobot robot

MyCobotBasic myCobot; // Declare and instantiate a MyCobotBasic object to call the robot's control method

Coords coords = {200.8, -87.400, 113.300, -178.260, -30.760, -60.880}; // Define a Coords variable to represent the six co

void setup()
{
myCobot.setup(); // Initialize the basic settings such as the robot's communication interface, which is required to start
delay(100); // Delay 100 milliseconds to ensure that the initialization is complete
myCobot.powerOn(); // Power on the robot so that it can respond to control commands
delay(100); // Delay 100 again milliseconds to ensure that the robot is fully started
myCobot.writeAngles({0, -10, -123, 45, 0, 20}, 50); // Set the initial posture of the robot, each joint angle is the speci
delay(6000); // Delay 6000 milliseconds and wait for the robot to move to the initial posture
}

void loop()
{
myCobot.writeCoord((Axis)3, 260, 30); // Control the third axis (Z axis) of the robot to move to 260mm, with a speed of 30
delay(300); // Delay 300 milliseconds and wait for the axis to move to the specified position before executing the next st
myCobot.writeCoords(coords, 30); // Control multiple axes to move to the target position at the same time according to the
delay(5000); // Delay 5000 milliseconds, wait for the robot to finish moving and stay still for a while
}
```

The sample code in the **GripperControl** folder is used to control the gripper of the robot. Please connect the gripper before running the sample code. The code includes robot initialization, power-on, and movement of the robot according to the specified coordinates. The following is a detailed comment on the code.

```
#include <MyCobotBasic.h> // Import the MyCobotBasic library to control the MyCobot robot

MyCobotBasic myCobot; // Declare and instantiate a MyCobotBasic object to call the robot control method

void setup()
{
myCobot.setup(); // Initialize the robot's communication interface and other basic settings, which is required to start th
delay(100); // Delay 100 milliseconds to ensure that the initialization is complete
myCobot.powerOn(); // Power on the robot so that it can respond to control commands
delay(100); // Delay another 100 milliseconds to ensure that the robot is fully started
}

void loop()
{
myCobot.setGripperValue(80, 50); // Move the gripper to 80° at a speed of 50
delay(500); // Delay 500 milliseconds and wait for the gripper to move to the specified position before executing the next
myCobot.setGripperValue(20, 50); // Move the gripper to 20°, speed 50
delay(500); // Delay 500 milliseconds, wait for the gripper to move to the specified position before executing the next st
myCobot.setGripperState(0, 30); // Open the gripper, speed 30
delay(600); // Delay 600 milliseconds, wait for the gripper to fully open before executing the next step
myCobot.setGripperState(1, 30); // Close the gripper, speed 30
delay(600); // Delay 600 milliseconds, wait for the gripper to fully close before executing the next step
}
```

arduino API

Overall status of the robot

1.1 `powerOn();`

- Function: Power on the robot, and the robot can be controlled only after powering on
- Return value: None

1.2 `powerOff();`

- Function: Power off the robot
- Return value: None

1.3 `isPoweredOn();`

- Function: Atom status query, return atom connection status
- Return value: TRUE for open, FALSE for close

1.4 `getAtomVersion();`

- Function: Get the Atom firmware version
- Return value: int type value, data needs /10, for example, the version number read is 12, the actual number needs to be divided by 10, and the final version number is 1.2

1.5 `setFreeMoveMode(bool mode);`

- Function: Set the free movement mode. After the free movement mode is turned on, the end LED is yellow. Long press the end atom to manually move the robot

Parameter description:

- mode: mode, 0/1, 0--turn off free movement, 1--turn on free movement
- Return value: None

Input program control mode MDI Mode and Robot Control (Manual Data Input)

2.1 `getAngles();`

- Function: Read all joint angles. When using, you should define an Angles angles to receive the read angles. Angles is a built-in variable or function definition of the library function. You can define a storage space angles with a memory of 6 to store angle variables. The method of use is the same as that of an array.
- Return value: Angles type array

2.2 `writeAngle(int joint, float value, int speed);`

- Function: Send single joint angle
- Parameter description: Joint number = joint, value range 1-6; Specified angle value = value, value range about -170°- +170°; Specified speed = speed, value range 1-100;
- Return value: None

2.3 `writeAngles(Angles angles, int speed);`

- Function: Joint angles are executed synchronously, and the angles of six joints are sent to the actuator at the same time. Angles is the definition type declared by the library function. It specifies that angles is a container with a capacity of 6 data, which can be understood as an array. When assigning values, you can use for loop assignment or assign values individually.
- Parameter description: Angles[0] = specific angle, Angles[2] = specific angle, and so on. The value range is 0-90 (the range is defined, and the value range should be the same as writeAngle) Unit: degree Symbol: ° Movement speed = speed, value range 1-100 Unit %
- Return value: None

2.4 `getCoords();`

- Function: Read the x, y, z, rx, ry, rz of the current robot end. When using, a Coords tempcoords should be defined to receive the read angle. Coords is a built-in variable or function definition of the library function. You can define a storage space tempcoords with a memory of 6 to store angle variables. The method of use is the same as that of an array.
- Return value: an array of Coords type, you need to define the variable of Coords type

2.5 `writeCoord(Axis axis, float value, int speed);`

- Function: send the specific value of the individual coordinate parameters X/ Y/ Z/ RX/ RY/ RZ, the end will move in a single direction,
- Parameter description: Moving path coordinate value = value value range -300-300 (axis=Axis::X, aixs=Axis::Y and axis=Axis::Z are position coordinates X, Y, Z respectively, unit mm, position coordinate value range is not uniform, axis=Axis::RX, aixs=Axis::RY and axis=Axis::RZ are RX, RY, RZ respectively, value range is -180°-180°, if it exceeds the value range, it will return the prompt of inverse kinematics no solution) Specified speed = speed value range 1-100 Unit %
- Return value: None

2.6 `writeCoords(Coords coords, int speed);`

- Function: Send the specified coordinate parameter. The parameter type should be Coords. You need to declare a variable of type Coords. The usage of this variable is the same as that of an array.
- Parameter description: coords[0] = X, coords[1] = Y, coords[2] = Z, X,Y,Z value range -300.00-300.00 (the value range is undefined. If it exceeds the range, the prompt "inverse kinematics no solution" will be returned) Unit mm coords[3] = RX, coords[4] = RY, coords[5] = RZ, RX,RY,RZ value range -180-180 Specified speed = speed value range 1-100 Unit %
- Return value: None

2.7 `checkRunning();`

- Function: Check if the device is moving
- Return value: Return TRUE if it is moving, otherwise return FALSE

2.8 `setEncoder(int joint, int encoder);`

- Function: Set a single joint to rotate to a specified potential value
- Parameter description: Joint number = joint value range 1-7 (No. 7 joint is generally a gripper, and the gripper potential value range is: 1325-2048); Servo potential value = encoder value range 0-4096 (this range should be positively correlated with the range of each joint)

- Return value: None

2.9 `getEncoder(int joint);`

- Function: Get the specified joint potential value
- Parameter description: Servo number = joint value range 1-7
- Return value: int type, reference value range 0-4096

2.10 `setEncoders(Angles angleEncoders, int speed);`

- Function: Set the six joints of the robot arm to execute synchronously to the specified position
- Parameter description: It is necessary to define a variable angleEncoders of the Angles type. The use of angleEncoders is equivalent to an array. Assign values to the array angleEncoders, with a value range of 0-4096 (the range should be positively correlated with the range of each joint). The length range of the array is 6. Specify speed = speed, with a value range of 1-100 units %
- Return value: None

2.11 `getEncoders();`

- Function: Get all joint potential values
- Return value: Angles type array, reference value range 0-4096

2.12 `getServoSpeeds();`

- Function: Get all servo speeds
- Return value: Angles type array, the speed is 0 when not moving

JOG Mode

3.1 `jogAngle(int joint, int direction, int speed);`

- Function: Control a single joint of the device to move in one direction
- Parameter description: Joint servo number = joint Value range 1-6 Joint movement direction = Direction Value range -1/1 Specified speed = speed, value range 1-100 unit %
- Return value: None

3.2 `jogCoord(Axis axis, int direction, int speed);`

- Function: Control the device to move in one direction in Cartesian space
- Parameter description: Device direction selection = axis Value X,Y,Z,RX,RY,RZ Joint movement direction = Direction Value -1/1 Specified speed = speed, value range 1-100 unit %
- Return value: None

3.3 `jogStop();`

- Function: Stop the movement in the specified direction that has already started
- Return value: None

3.4 `ProgramPause();`

- Function: Pause the program

- Return value: None

3.5 `ProgramResume();`

- Function: Resume the program
- Return value: None

3.6 `TaskStop();`

- Function: Stop the program
- Return value: None

Running auxiliary information Running Status and Settings

4.1 `getSpeed();`

- Function: Read the current running speed of the device
- Return value: int type, value range 1-100, unit %

4.2 `setSpeed(int percentage);`

- Function: Set the running speed of the device
- Parameter description: percentage value range 1-100, unit %

4.3 `getJointMin(int joint);`

- Function: Read the minimum limit angle of the joint
- Parameter description: Joint servo number = joint, value range 1-6
- Return value: float type value

4.4 `getJointMax(int joint);`

- Function: Read the maximum limit angle of the joint
- Parameter description: Joint servo number = joint, value range 1-6
- Return value: float type value

4.5 `setMovementType(MovementType movement_type);`

- Function: Set the movement mode
- Parameter description: The movement modes are nonlinear path movement (movej) and linear path movement (movel)
- Return value: None

4.6 `getMovementType();`

- Function: Read the movement mode
- Return value: Nonlinear mode returns 0; linear mode returns 1

Joint motor settings Joint Servo Control

5.1 `isServoEnabled(int joint);`

- Function: Check the connection status of a single joint
- Parameter description: Joint servo number = joint, value range 1-6
- Return value: connection status, 0/1, 1--connected, 0--unconnected

5.2 `isAllServoEnabled();`

- Function: Detect the connection status of all joints
- Return value: connection status, 0/1, 1--connected, 0--unconnected

5.3 `getServoData(int joint, byte data_id);`

- Function: Read servo system parameters
- Parameter description: Joint servo number = joint, value range 1-6; Data address = data_id, please refer to the address in the figure below for the value range
- Return value: The value range in Figure 1.1 below

Address	Function	Range of values	Initial value	Explanation of values
20	LED alarm conditions	0-254	0	Corresponding bit setting 1 to turn on the flashing light alarm Corresponding bit setting 0 to turn off the flashing light alarm
21	Position loop P scale factor	0-254	123 Joints take value 8, 456 take value 5.	Proportionality factor of control motor
22	Position loop D differentiation factor	0-254	123 Joints take value 20, 456 take value 13.	Differential coefficient of control motor
23	Position loop I integration factor	0-254	0	Integral coefficient of the control motor
24	Minimum start-up force	0-1000	0	Set the minimum output starting torque of the servo, set 1000 = 100% * Plugging torque

5.4 `setServoData(int joint, byte data_id, byte data);`

- Function: Set servo system parameters
- Parameter description: Joint servo number = joint, value range 1-6 Data address = data_id, value range please refer to the address in the figure above Data = value range in the figure above
- Return value: None

5.5 `setServoCalibration(int joint);`

- Function: Joint zero position calibration, corresponding potential value is 2048
- Parameter description: Joint servo number = joint, value range 1-6

5.6 `releaseServo(byte servo_no);`

- Function: Relax/disable a joint of the robot

- Parameter description: servo_no is 1-6
- Return value: None

5.7 `focusServo(byte servo_no);`

- Function: Enable a joint of the robot
- Parameter description: servo_no is 1-6
- Return value: None

5.8 `getServoVoltages();`

- Function: Get all servo voltages
- Return value: Angles type array, reference value range 8.4-12.0

5.9 `getServoStatus();`

- Function：Get all servo status
- Return value: 0 means everything is normal; 1 means voltage overvoltage/undervoltage; 2 means magnetic encoding status is abnormal; 4 means temperature overheating; 8 means current overcurrent; 32 means load overload; when the number is not equal to the above abnormal number, for example: 3 means voltage overvoltage/undervoltage and magnetic encoding status is abnormal, 7 means voltage overvoltage/undervoltage, magnetic encoding status is abnormal and temperature is overheating

5.10 `getServoTemps();`

- Function: Get all servo temperatures
- Return value: Angles type array, reference value range 0-255

Atom terminal IO control Atom IO Control

6.1 `setPinMode(byte pin_no, byte pin_mode);`

- Function: Set the state mode of the atom specified pin
- Parameter description: Pin number = `pin_no` Value range: 19, 22, 23, 26, 32, 33 Output mode = `pin_mode` Value range: 0, 1
- Return value: None

6.2 `setLEDRGB(byte r, byte g, byte b);`

- Function: Set the color of the RGB light of the atom screen:
- Parameter description: Parameter value corresponding to red light = r, value range 0x00-0xFF; Parameter value corresponding to green light = g, value range 0x00-0xFF; Parameter value corresponding to blue light = b, value range 0x00-0xFF;
- Return value: None

6.3 `setGripperState(byte mode, int sp);`

- Function: Set the gripper opening and closing state
- Parameter description:

- mode, gripper opening and closing mode, range 0/1, 0--gripper opens to the maximum, 1--gripper closes to the minimum
- sp, gripper opening and closing speed, range 1-100

6.4 `setGripperValue(int data, int sp);`

- Function: Set the gripper opening and closing angle
- Parameter description:
- data, gripper opening and closing angle, range 0-100, 0--close to the minimum angle, 100--open to the maximum angle
- sp, gripper opening and closing speed, range 1-100
- Return value: None

6.5 `setGripperIni();`

- Function: Set the gripper zero point
- Return value: None

6.6 `getGripperValue();`

- Function: Get the current gripper angle
- Return value: Return the current gripper angle, range 0-100

6.7 `isGripperMoving();`

- Function: Detect whether the gripper is moving
- Return value: 0 not moving, 1 moving

6.8 `void setEletricGripper(bool mode);`

- Note: This interface is only available for MyCobot320 robot
- Function: Control the opening and closing of the electric gripper
- Parameter description:
- mode: mode, 0/1, 0--the gripper opens to the maximum, 1--the gripper closes to the minimum
- Return value: None

6.9 `void InitEletricGripper();`

- Note: This interface is only available for MyCobot320 robot
- Function: Initialize the opening and closing of the electric gripper. Each time the electric gripper is plugged in, it needs to be initialized before it can be controlled. After successful initialization, the gripper will open and close once
- Return value: None

6.10 `void setGripperMode(bool mode);`

- Note: This interface is only available for MyCobot320 robot
- Function: Set the adaptive gripper control mode
- Parameter description:

- mode: mode, 0/1, 0--485 communication control, 1--io control (in io mode, it can only be turned on or off, and the angle cannot be set. When turning on or off, pins 23 and 33 need to be set to different states, one high and one low)
- Return value: None

6.11 `bool getGripperMode();`

- Note: This interface is only available for MyCobot320 robots
- Function: Set the adaptive gripper control mode
- Return value: Adaptive gripper control mode, 0/1, 0--485 communication control, 1--io control

6.12 `setDigitalOutput(byte pin_no, byte pin_state);`

- Function: Set the working state of the IO pin
- Parameter description: 0 input; 1 output; 2 `pull_up_input`
- Return value: None

6.13 `getDitialInput(byte pin_no);`

- Function: Read input
- Parameter description: Pin number = pin_no Value range: 19, 22, 23, 26, 32, 33
- Return value: None

6.14 `setPWMOutput(byte pin_no, int freq, byte pin_write);`

- Function: Set the ATOM terminal IO to output a PWM signal with a specified duty cycle
- Parameter description:
- pin_no: IO number
- freq: clock frequency
- pin_write: Duty cycle 0-256; 128 means 50%
- Return value: None

Coordinate control mode

7.1 `setToolReference(Coords coords);`

- Function: Set tool coordinate system
- Parameter description: X, Y, Z value range -300.00-300.00 (the value range is undefined, and it will be returned if it exceeds the range inverse kinematics no solution prompt) Unit mm RX,RY,RZ value range -180.00-180.00
- Return value: None

7.2 `setWorldReference(Coords coords);`

- Function: Set the world coordinate system

- Parameter description: X,Y,Z value range -300.00-300.00 (the value range is not defined, and the inverse kinematics no solution prompt will be returned if it exceeds the range) Unit mm RX,RY,RZ value range -180.00-180.00
- Return value: None

7.3 `getToolReference();`

- Function: Get the tool coordinate system
- Return value: X,Y,Z value range -300.00-300.00 (the value range is not defined, and the inverse kinematics no solution prompt will be returned if it exceeds the range) Tip) Unit mm RX,RY,RZ Value range -180.00-180.00

7.4 `getWorldReference();`

- Function: Get the world coordinate system
- Return value: X,Y,Z Value range -300.00-300.00 (the value range is undefined, and the inverse kinematics no solution prompt will be returned if it exceeds the range) Unit mm RX,RY,RZ Value range -180.00-180.00

7.5 `setReferenceFrame(RFType rftype);`

- Function: Set the flange coordinate system
- Parameter description:

  RFType::BASE is to use the robot base as the base coordinate, and RFType::WORLD is to use the world coordinate system as the base coordinate.
- Return value: None

7.6 `getReferenceFrame();`

- Function: Get flange coordinate system
- Return value: X,Y,Z range -300.00-300.00 (the range is undefined, and the inverse kinematics no solution prompt will be returned if it exceeds the range) Unit mm RX,RY,RZ range -180.00-180.00

7.7 `setEndType(EndType end_type);`

- Function: Set the end coordinate system
- Parameter description: EndType::FLANGE is to set the end to flange, EndType::TOOL is to set the end to tool end.
- Return value: None

7.8 `getEndType();`

- Function: Get the end coordinate system
- Return value: X,Y,Z range -300.00-300.00 (the range is undefined, and the inverse kinematics no solution prompt will be returned if it exceeds the range) Unit mm RX,RY,RZ range -180.00-180.00

JavaScript

JavaScript is a scripting language that runs on the client; it does not require compilation, and is interpreted and executed one by one by the js interpreter during operation.

What is JavaScript?

JavaScript is a dynamic computer programming language. It is lightweight and most commonly used as part of a web page, and its implementation allows client-side scripts to interact with users and generate dynamic pages. It is an interpreted programming language with object-oriented capabilities.

JavaScript is a very famous programming language that was originally started twenty years ago with the motivation of making web pages lively. It is also an important part of the skillset of web developers.

The JavaScript scripting language does not depend on the operating system and only requires browser support. Therefore, a JavaScript script can be brought to any machine after it is written, provided that the browser on the machine supports the JavaScript scripting language, which is supported by most browsers.

JavaScript is easy to learn but difficult to master and is used for a variety of purposes, from simply enhancing website functionality to running cool games and web-based software.

Applicable devices:

- myCobot 280
- **myCobot 280 M5**
- myCobot 280 for Arduino

Prerequisites:

- **M5** series version, **M5Stack-basic** burn **miniRobot** at the bottom, select **Transponder** function, **ATOM** burn the latest version of **atomMain** at the end (factory default burned)

Programming development

Development environment

- **Node**

- **Windows Node**

- **MacOs Node**

- **Linux Node**

Usage prerequisites:

- Burn the latest version of atomMain in Atom.
- Burn minirobot in Basic, select the transponder function. The Pi series does not need to burn Basic.

JavaScript Development Guide

You can use JavaScript to develop our robot arm according to the following guidelines

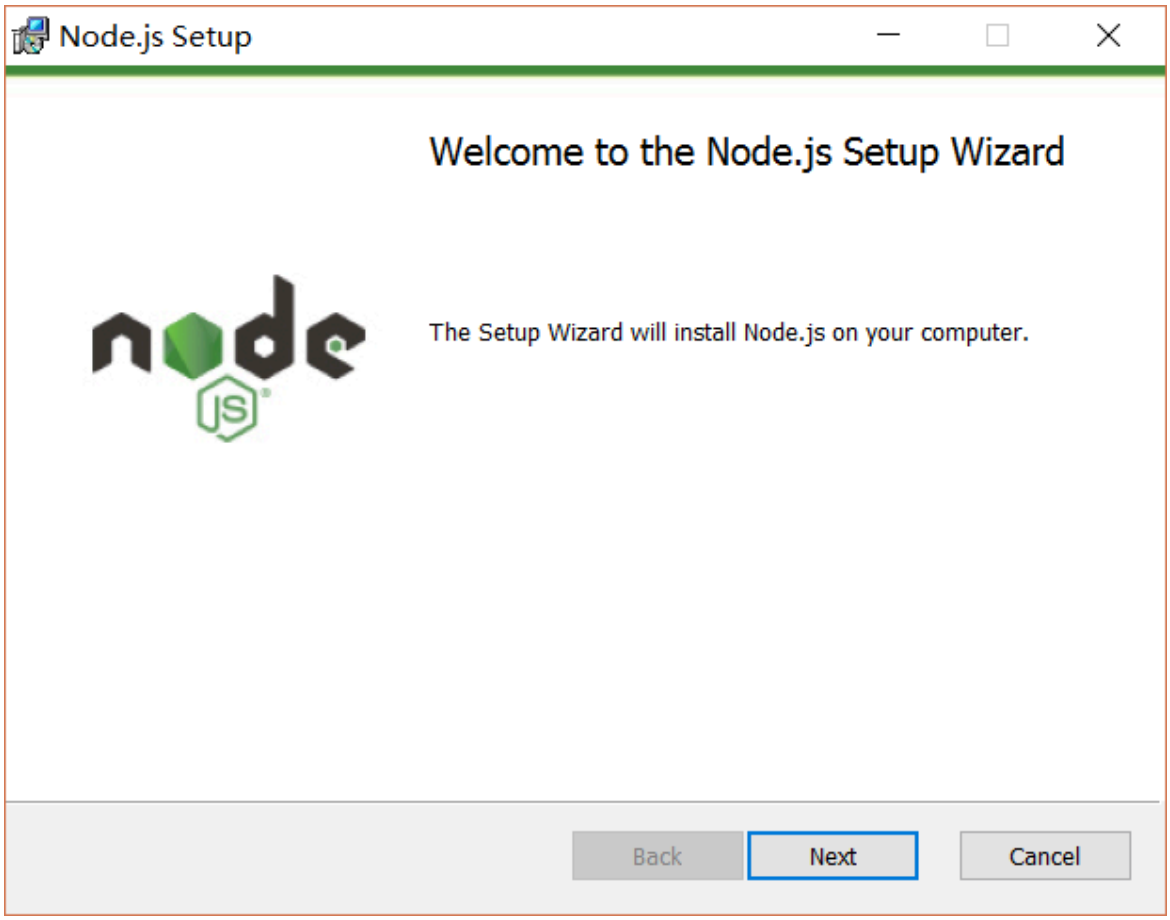
1. Preparation before development
2. Preparation for development
3. IO control
4. Joint control
5. Gripper control
6. What is js
7. Use cases
8. API description

Preparation before development

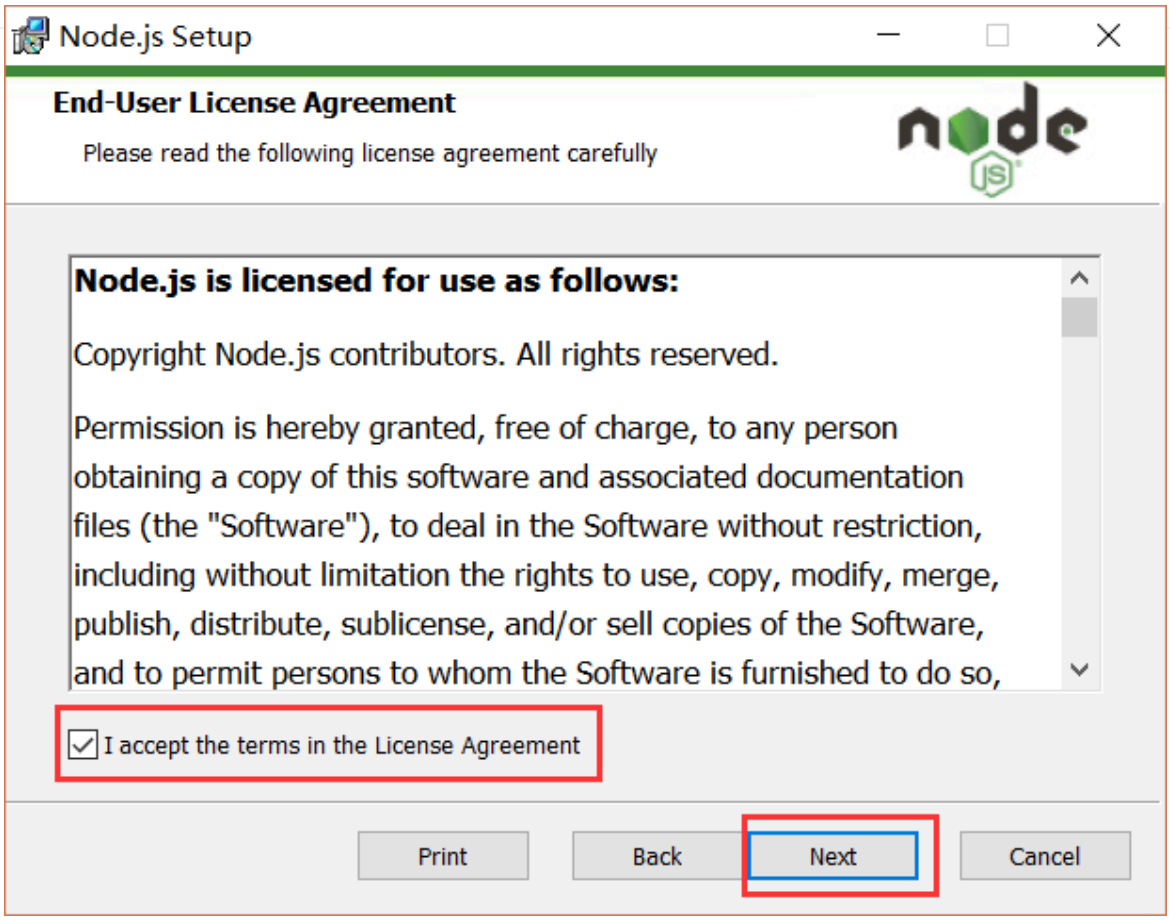
`Node environment setup` Windows 32-bit download address Windows 64-bit download address MacOS download address

Windows Node environment setup

First step After the download is complete, double-click the downloaded installation package to start installing Node.js, and click the next button

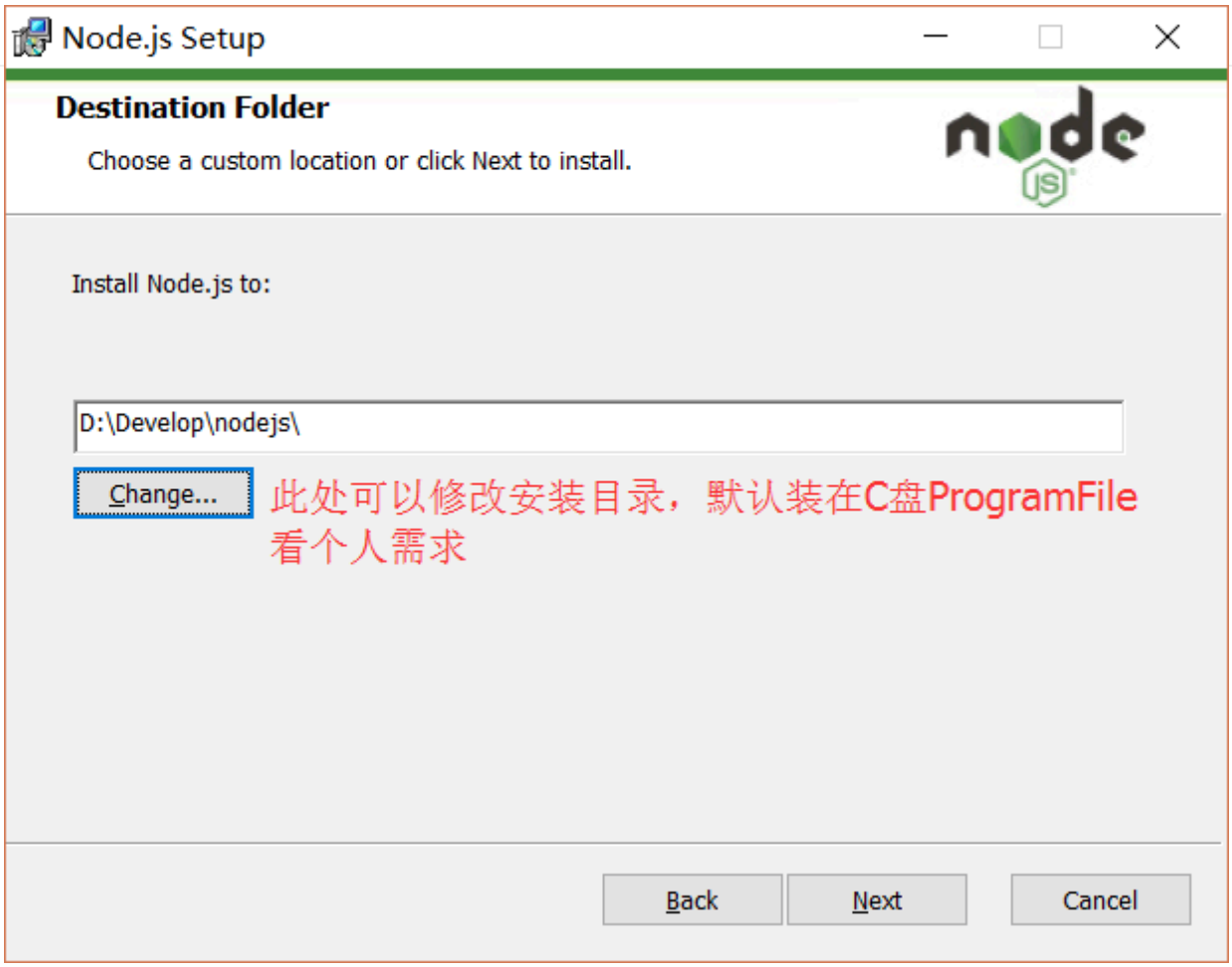


Step 2 Check the option in the red box on the lower left, and then click next

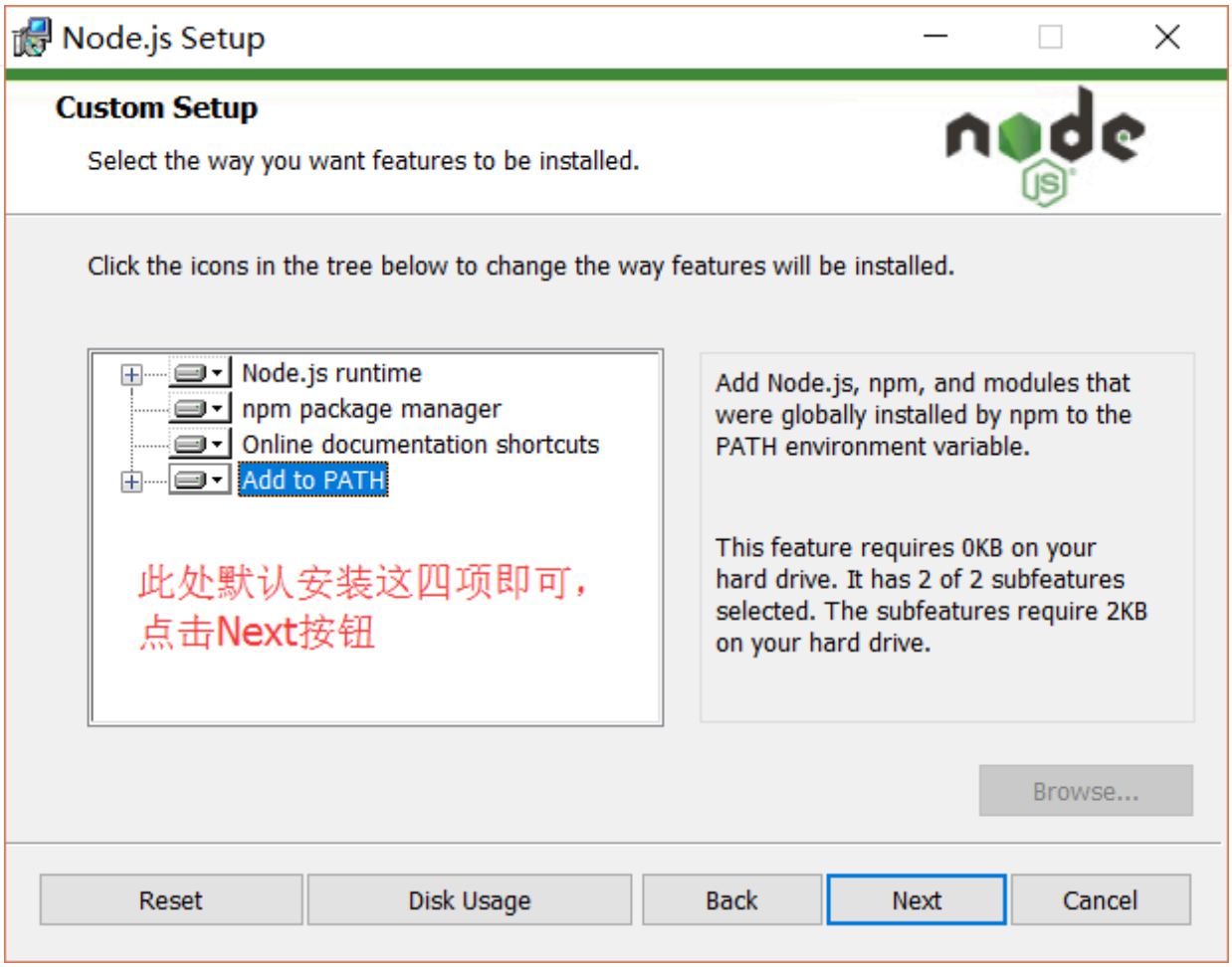


Step 3 Customize the installation directory

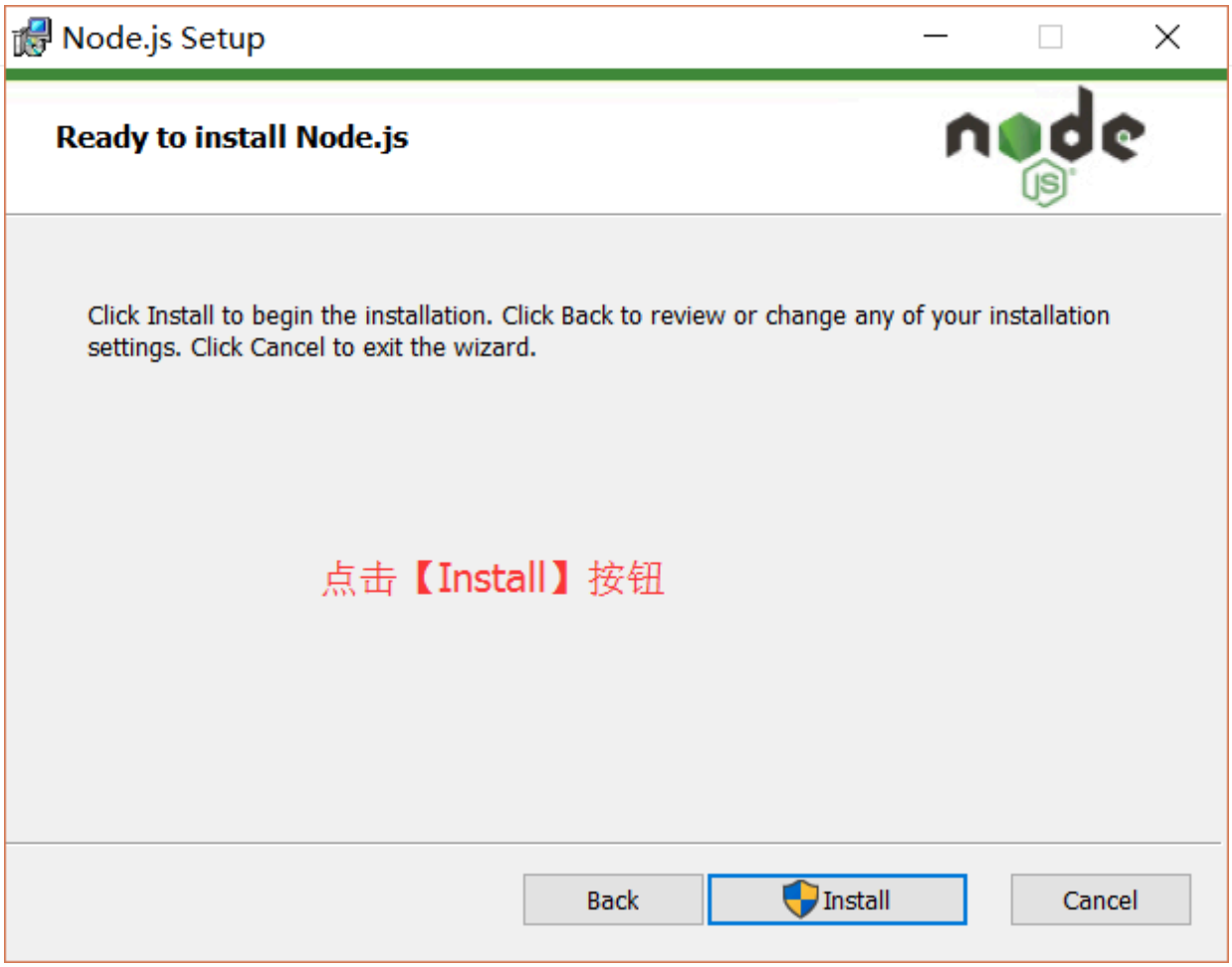
You can modify the installation directory here. By default, it is installed in the ProgramFile folder of the C drive. You can modify it according to your personal needs.



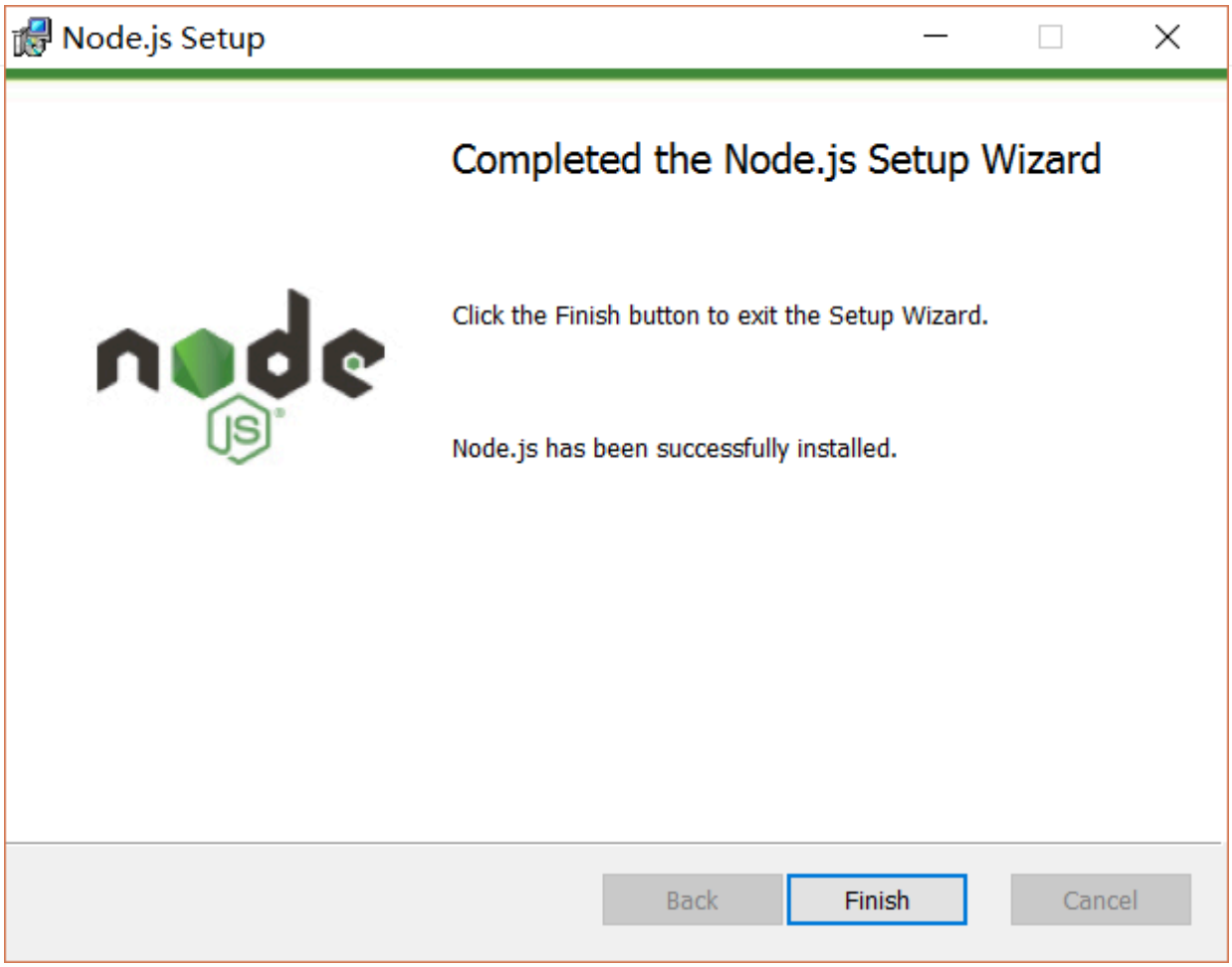
Step 4 By default, click the next button to continue to the next step.Here are the four items installed by default



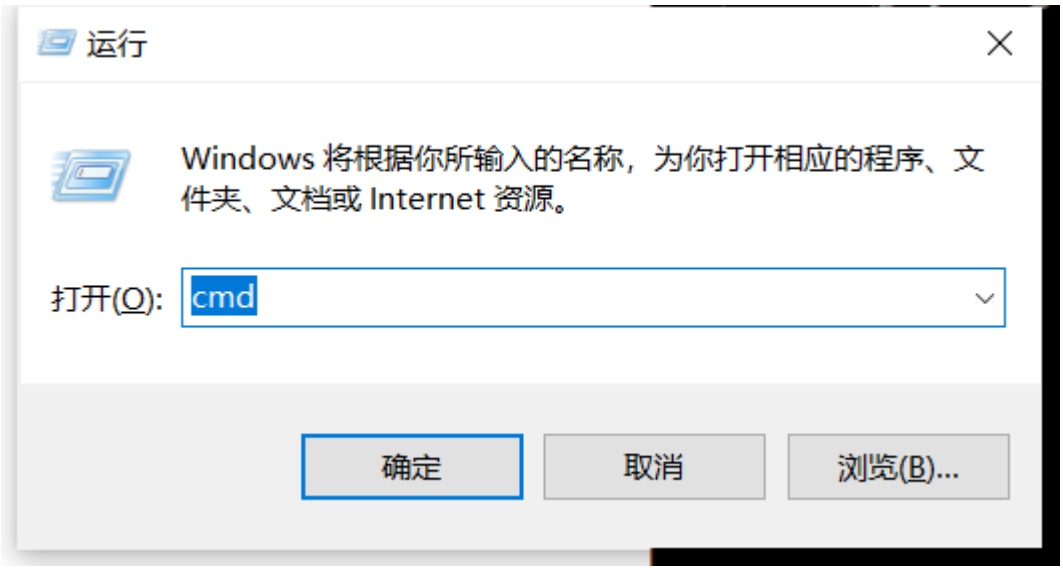
Step 5 Click install



Step 6 Click finsh to complete the installation

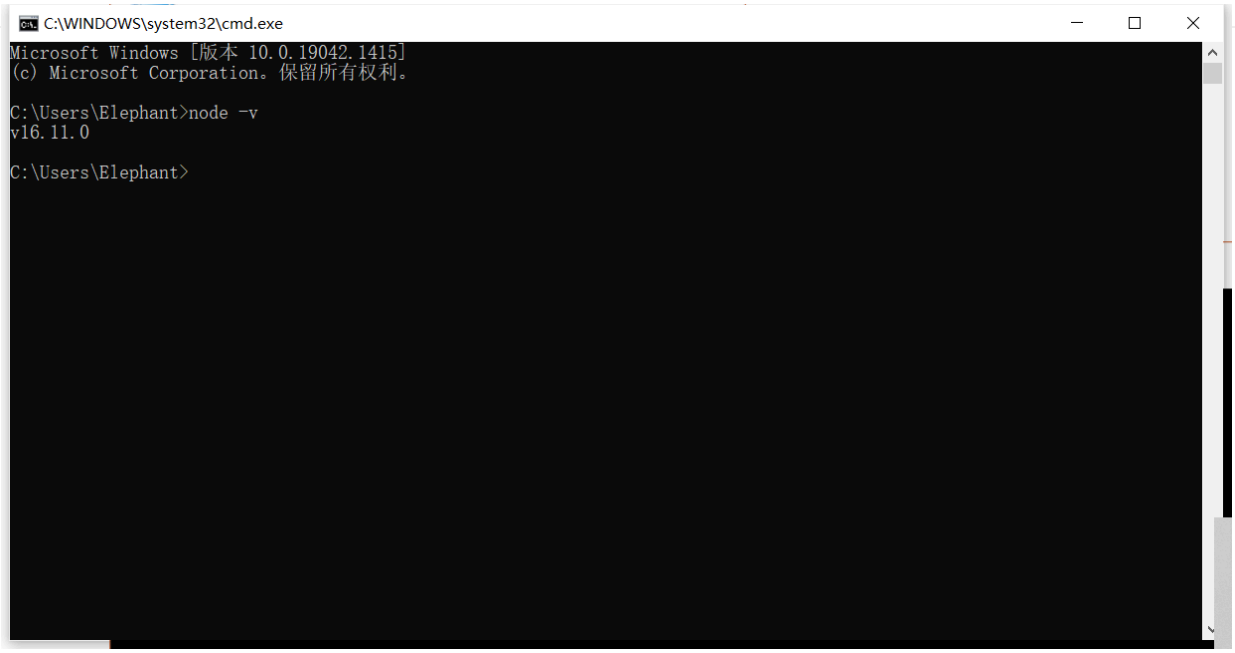


Step 7 Press win+r to open the run command and enter cmd to enter the command prompt



Step 8 Enter

node -v gets the node version. If the version is displayed, the installation is successful.



2 MacOs node environment setup

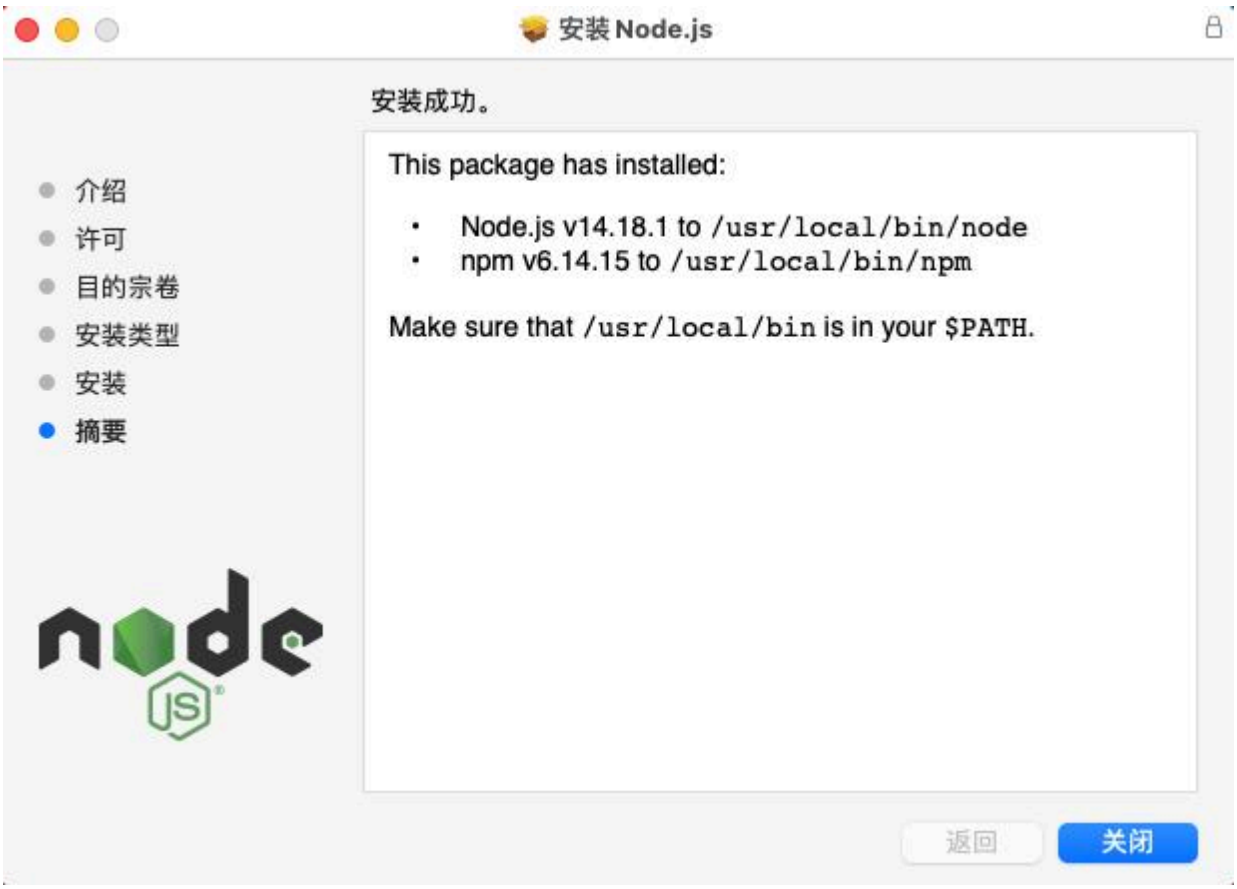
Step 1 After downloading, double-click the downloaded installation package to start installing Node.js, click the next button, and click Continue

Step 2 Click Continue again

Step 3 Click Agree Continue to the next step

Step 4 Click Customize and select the installation address, or click Install to continue the installation and enter your password to install

Step 5 Click Close when prompted that the installation is successful to exit the installation program



Right-click the desktop and select the check-in terminal. Enter the terminal and enter node -v, displaying the node version number indicates successful installation

3 Linux node environment setup

The first step is that the Node official website has changed the Linux download version to a compiled version. We can directly download and decompress it for use:

```
# wget https://nodejs.org/dist/v10.9.0/node-v10.9.0-linux-x64.tar.xz // Download
# tar xf node-v10.9.0-linux-x64.tar.xz // Decompress
# cd node-v10.9.0-linux-x64/ // Enter the decompression directory
# ./bin/node -v // Execute the node command to view the version
v10.9.0
```

The second step is to decompress the bin of the file The directory contains commands such as node and npm. We can use the ln command to set up soft links:

```
ln -s /usr/software/nodejs/bin/npm /usr/local/bin/
ln -s /usr/software/nodejs/bin/node /usr/local/bin/
```

4 Install Node.js from source code in Ubuntu

> Step 1 In the following section, we will introduce how to install Node.js from source code in Ubuntu Linux. Other Linux systems, such as Centos, have similar installation steps as follows. Get the Node.js source code from Github:
>
> ```
> $ sudo git clone https://github.com/nodejs/node.git
> Cloning into 'node'...
> ```
>
> Step 2 Modify directory permissions
>
> ```
> $ sudo chmod -R 755 node
> ```
>
> Step 3 Use ./configure to create a compilation file and enter the instructions in the following order:
>
> ```
> $ cd node
> $ sudo ./configure
> $ sudo make
> $ sudo make install
> ```
>
> Step 4 Check the node version:
>
> ```
> $ node --version
> v0.10.25
> ```

Download the project file

> Open the command prompt

```
git clone https://github.com/elephantrobotics/jsmycobot.git
```

Initialize the development program

> Note: Open the command prompt in the downloaded project file

```
<!-- Initialize the program and install all the plug-ins required to run the program -->
npm i
```

Initialize the program

```
<!-- Import the plug-ins installed in step 1-1 -->
const mycobot = require("mycobot")

<!-- Initialize the program, mycobot.connect(serial port number, serial port baud rate) -->
const obj = mycobot.connect("COM15",115200)

<!-- Write the first instruction, power on the robot and keep the current robot posture -->
obj.write(mycobot.powerOn())
```

IO control

The main function of this JavaScript code is to initialize a robot connected to a port and perform some initial settings for it. Specifically, the code uses the mycobot library to control the robot and performs the following operations:

Connect the robot: Connect to the robot by specifying the serial port (COM15) and baud rate (115200).

Set the color of the robot's indicator light: Set the color of the indicator light by specifying three color values (125, 11, 9) for red, green, and blue.

Initialize the position of the robot: Set the current angle and coordinates of the robot as the starting point of the robot's operation.

```
<!-- Initialization program -->
const mycobot = require('mycobot')

const obj = mycobot.connect('COM15',115200)

<!-- Set the ATOM indicator color mycobot.setColor(redValue,greenValue,blueValue)-->
<!-- Note: The three parameters are limited to 0~255 -->
obj.write(mycobot.setColor(125,11,9))

<!-- Set the current robot arm angle and coordinates to the robot arm operation starting point -->
obj.write(mycobot.setGripperInit())
```

Single joint control

```
<!-- Initialization program -->
const mycobot = require('mycobot')

const obj = mycobot.connect('COM15',115200)

<!-- Set the angle of a single robot arm mycobot.sendAngle(robot arm ID, angle value, speed of the robot arm when adjustin
<!-- Note: When setting the value of changing the angle, you need to pay attention to the number of robot arm joints. If t
<!-- For details on the angle setting of the four-axis and six-axis robot arms, please refer to Figure 1-3 -->
obj.write(mycobot.sendAngle(1,110,10))

<!-- Set the coordinates of a single robot arm mycobot.sendCoord(robot ID, coordinate value, movement speed of the robot w
obj.write(mycobot.sendCoord(1,20,10))
```

Multi-joint control

Note: When operating multiple joints, fill in the corresponding number of parameters according to the number of joints of the robot

```
<!-- Initialization program -->
const mycobot = require('mycobot')

const obj = mycobot.connect('COM15',115200)

<!-- Set the multi-joint robot angle mycobot.sendAngles([joint 1 angle, joint 2 angle, joint 3 angle, joint 4 angle, joint
obj.write(mycobot.sendAngles([-110,23,-22,110],20))

<!-- Set the coordinates of the multi-joint robot arm mycobot.sendCoords([joint 1 coordinate, joint 2 coordinate, joint 3
obj.write(mycobot.sendCoords([22.5,12,-22,45],20))
```

Four-axis and six-axis robot arm angle coordinate parameter standard

- Four-axis

Joint ID	Limit
1	-160~160
2	0~90
3	-90~45
4	Unlimited value

- Six-axis

Joint ID	Limit
1	-170~170
2	-170~170
3	-170~170
4	-170~170
5	-170~170
6	Infinite value

Gripper control

The main function of this JavaScript code is to initialize a robot arm connection through the mycobot library and set the switch state and angle value of the robot arm gripper. Specifically, the code implements the following operations:

Connect the robot arm: connect to the robot arm by specifying the serial port (COM15) and baud rate (115200).

Set the switch state of the robot arm gripper: control the opening and closing of the gripper by specifying the switch state (0 for open, 1 for closed) and the operating speed (ranging from 0 to 100).

Set the angle value of the robot arm gripper: control the angle and movement speed of the gripper by specifying the angle value and speed (both ranging from 0 to 100).

```
<!-- Initialization program -->
const mycobot = require('mycobot')

const obj = mycobot.connect('COM15',115200)

<!-- Set the switch state of the gripper mycobot.setGripperState(switch state, operation speed)-->
<!-- Note: switch state reference value: 0 is open, 1 is closed, and the operation speed limit is 0~100 -->
obj.write(mycobot.setGripperState(0,10))

<!-- Set the angle value of the gripper mycobot.setGripperValue(angle value, speed)-->
<!-- Note: the angle value and speed value limit are 0~100 -->
obj.write(mycobot.setGripperValue(80,20)))
```

What is js

The original purpose of the birth of javascript was to "give life to web pages".

We call this programming language scripts. They can be written in HTML and automatically executed when the page is loaded.

Scripts exist and execute as plain text. They do not require special preparation or compilation to run.

What can JavaScript do in the browser?

Modern JavaScript is a "safe" language. It does not provide low-level access to memory or CPU because it was originally created for browsers and does not need these features. JavaScript's capabilities depend largely on the environment in which it is executed. For example: Node.js allows JavaScript to read and write arbitrary files, perform network requests, etc. JavaScript in the browser can do everything related to web page operations, user interaction, and web servers. For example, JavaScript in the browser can do the following:

- Insert new HTML into the web page, modify the existing web page content and the style of the web page.
- Respond to user behavior, respond to mouse clicks or movements, keyboard taps.
- Send network requests to remote servers to download or upload files (so-called AJAX and COMET technologies).
- Get or modify cookies, ask questions to visitors, send messages.
- Remember client data (local storage).

What can't JavaScript do in the browser?

For the sake of user security, the capabilities of JavaScript in the browser are limited. This is mainly to prevent evil websites from obtaining or modifying users' private data.

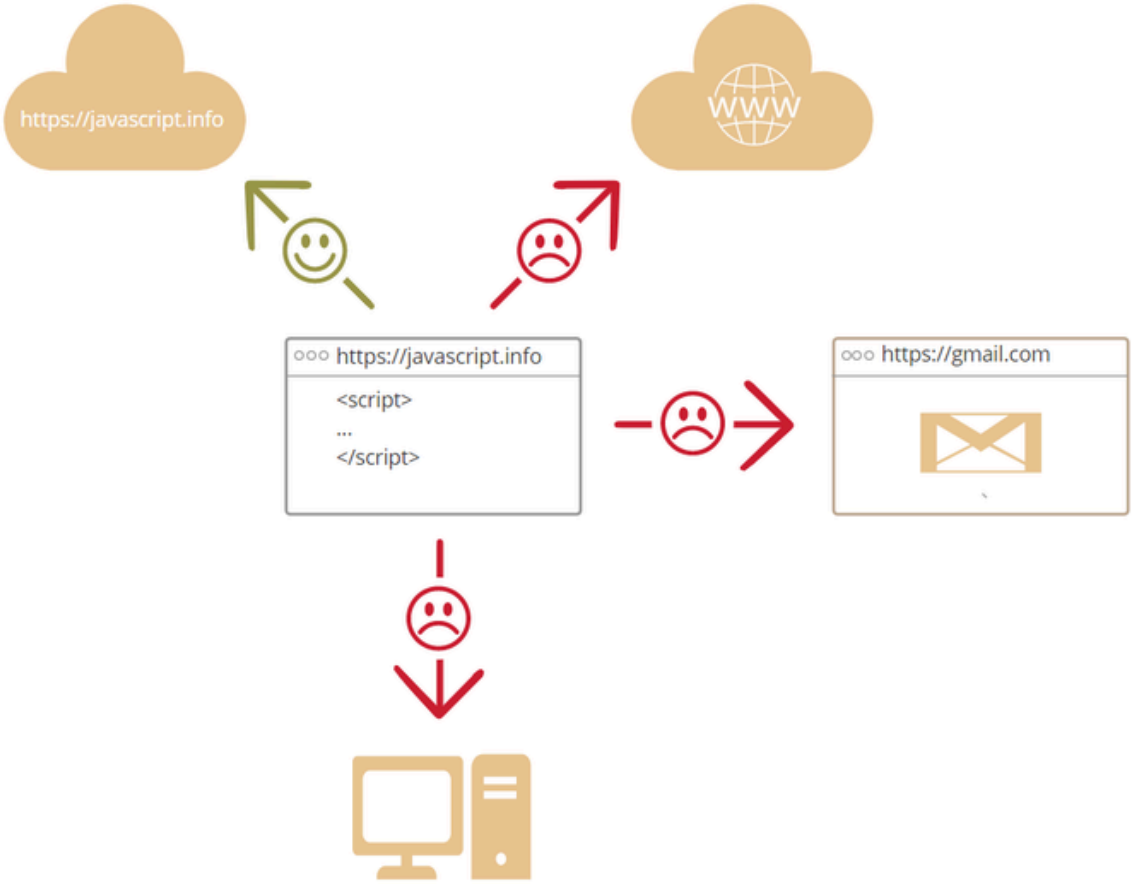
Examples of these limitations are:

- JavaScript in a web page cannot read, write, copy or execute files or programs on the user's disk. It has no direct access to the operating system.

Modern browsers allow JavaScript to do some file-related operations, but these operations are limited. JavaScript can only operate on the file if the user uses a certain action.

For example, "dragging" a file into the browser, or selecting a file through an input tag. JavaScript has many ways to interact with the camera/microphone or other devices, but these require the user's permission in advance. So, a web page with JavaScript enabled should not secretly start the webcam to observe you and send your information to the NSA.

- Different browser tabs are basically unrelated to each other. Sometimes, there are some relationships. For example, a tab opens another new tab via JavaScript. But even in this case, if the two tabs are not opened on the same website (domain, protocol or port), they cannot communicate with each other. This is the "same-origin policy". In order to solve the "same-origin policy" problem, both tabs must contain some special JavaScript code that handles this problem and allows data exchange, so that data exchange between two tabs of the same origin can be achieved.
- JavaScript can easily communicate with the server of the current web page domain through the Internet. But the ability to obtain data from servers of other websites/domains is limited. Although this can be achieved, it requires an explicit agreement from the remote server (in the HTTP header). This is also for the safety of user data.



What makes javascript special

- Full integration with HTML/CSS.
- Use simple tools to complete simple tasks.
- Supported by all major browsers and enabled by default.

The only browser technology that meets all three of these criteria is JavaScript.

This is why JavaScript is special! This is also why it is the most common tool for creating browser interfaces.

In addition, JavaScript also supports the creation of servers, mobile applications, etc.

Case 1

The main function of this JavaScript program is to initialize the connection of a robot arm and perform different operations according to different types of robot arms (four-axis or six-axis). Specifically, it sets the joint angles of the robot arm and makes some adjustments to the color of the indicator light. This program can achieve basic control and status monitoring of the robot arm.

```
<!-- Initialization program -->
const mycobot = require('mycobot')
const obj = mycobot.connect('COM15',115200)

<!-- Assume that the connected device is a four-axis robot -->
const name = "myPallizer"
<!-- If the connected device is a six-axis robot -->
if(name == "myCobot"){
<!-- Set the angles of the six joints -->
obj.write(mycobot.sendAngles([-1.49,115,-153.45,30,-33.42,137.9],80))
<!-- And determine whether the coordinate has been reached -->
if(obj.write(mycobot.isInPosition([-1.49,115,-153.45,30,-33.42,137.9],0)) == 1){
<!-- Resume robot arm movement -->
obj.write(mycobot.programResume())
<!-- Wait for 0.5 seconds -->
settimeout(() =>{
<!-- Pause robot arm movement -->
obj.write(mycobot.programPause())
},500)
}
}else{
<!-- Set the angles of the four joints -->
obj.write(mycobot.sendAngles([-1.49,45,-23,30],80))
<!-- Set the color of the ATOM indicator -->
obj.write(mycobot.setColor(0,0,50))
<!-- Wait for 0.7 seconds -->
settimeout(() =>{
<!-- Set the angles of the four joints again -->
obj.write(mycobot.sendAngles([-1.49,60,11,30],80))
<!-- Set the color of the ATOM indicator -->
obj.write(mycobot.setColor(0,50,0))
},700)

}
```

Case 2

Case 2 The main function of this code is to initialize a robot arm and perform a series of operations through the mycobot library, including:

- Get and output the current joint angle.
- Set the initial angle of all joints.
- Set the angle of each joint step by step.

- Finally, set the robot arm to free mode. Through these steps, precise control and status monitoring of the robot arm can be achieved

```
<!-- Initialization program -->
const mycobot = require('mycobot')
const obj = mycobot.connect('COM15',115200)

<!-- Get the angles of all joints -->
const botData = obj.write(mycobot.getAngles())
<!-- Output the angles of all joints -->
console.log(botdata)
<!-- Set the angles of all joints -->
obj.write(mycobot.sendAngles([0,0,0,0],50))
<!-- Print whether the robot arm has reached this position -->
console.log(obj.write(mycobot.isInPosition([0,0,0,0,0,0],0)) == 1)

<!-- Wait for 3 seconds -->
settimeout(() =>{
<!-- Set the angle of the first joint -->
obj.write(mycobot.sendAngle(1,90,50))
},3000)

<!-- Wait for two seconds -->
settimeout(() =>{
<!-- Set the angle of joint 2 to 50 degrees -->
obj.write(mycobot.sendAngle(2,50,50))
},2000)
<!-- Wait for 1.5 seconds -->
settimeout(() =>{
<!-- Set the three joint angles to 50 degrees -->
obj.write(mycobot.sendAngle(3,-50,50))
},1500)
<!-- Wait for 1.5 seconds -->
settimeout(() =>{
<!-- Set all joint angles of the robot -->
obj.write(mycobot.sendAngles([88.68, -138.51, 155.65, -128.05, -9.93, -15.29],50))
},1500)
<!-- Wait for 2.5 seconds -->
settimeout(() =>{
<!-- Set the robot to free mode -->
obj.write(mycobot.releaseAllServos())
},2500)
```

myCobot Javascript Version

Programming in javascript environment

- jsmycobot is a js package for serial communication with Mycobot. If you want to use mycobot through JavaScript programming, then it will be your choice

API function introduction

2.1 Introduction to the robot arm 2.2 JOG mode and operation 2.3 Servo control 2.4 Atom IO 2.5 MDI mode and operation

API method introduction

Included classes:

- mycobot
- Coord

Import project

```
<!-- Import jsmycobot package -->
const mycobot = require("mycobot")

<!-- Initialize mycobot object -->
const obj = mycobot.connect("COM15",115200)

<!-- Write code to execute the robot arm power-on command -->
obj.write(mycobot.powerOn())

<!-- -->
obj.on("data",data=>{
const res = mycobot.processReceived(data)
console.log(`res:${res}`)
})
```

Robotic Arm Status

5.1 `connect()`

- `Description: Create an object and connect to the device`
- `Parameters: Parameter 1: Serial port number, Parameter 2: Baud rate`
- `Return value: None`

5.2 `powerOn()`

- `Description: Power on the robot`
- `Parameters: None`
- `Return value: None`

5.3 `powerOff()`

- `Description: Power off the robot`

- `Parameters: None`
- `Return value: None`

5.4 `isPowerOn()`

- `Description: Determine whether the robot is powered on`
- `Parameter: None`
- `Return value: 1: power on 0: power off -1: error`

5.6 `releaseAllServos()`

- `Description: Set the robot to free movement mode`
- `Parameter: None`
- `Return value: None`

MDI mode and operation

6.1 `getAngles`

- `Description: Get the angles of all joints`
- `Parameter: [float] type list of all joint angles of the robot`
- `Return value:`

6.2 `sendAngle`

- `Description: Send the angle of a single joint of the robot`
- `Parameters: id: robot joint number, degree: angle (number), speed: speed 0~100 (number)`
- `Return value: None`

6.3 `sendAngles`

- `Description: Send the angles of all robot joints`
- `Parameters: angles: contains the sequence value list of all joint angles (Array[float]), speed: (int) 0~100`
- `Return value: None`

6.4 `getCoords`

- `Description: Get the angles of all robot joints`
- `Parameters: Coordinates [float] type list mycobot: [x, y, z, rx, ry, rz]; mypalletizer: [x, y, z, θ]`
- `Return value: None`

6.5 `sendCoord`

- `Description: Send the coordinates of a single joint of the robot`
- `Parameters: id: robot joint id, coord: coordinate value, speed: (int) 0~100`
- `Return value: None`

6.6 `sendCoords`

- `Description: Send the coordinates of all joints of the robot`
- `Parameters: coords: a list of all robot joint coordinate values, speed: (int) 0~100, mode: mode`
- `Return value: None`

6.7 `isInPosition`

- `Description: Determine whether the position has been reached`
- `Parameters: 1: reached the position, 2: not reached the position`
- `Return value: data: parameter list, angle or coordinate, flag: mark data type - angle, -Coordinates`

Jog mode and operation

7.1 `jogAngle`

- `Description: Jog control angle`
- `Parameters: joinId: joint id 1~6 (int), direction: 0 decrease, 1 increase, speed: speed 0~100`
- `Return value: None`

7.2 `jogCoord`

- `Description: Jog control coordinates`
- `Parameters: coordid: joint id 1~6 (int), direction: decrease increase 0~1, speed: speed 0~100`
- `Return value: None`

7.3 `jogStop`

- `Description: Stop jogging movement`
- `Parameters: None`
- `Return value: None`

7.4 `programPause`

- `Description: Pause movement`
- `Parameters: None`
- `Return value: None`

7.5 `programResume`

- `Description: Resume movement`
- `Parameters: None`
- `Return value: None`

7.6 `stop`

- `Description: Stop movement`
- `Parameters: None`
- `Return value: None`

7.7 `setEncoder`

- `Description: Set a single joint rotation to a specified potential value`
- `Parameters: None`
- `Return value: None`

7.8 `getEncoder`

- `Description: Get the specified joint potential value`
- `Parameters: jointId: joint ID`
- `Return value: 0~4096`

7.9 `setEncoders`

- `Description: Set the six joints of the robot to execute synchronously to the specified position`
- `Parameters: encoders: encoder list, length 6; speed: speed 0~100`
- `Return value: None`

7.10 `getEncoders`

- `Description: Get all joints of the robot`
- `Parameters: None`

- `Return value: Encoder list`

Running status and settings

8.1 `getSpeed`

- `Description: Get speed`
- `Parameters: None`
- `Return value: speed`

8.2 `setSpeed`

- `Description: Set speed`
- `Parameter: number (0~100)`
- `Return value: None`

8.3 `getJointMin`

- `Description: Get the minimum moving angle of the specified joint`
- `Parameter: jointId: specified joint ID`
- `Return value: None`

8.4 `getJointMax`

- `Description: Get the maximum moving angle of the specified joint`
- `Parameter: jointId: specified joint ID`
- `Return value: angle value (float)`

Servo control

9.1 `isServoEnable`

- `Description: Determine whether all servos are connected`
- `Parameter: servoId: servo ID`
- `Return value: None`

9.2 `isAllServoEnable`

- `Description: Determine if the specified servo is connected`
- `Parameter: None`
- `Return value: 0: Disable, 1: Enable`

9.3 `setServoData`

- `Description: Set the data parameters of the specified address of the servo`
- `Parameter: servo_no: the serial number of the servo being set (1~6), dataId: data address, value: (0~4096)`
- `Return value: None`

9.4 `getServodata`

- `Description: Read the data parameters of the specified address of the servo`
- `Parameter: servo_no: the serial number of the servo, 1 - 6, dataId: data address`
- `Return value: 0~4096`

9.5 `setServoCalibration`

- `Description: The current position of the calibration joint actuator is the angle zero point, and the corresponding point value is 2048`
- `Parameter: servo_no: the serial number of the servo, 1 - 6`

- `Return value: None`

9.6 `releaseServo`

- `Description: Power off the specified servo`
- `Parameter: servo_no: the serial number of the set servo (1~6)`
- `Return value: None`

9.7 `focusServo`

- `Description: Turn on the power of the specified servo`
- `Parameter: None`
- `Return value: servo_no: the serial number of the set servo (1~6)`

ATOM IO

10.1 `setColor`

- `Description: Set the color of the light on the top of the robot arm`
- `Parameters: r(0~255), g(0~255), b(0~255)`
- `Return value: None`

10.2 `setPinMode`

- `Description: Set the state mode of the specified pin in the atom`
- `Parameters: pin_no: pin number, pinMode: 0-input, 1-output, 2-input splicing`
- `Return value: None`

10.3 `setDigitalOutput`

- `Description: Set the pin signal value`
- `Parameters: pin_no: pin number, pinSingal`
- `Return value: None`

10.4 `getDigitalInput`

- `Description: Return the pin signal value`
- `Parameter: pin_no: pin number`
- `Return value: signal value`

10.5 `getGripperValue`

- `Description: Get the gripper angle`
- `Parameter: None`
- `Return value: gripper angle`

10.6 `setGripperState`

- `Description: Set the gripper switch state`
- `Parameter: flag: 0-open, 1-close; speed: speed (0~100)`
- `Return value: None`

10.7 `setGripperValue`

- `Description: Set the gripper value`
- `Parameter: value (0~100), speed (0~100)`
- `Return value: None`

10.8 `setGripperIni`

- `Description: Set the current position to zero`
- `Parameter: None`
- `Return value: None`

10.9 `isGripperMving`

- `Description: Determine whether the gripper is moving`
- `Parameter: None`
- `Return value: 0: not moving, 1: moving`

M5Stack-basic

11.1 `setBasicOutput`

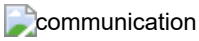
- `Description: Set the bottom pin`
- `Parameter: pin_no: pin number, pinSignal: 0 / 1`
- `Return value: None`

11.2 `getBasicOutput`

- `Description: Get the bottom pin`
- `Parameter: pin_no: pin number`
- `Return value: None`

Communication and message commands

Note: To use the communication protocol for direct communication, you need to burn transponder in basic and the latest version of atomMain in atom

 communication

Robotic arm motion parameters

Joint	*Joint minimum value °	Joint maximum value °	Joint maximum speed °/s	Joint maximum acceleration °/s²
J1	-168	168	150	200
J2	-135	135	150	200
J3	-150	150	150	200
J4	-145	145	150	200
J5	-165	165	150	200
J6	-180	180	150	200

Axis	*Minimum value of coordinate mm	Maximum value of coordinate mm	Maximum velocity of coordinate mm/s	Maximum acceleration of coordinate mm/s²
x	-281.45	281.45	100	400
y	-281.45	281.45	100	400
z	-70	412.76	100	400
rx	-180°	180°	40°	66°/s²
ry	-180°	180°	40°	66°/s²
rz	-180°	180°	40°	66°/s²

USB Communication Settings

Please make sure your communication settings are as follows

- Bus interface: USB Type-C connection
- Baud rate: 115200
- Data bits: 8
- Parity: None
- Stop bits: 1

Command frame description and single command analysis

The host Basic sends data to the slave, and the slave parses the data after receiving it. If the command contains a return value, the slave will return it to the host within 500ms.

Command frame sending and receiving format

All commands are in hexadecimal, and the sending and receiving formats are consistent.

Each communication command must contain the following 5 parts, of which 3 and 4 can be empty.

- 1 **Command header**: 0xFE 0xFE
- Fixed
- Required
- 2 **Effective command length**: 0x02 ~ 0x10
- Length of all the following commands
- Required
- 3 **Command number**: 00 ~ 8F
- Multiple commands have been developed
- Can be empty
- 4 **Command content**: Several
- Can be empty
- 5 **Command end**: 0XFA
- Fixed
- Required

Command parsing

The host Basic sends data to the slave, and the slave parses the data after receiving it. If the command contains a return value, the slave will return it to the host within 500ms.

Type	Data description	Data length	Description
Command frame	Header byte 0	1	Frame header identification, 0XFE
	Header byte 1	1	Frame header identification, 0XFE
	Data length byte	1	Different instructions correspond to different lengths of data
	Command byte	1	Depends on different commands
Data frame	Data	0-16	Data attached to the command, depending on different commands
End frame	End byte	1	Stop bit, 0XFA

Single command analysis

Robot power on

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X10
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 10 FA

No return value

Robotic arm power off and disconnect

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X11
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 11 FA

No return value

Atom status query

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X12
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 12 FA

Return data structure

Data field	Description	Data
Data[0]	Return frame header	0XFE
Data[1]	Return frame header	0XFE
Data[2]	Return length frame	0X03
Data[3]	Return command frame	0X12
Data[4]	Power on/off	0X01/0X00
Data[5]	End frame	0XFA

Assume that Atom is powered on

Serial port return example: FE FE 03 12 01 FA

Robotic arm only powers off

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X13
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 13 FA

No return value

Robot system detection is normal

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X14
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 14 FA

Return data structure

Data field	Description	Data
Data[0]	Return frame header	0XFE
Data[1]	Return frame header	0XFE
Data[2]	Return length frame	0X03
Data[3]	Return command frame	0X14
Data[4]	Normal connection/disconnection	0X01/0X00
Data[5]	End frame	0XFA

Assuming Atom connection is successful

Serial port return example: FE FE 03 14 01 FA

Command refresh mode switch (set interpolation/refresh motion mode)

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Command frame	0X16
Data[4]	Command frame	0X01/0X00
Data[5]	End frame	0XFA

Set to refresh motion mode:

Serial port sending example: FE FE 03 16 01 FA

Set to interpolation motion mode:

Serial port sending example: FE FE 03 16 00 FA

Robot free mode (turn off all torque output)

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Command frame	0X1A
Data[4]	Open/Close	01/00
Data[5]	End frame	0XFA

Set to free movement mode:

Serial port sending example: FE FE 03 1A 01 FA

Check whether it is free mode

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X1B
Data[5]	End frame	0XFA

Serial port sending example: FE FE 02 1B FA

Return data structure

Data field	Description	Data
Data[0]	Return frame header	0XFE
Data[1]	Return frame header	0XFE
Data[2]	Return length frame	0X03
Data[3]	Return instruction frame	0X1B
Data[4]	Open/Close	0X01/0X00
Data[5]	End frame	0XFA

Assuming Atom is in free movement mode

Serial port return example: FE FE 03 1B 01 FA

Read angle (read movement information)

Data field	Description	Data
Data[0]	Identify frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X20
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 20 FA

Return data structure

Data field	Description	Data
Data[0]	Return frame header	0XFE
Data[1]	Return frame header	0XFE
Data[2]	Return length frame	0X0E
Data[3]	Return command frame	0X20
Data[4]	No. 1 servo angle high	Angle1_high
Data[5]	No. 1 servo angle low	Angle1_low
Data[6]	Angle 2 high position	Angle2_high
Data[7]	Angle 2 low position	Angle2_low
Data[8]	Angle 3 high position	Angle3_high
Data[9]	Angle 3 low position	Angle3_low
Data[10]	Angle 4 high position	Angle4_high
Data[11]	Angle 4 low position	Angle4_low
Data[12]	Angle 5 high position	Angle5_high
Data[13]	Angle 5 low position	Angle5_low
Data[14]	Angle 6 high position	Angle6_high
Data[15]	Angle 6 low position	Angle6_low
Data[16]	End frame	0XFA

Serial port return example: FE FE 0E 20 00 8C 00 3D FF E6 FF 3F 00 AF FF 51 FA

How to get the angle of joint 1

temp = angle1_low+angle1_high*256

Angle1=（temp \ 33000 ?(temp – 65536) : temp）/100

Calculation method: angle value low + angle value high multiplied by 256 First determine whether it is greater than 33000 If it is greater than 33000, subtract 65536 and finally divide by 100. If it is less than 33000, directly divide by 100

(The same applies to the rest)

Send a single angle

Data field	Description	Data
Data[0]	Identify frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X06
Data[3]	Command frame	0X21
Data[4]	Servo serial number	joint_no
Data[5]	Angle value high	angle_high
Data[6]	Angle value low	angle_low
Data[7]	Specified speed	sp
Data[8]	End frame	0XFA

Move servo No. 1 to zero position at 20% speed

Serial port sending example: FE FE 06 21 01 00 00 14 FA

joint_no value range: 1~6

angle_high: data type byte

Calculation method: multiply the angle value by 100 and convert it to int format first Then take the high byte of the hexadecimal

angle_low: data type byte

Calculation method: multiply the angle value by 100, convert it to int format, and then take the low byte of the hexadecimal

No return value

Send all angles

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X0F
Data[3]	Command frame	0X22
Data[4]	No. 1 servo angle value high byte	Angle1_high
Data[5]	No. 1 servo angle value low byte	Angle1_low
Data[6]	No. 2 servo angle value high byte	Angle2_high
Data[7]	No. 2 servo angle value low byte	Angle2_low
Data[8]	No. 3 servo angle value high byte	Angle3_high
Data[9]	No. 3 servo angle value low byte	Angle3_low
Data[10]	High byte of the angle value of Servo No. 4	Angle4_ high
Data[11]	Low byte of the angle value of Servo No. 4	Angle4_ low
Data[12]	High byte of the angle value of Servo No. 5	Angle5_ high
Data[13]	Low byte of the angle value of Servo No. 5	Angle5_ low
Data[14]	High byte of the angle value of Servo No. 6	Angle6_ high
Data[15]	Low byte of the angle value of Servo No. 6	Angle6_ low
Data[16]	Specified speed	Sp
Data[17]	End frame	0XFA

Send all angles to zero/restore the machine to zero position and move at 30% speed

Serial port sending example: FE FE 0F 22 00 00 00 00 00 00 00 00 00 00 00 00 1E FA

angle1_high: data type byte

Calculation method: multiply the angle value of servo No. 1 by 100, convert it to int format first, and then take the high byte of hexadecimal

angle1_low: data type byte

Calculation method: multiply the angle value of servo No. 1 by 100, convert it to int format first, and then take the low byte of hexadecimal

(The same applies to the rest)

No return value

Read all coordinates

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X23
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 23 FA

Return data structure

Data field	Description	Data
Data[0]	Return frame header	0XFE
Data[1]	Return frame header	0XFE
Data[2]	Return length frame	0X0E
Data[3]	Return instruction frame	0X23
Data[4]	Specify x coordinate high	x_high
Data[5]	Specify x coordinate low	x_low
Data[6]	Specify y coordinate high	y_high
Data[7]	Specify y coordinate low	y_low
Data[8]	Specify z coordinate high	z_high
Data[9]	Specify z coordinate low	z_low
Data[10]	Specify rx coordinate high	rx_high
Data[11]	Specify the low bit of the rx coordinate	rx_low
Data[12]	Specify the high bit of the ry coordinate	ry_high
Data[13]	Specify the low bit of the ry coordinate	ry_low
Data[14]	Specify the high bit of the rz coordinate	rz_high
Data[15]	Specify the low bit of the rz coordinate	rz_low
Data[16]	End frame	0XFA

Serial port return example: FE FE 0E 23 01 BC FD A0 10 15 DC 66 FF 54 DE 21 FA

How to get the x coordinate

temp = x_low + x_high*256

x coordinate = (temp \ 33000 ?(temp – 65536) : temp)/10

Calculation method: x coordinate value low bit + x coordinate value high bit multiplied by 256 First determine whether it is greater than 33000 If it is greater than 33000, subtract 65536 and finally divide by 10. If it is less than 33000, just divide by 10 directly

(The same applies to y coordinates and z coordinates)

How to get the rx coordinate

temp = rx_low + rx_high*256

rx coordinate = (temp \ 33000 ?(temp – 65536) : temp)/100

Calculation method: x coordinate value low bit + x coordinate value high bit multiplied by 256 First determine whether it is greater than 33000 If it is greater than 33000, subtract 65536 and finally divide by 100. If it is less than 33000, just divide by 100 directly

(The same applies to ry coordinates and rz coordinates)

Send individual coordinate parameters

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X06
Data[3]	Command frame	0X24
Data[4]	axis	x/y/z/rx/ry/rz
Data[5]	Specify xyz/rxryrz parameter high	xyz/rxryrz_high
Data[6]	Specify xyz/rxryrz parameter low	xyz/rxryrz_low
Data[7]	Specify speed	Sp
Data[8]	End frame	0XFA

Set X coordinate to 200 and target speed to 20

Serial port sending example: FE FE 06 24 01 07 D0 14 FA

Specify axis: data type byte

Value range: 1~6

xyz_high: data type byte

Calculation method: x/y/z coordinate value multiplied by 10 and then take the high byte of hexadecimal

xyz_low: data type byte

Calculation method: x/y/z coordinate value multiplied by 10 and then take the low byte of hexadecimal

rxryrz_high: data type byte

Calculation method: rx/ry/rz multiplied by 100 and then take the high byte of hexadecimal

rxryrz_low: data type byte

Calculation method: rx/ry/rz multiplied by 100 and then take the low byte of hexadecimal

No return value

Send all coordinate parameters

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X10
Data[3]	Command frame	0X25
Data[4]	Specify x coordinate high	x_high
Data[5]	Specify x coordinate low	x_low
Data[6]	Specify y coordinate high	y_high
Data[7]	Specify y coordinate low	y_low
Data[8]	Specify z coordinate high	z_high
Data[9]	Specify z coordinate low	z_low
Data[10]	Specify rx coordinate high	rx_high
Data[11]	Specify the low bit of rx coordinate	rx_low
Data[12]	Specify the high bit of ry coordinate	ry_high
Data[13]	Specify the low bit of ry coordinate	ry_low
Data[14]	Specify the high bit of rz coordinate	rz_high
Data[15]	Specify the low bit of rz coordinate	rz_low
Data[16]	Specify the speed	Sp
Data[17]	Mode	0X01
Data[18]	End frame	0XFA

Set the target position of the end of the robot arm (150.3, -68.7, 101.8, 10.18, 0, -90), target speed 10

Serial port sending example: FE FE 10 25 05 DF FD 51 03 FA BC 30 00 00 DC D8 0A 01 FA

x_high: Data type byte

Calculation method: x coordinate multiplied by 10 and then take the high byte of hexadecimal

x_low: Data type byte

Calculation method: x coordinate multiplied by 10 and then take the low byte of hexadecimal

(The same applies to y-axis coordinates and z-axis coordinates)

rx_high: Data type byte

Calculation method: rx coordinate value multiplied by 100 and then take the high byte of hexadecimal

rx_low: Data type byte

Calculation method: rx coordinate value multiplied by 100 and then take the low byte of hexadecimal

(The same applies to ry-axis coordinates and rz-axis coordinates)

No return value

Program pause

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X26
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 26 FA

No return value

Is the program paused?

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X27
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 27 FA

Return data structure

Data field	Description	Data
Data[0]	Return frame header	0XFE
Data[1]	Return frame header	0XFE
Data[2]	Return length frame	0X03
Data[3]	Return command frame	0X27
Data[4]	Pause/unpause	0X01/0X00
Data[5]	End frame	0XFA

Assume the program is in pause state

Serial port return example: FE FE 03 27 01 FA

Program resume

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X28
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 28 FA

No return value

Program stop

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X29
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 29 FA

No return value

Whether the point is reached

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X0E/0X0F
Data[3]	Command frame	0X2A
Data[4]	Coordinate x high byte/No. 1 servo angle value high byte	x_high/Angle1_high
Data[5]	Coordinate x low byte/No. 1 servo angle value low byte	x_low/Angle1_low
Data[6]	Coordinate y high byte/No. 2 servo angle value high byte	y_high/Angle2_high
Data[7]	Coordinate y low byte/No. 2 servo angle value low byte	y_low/Angle2_low
Data[8]	Coordinate z high byte/No. 3 servo angle value high byte	z_high/Angle3_high
Data[9]	Coordinate z low byte/No. 3 servo angle value low byte	z_low/Angle3_low
Data[10]	Coordinate rx high bit/No. 4 servo angle value high byte	rx_high/Angle4_high
Data[11]	Coordinate rx low bit/No. 4 servo angle value low byte	rx_low/Angle4_low
Data[12]	Coordinate ry high bit/No. 5 servo angle value high byte	ry_high/Angle5_high
Data[13]	Coordinate ry low bit/No. 5 servo angle value low byte	ry_low/Angle5_low
Data[14]	Coordinate rz high bit/No. 6 servo angle value high byte	rz_high/Angle6_high
Data[15]	Coordinate rz low bit/No. 6 servo angle value low byte	rz_low/Angle6_low
Data[16]	Coordinate/angle	0X01/0X00
Data[17]	End frame	0XFA

Judge whether the robot has reached the origin

Serial port sending example: FE FE 0F 2A 00 00 00 00 00 00 00 00 00 00 00 00 00 FA

x_high: data type byte

Calculation method: x coordinate multiplied by 10, first converted to int type, then take the hexadecimal high byte

x_low: data type byte

Calculation method: x coordinate multiplied by 10, first converted to int type, then take the hexadecimal low byte

(The same applies to y-axis coordinates and z-axis coordinates)

rx_high: data type byte

Calculation method: rx coordinate multiplied by 100, first converted to int type, then take the hexadecimal high byte

rx_low: data type byte

Calculation method: rx coordinate multiplied by 100, first converted to int type Then take the low byte of hexadecimal

(The same applies to the ry axis coordinates and the rz axis coordinates)

angle_high: data type byte

Calculation method: multiply the angle value by 100, convert it to int format first, and then take the high byte of hexadecimal

angle_low: data type byte

Calculation method: multiply the angle value by 100, convert it to int format first, and then take the low byte of hexadecimal

Type: data type byte (not used yet)

Return data structure

Data field	Description	Data
Data[0]	Return frame header	0XFE
Data[1]	Return frame header	0XFE
Data[2]	Return length frame	0X03
Data[3]	Return instruction frame	0X2a
Data[4]	Arrived point/unreached point	0X01/0X00
Data[5]	End frame	0XFA

Assume the robot arm has not reached the specified point

Serial port return example: FE FE 03 2A 00 FA

Robotic arm motion detection

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X2B
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 2B FA

Return data structure

Data field	Description	Data
Data[0]	Return frame header	0XFE
Data[1]	Return frame header	0XFE
Data[2]	Return length frame	0X03
Data[3]	Return command frame	0X2B
Data[4]	Moving/Not Moving	0X01/0X00
Data[5]	End Frame	0XFA

Assuming the program is in motion

Serial port return example: FE FE 03 2B 01 FA

jog-Joint direction movement

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X05
Data[3]	Command frame	0X30
Data[4]	Joint servo number	Joint
Data[5]	Joint servo direction	direction
Data[6]	Specified speed	sp
Data[7]	End Frame	0XFA

Set servo No. 1 to rotate clockwise at 20% speed

Serial port sending example: FE FE 05 30 01 01 14 FA

Joint number range: 1~6

di: Data type byte Value range 0 and 1

sp: Data type byte Value range 0-100

No return value

jod-absolute control

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X06
Data[3]	Command frame	0X31
Data[4]	Joint servo number	Joint
Data[5]	Joint servo angle value high byte	Angle_high
Data[6]	Low byte of joint servo angle value	Angle_low
Data[7]	Specified speed	sp
Data[8]	End frame	0XFA

Set servo No. 1 to 45°, speed 20

Serial port sending example: FE FE 06 31 01 11 94 14 FA

Joint number value range: 1~6

Angle_high: Data type byte

Calculation method: Multiply the angle value by 100, convert it to int format first, and then take the high byte of hexadecimal

Angle_low: Data type byte

Calculation method: Multiply the angle value by 100, convert it to int format first, and then take the low byte of hexadecimal

sp: Data type byte, value range 0-100

No return value

jog-coordinate direction movement

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X05
Data[3]	Command frame	0X32
Data[4]	Specified coordinates	axis
Data[5]	Joint servo direction	di
Data[6]	Specified speed	sp
Data[7]	End frame	0XFA

Set the robot arm to move in the x direction, speed 20

Serial port sending example: FE FE 05 32 01 01 14 FA

axis value range: 1~6, representing x, y, z, rx, ry, rz respectively

di: data type byte value range 0 and 1

sp: data type byte value range 0-100

No return value

jog-stepping mode

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X06
Data[3]	Command frame	0X33
Data[4]	Joint servo serial number	Joint
Data[5]	Joint servo angle value high byte	Angle_high
Data[6]	Joint servo angle value low byte	Angle_low
Data[7]	Specified speed	sp
Data[8]	End frame	0XFA

Set the angle of servo No. 1 to increase by 45 and rotate at 20% speed

Serial port sending example: FE FE 06 33 01 11 94 14 FA

Joint serial number value range: 1~6

Angle_high: Data type byte

Calculation method: Multiply the angle value by 100, convert to int format first, and then take the high byte of hexadecimal

Angle_low: Data type byte

Calculation method: Multiply the angle value by 100, convert to int format first, and then take the low byte of hexadecimal

sp: Data type byte Value range 0-100

No return value

Send potential value

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X06
Data[3]	Command frame	0X3A
Data[4]	Joint servo serial number	Joint
Data[5]	Potential value high	Encoder_high
Data[6]	Potential value low	Encoder_low
Data[7]	Specified speed	sp
Data[8]	End frame	0XFA

Example, set joint 5 to 2048 potential and rotate at 20% speed

Serial port sending example: FE FE 06 3A 05 08 00 14 FA

Joint number range: 1~6

Joint: Data type byte

Encoder_high: Data type byte

Calculation method: Take the high bit of the potential value (hexadecimal)

Encoder_low: Data type byte

Calculation method: Take the low bit of the potential value (hexadecimal)

No return value

Get potential value

Data field	Description	Data
Data[0]	Identify frame	0XFE
Data[1]	Identify frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Command frame	0X3B
Data[4]	Joint number	joint
Data[5]	End frame	0XFA

Get the potential value of servo No. 2

Serial port sending example: FE FE 03 3B 02 FA

Joint number range: 1-6

Return data structure

Data field	Description	Data
Data[0]	Return identification frame	0XFE
Data[1]	Return identification frame	0XFE
Data[2]	Return data length frame	0X04
Data[3]	Return command frame	0X3B
Data[4]	Servo potential value high	Encoder_high
Data[5]	Servo potential value low	Encoders_low
Data[6]	End frame	0XFA

Serial port return example: FE FE 04 3B 08 07 FA

How to calculate the potential value

Potential value = potential value low bit + potential value high bit * 256

Send the potential values of six servos

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X0F
Data[3]	Command frame	0X3C
Data[4]	High byte of potential value of servo No. 1	encoder_1_high
Data[5]	Low byte of potential value of servo No. 1	encoder_1_low
Data[6]	High byte of potential value of servo No. 2	encoder_2_high
Data[7]	Low byte of potential value of servo No. 2	encoder_2_low
Data[8]	High byte of potential value of servo No. 3	encoder_3_high
Data[9]	Low byte of potential value of servo No. 3	encoder_3_low
Data[10]	No. 4 servo potential value high byte	encoder_4_high
Data[11]	No. 4 servo potential value low byte	encoder_4_low
Data[12]	No. 5 servo potential value high byte	encoder_5_high
Data[13]	No. 5 servo potential value low byte	encoder_5_low
Data[14]	No. 6 servo potential value high byte	encoder_6_high
Data[15]	No. 6 servo potential value low byte	encoder_6_low
Data[16]	Specified speed	Sp
Data[17]	End frame	0XFA

The potential value of all motors sent is 2048, and the speed is 20

Serial port sending example: FE FE 0F 3C 08 00 08 00 08 00 08 00 08 00 08 00 14 FA

(Refer to the above for sending a single potential value)

encoder_1_high: Data type byte

Calculation method: The potential value of servo No. 1 is first converted to int type and then the hexadecimal high byte is taken

encoder_1_low: Data type byte

Calculation method: The potential value of servo No. 1 is first converted to int type and then the hexadecimal low byte is taken

(The same applies to the rest)

Sp: Data type byte Value range: 0~100

No return value

Read the potential values of six servos

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X3D
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 3D FA

Return data structure

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X0E
Data[3]	Command frame	0X3D
Data[4]	High byte of the potential value of Servo No. 1	encoder_1_high
Data[5]	Low byte of the potential value of Servo No. 1	encoder_1_low
Data[6]	High byte of the potential value of Servo No. 2	encoder_2_high
Data[7]	Low byte of the potential value of Servo No. 2	encoder_2_low
Data[8]	Servo 3 potential value high byte	encoder_3_high
Data[9]	Servo 3 potential value low byte	encoder_3_low
Data[10]	Servo 4 potential value high byte	encoder_4_high
Data[11]	Servo 4 potential value low byte	encoder_4_low
Data[12]	Servo 5 potential value high byte	encoder_5_high
Data[13]	Servo 5 potential value low byte	encoder_5_low
Data[14]	Servo 6 potential value high byte	encoder_6_high
Data[15]	Servo 6 potential value low byte	encoder_6_low
Data[16]	End frame	0XFA

Assume that all joints of the current robot arm are at 0 position

Serial port return example: FE FE 0E 3D 08 00 08 00 08 00 08 00 08 00 08 00 FA

How to calculate the potential value

Potential value = potential value low bit + potential value high bit * 256

Set speed

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Instruction frame	0X41
Data[4]	Specified speed	sp
Data[5]	End frame	0XFA

Sp: Data type byte Value range: 0~100

Set the current speed to 50%

Serial port sending example: FE FE 03 41 32 FA

No return value

Read the minimum angle of the joint

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Command frame	0X4A
Data[4]	Joint servo serial number	Joint_number
Data[5]	End frame	0XFA

Read the minimum angle of joint No. 2

Serial port sending example: FE FE 03 4A 02 FA

joint_no value range: 1-6

Return data structure

Data field	Description	Data
Data[0]	Return identification frame	0XFE
Data[1]	Return identification frame	0XFE
Data[2]	Return data length frame	0X05
Data[3]	Return command frame	0X4A
Data[4]	Joint servo number	Joint_number
Data[5]	Servo angle value high	Angle_high
Data[6]	Servo angle value low	Angle_low
Data[7]	End frame	0XFA

Serial port return example: FE FE 05 4A 02 F9 F2 FA

How to get the minimum angle of the joint

temp = angle1_low+angle1_high*256

Angle1=（temp \ 33000 ?(temp – 65536) : temp）/10

Calculation method: angle value low + angle value high multiplied by 256 First determine whether it is greater than 33000 If it is greater than 33000, subtract 65536 and finally divide by 10. If it is less than 33000, divide by 10 directly

Read the maximum angle of the joint

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Command frame	0X4B
Data[4]	Joint servo serial number	joint_number
Data[5]	End frame	0XFA

joint_no value range: 1-6

Read the maximum angle of joint 2

Serial port sending example: FE FE 03 4B 02 FA

Return data structure

Data field	Description	Data
Data[0]	Return identification frame	0XFE
Data[1]	Return identification frame	0XFE
Data[2]	Return data length frame	0X05
Data[3]	Return command frame	0X4B
Data[4]	Joint servo number	joint_number
Data[5]	Servo angle value high	Angle_high
Data[6]	Servo angle value low	Angle_low
Data[7]	End frame	0XFA

Serial port return example: FE FE 05 4B 02 06 72 FA

How to get the maximum angle of the joint

temp = angle1_low+angle1_high*256

Angle1=（temp \ 33000 ?(temp – 65536) : temp）/10

Calculation method: angle value low bit + angle value high bit multiplied by 256 First determine whether it is greater than 33000 If it is greater than 33000, subtract 65536 and finally divide by 10. If it is less than 33000, just divide by 10

Set the minimum angle of the joint

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X05
Data[3]	Command frame	0X4C
Data[4]	Joint servo number	Joint_number
Data[5]	Joint servo angle value high byte	Angle_high
Data[6]	Joint servo angle value low byte	Angle_low
Data[7]	End frame	0XFA

Set the minimum angle of joint 2 to 0

joint_no value range: 1-6

angle1_high: data type byte

Calculation method: multiply the servo angle value by 100, convert it to int format first, and then take the high byte of hexadecimal

angle1_low: data type byte

Calculation method: multiply the servo angle value by 100, convert it to int format first, and then take the low byte of hexadecimal

Serial port sending example: FE FE 05 4C 02 00 00 FA

No return value

Set the maximum angle of the joint

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X05
Data[3]	Command frame	0X4D
Data[4]	Joint servo number	Joint_number
Data[5]	Joint servo angle value high byte	Angle_high
Data[6]	Joint servo angle value low byte	Angle_low
Data[7]	End frame	0XFA

Set the maximum angle of joint 2 to 45

Joint_no value range: 1-6

angle1_high: data type byte

Calculation method: Multiply the servo angle value by 100 and convert it to int format first Then take the high byte of hexadecimal

angle1_low: data type byte

Calculation method: Multiply the servo angle value by 100, convert it to int format first, and then take the low byte of hexadecimal

Serial port sending example: FE FE 05 4C 02 11 94 FA

No return value

View connection

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Command frame	0X50
Data[4]	Joint servo serial number	Joint_number
Data[5]	End frame	0XFA

joint_no value range: 1-6

Check whether servo No. 1 is connected

Serial port sending example: FE FE 03 50 01 FA

Return data structure

Data field	Description	Data
Data[0]	Return identification frame	0XFE
Data[1]	Return identification frame	0XFE
Data[2]	Return data length frame	0X04
Data[3]	Command frame	0X50
Data[4]	Joint servo number	Joint_number
Data[5]	Connected/unconnected	0X01/0X00
Data[6]	End frame	0XFA

Servo No. 1 is connected normally

Serial port return example: FE FE 04 50 01 01 FA

Check if all servos are powered on

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X51
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 51 FA

Return data structure

Data field	Description	Data
Data[0]	Return identification frame	0XFE
Data[1]	Return identification frame	0XFE
Data[2]	Return data length frame	0X03
Data[3]	Command frame	0X51
Data[4]	Power on/off	0X01/0X00
Data[5]	End frame	0XFA

Not all servos are powered on Serial port return example: FE FE 03 51 01 FA

Read servo parameters

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X04
Data[3]	Command frame	0X53
Data[4]	Joint servo serial number	joint_no
Data[5]	Data address	data_id
Data[6]	End frame	0XFA

Read the proportional parameters of position P of servo No. 1

Serial port sending example: FE FE 04 53 01 15 FA

joint_no value range 1~6

Data_id: data type byte, value as shown in the following table

Address	Function	Value range	Initial value	Value analysis
20	LED alarm	0-254	0	1\0 = Turn on or off LED alarm
21	Position loop P	0-254	10	Proportional coefficient of controlling motor
22	Position loop I	0-254	0	Differential coefficient of controlling motor
23	Position loop D	0-254	1	Integral coefficient of controlling motor
24	Minimum starting force	0-1000	0	Set the minimum output torque 1000 = 100%

Return data structure

Data field	Description	Data
Data[0]	Return identification frame	0XFE
Data[1]	Return identification frame	0XFE
Data[2]	Return data length frame	0X03
Data[3]	Return instruction frame	0X53
Data[4]	Return data	data
Data[5]	End frame	0XFA

Serial port return example: FE FE 03 53 10 FA

Set servo parameters of steering gear

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X05
Data[3]	Command frame	0X52
Data[4]	Joint servo serial number	joint_no
Data[5]	Data address	data_id
Data[6]	Data	data
Data[7]	End frame	0XFA

Set the position P ratio parameter of servo No. 1 to 1

Serial port sending example: FE FE 05 52 01 15 01 FA

joint_no value range: 1~6

No return value

```
data_id value is as follows
```

Address	Function	Value range	Initial value	Value analysis
20	LED alarm	0-254	0	1_0 = Turn LED alarm on or off
21	Position loop P	0-254	10	Proportional coefficient of the control motor
22	Position loop I	0-254	0	Differential coefficient of the control motor
23	Position loop D	0-254	1	Integral coefficient of the control motor
24	Minimum starting force	0-1000	0	Set the minimum output torque 1000 = 100%

Set the servo zero point

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Command frame	0X54
Data[4]	Joint servo serial number	joint_number
Data[5]	End frame	0XFA

Set the zero position of servo No. 1

Serial port sending example: FE FE 03 54 01 FA

joint_number:1~6

No return value

Brake a single motor

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Command frame	0X55
Data[4]	Joint servo number	joint_number
Data[5]	End frame	0XFA

Brake servo No. 1

joint_number:1~6

Serial port sending example: FE FE 03 55 01 FA

No return value

Power off a single motor

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Command frame	0X56
Data[4]	Servo serial number	Servo_no
Data[5]	End frame	0XFA

Power off servo No. 3

Serial port sending example: FE FE 03 56 03 FA

Servo_no: 1~6

No return value

Power on a single motor

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Command frame	0X57
Data[4]	Servo number	Servo_no
Data[5]	End frame	0XFA

Power on servo No. 1

Serial port sending example: FE FE 03 57 01 FA

Servo_no:1~6

No return value

Set atom pin mode

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X04
Data[3]	Command frame	0X60
Data[4]	Pin number	pin_no
Data[5]	Input/output	00X00/00X01
Data[6]	End frame	0XFA

Set atom pin22 to input mode

Serial port sending example: FE FE 04 60 16 00 FA

Pin_no: Data type byte

Pin_mode: 0/1

No return value

Set Atom IO (setDigitalOutput)

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X04
Data[3]	Instruction frame	0X61
Data[4]	Pin number	Pin_no
Data[5]	Level signal	0X00/0X01
Data[6]	End frame	0XFA

Set pin P23 to high level

Serial port sending example: FE FE 04 61 17 01 FA

No return value

Read Atom IO (getDigitalInput)

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Instruction frame	0X62
Data[4]	Pin number	pin_no
Data[5]	End frame	0XFA

Read the level signal of pin P22

Serial port sending example: FE FE 03 62 16 FA

Return data structure

Data field	Description	Data
Data[0]	Return identification frame	0XFE
Data[1]	Return identification frame	0XFE
Data[2]	Return data length frame	0X04
Data[3]	Return instruction frame	0X62
Data[4]	Pin number	pin_no
Data[5]	Level signal	0X00/0X01
Data[6]	End frame	0XFA

Assume that pin P22 is high level

Serial port return example: FE FE 04 62 16 01 FA

Read the gripper angle

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X65
Data[6]	End frame	0XFA

Serial port sending example: FE FE 02 65 FA

Return data structure

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Command frame	0X65
Data[4]	Gripper opening range	value
Data[6]	End frame	0XFA

value: 0-100%

Assume the gripper is in full open state

Serial port return example: FE FE 03 65 64 FA

Gripper opening size = 6 * 16 + 4 = 100

Set the gripper mode

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X04
Data[3]	Command frame	0X66
Data[4]	Gripper open/close	0X00/0X01
Data[5]	Speed	Sp
Data[6]	End frame	0XFA

Set the gripper to open at a speed of 50

Serial port sending example: FE FE 04 66 00 32 FA

No return value

Set the gripper angle

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X04
Data[3]	Command frame	0X67
Data[4]	Gripper opening range	value
Data[6]	Speed	Sp
Data[7]	End frame	0XFA

Assume the gripper is open 50% and the speed is 20

Serial port sending example: FE FE 04 67 32 14 FA

value can be directly converted to hexadecimal

No return value

Set the gripper to zero point

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Instruction frame	0X68
Data[4]	End frame	0XFA

Set the gripper's current position to zero point

Serial port sending example: FE FE 02 68 FA

Detect whether the gripper is moving

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X69
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 69 FA

Return data structure

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Command frame	0X69
Data[4]	Stop/Move	00/01
Data[5]	End frame	0XFA

Assume the gripper is in the stopped state

Serial port return example: FE FE 03 69 00 FA

Set the color of the RGB light on the atom screen

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X05
Data[3]	Command frame	0X6A
Data[4]	R	0X00/0XFF
Data[5]	G	0X00/0XFF
Data[6]	B	0X00/0XFF
Data[7]	End frame	0XFA

Set RGB to blue

Serial port sending example: FE FE 05 6A 00 00 FF FA

No return value

Set the base IO output

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X04
Data[3]	Command frame	0Xa0
Data[4]	Pin number	Pin_no
Data[5]	Level signal	0X00/0X01
Data[6]	End frame	0XFA

Set pin 2 to output high level

Serial port sending example: FE FE 04 a0 02 01 FA

Read base IO output

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Command frame	0Xa1
Data[4]	Pin number	Pin_no
Data[5]	End frame	0XFA

Serial port sending example: FE FE 03 a1 02 FA

Return data structure

Data field	Description	Data
Data[0]	Return identification frame	0XFE
Data[1]	Return identification frame	0XFE
Data[2]	Return data length frame	0X04
Data[3]	Return instruction frame	0Xa1
Data[4]	Pin number	Pin_no
Data[5]	Level signal	0X00/0X01
Data[6]	End frame	0XFA

Assume that pin 2 is high level

Serial port return example: FE FE 04 a1 02 01 FA

Get WiFi account & password

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0Xb1
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 b1 FA

Serial port return example: ssid: MyCobotWiFi2.4G password: mycobot123

ssid: WiFi account

password: WiFi password

Set port number

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X04
Data[3]	Command frame	0Xb2
Data[4]	Port number high byte	port_high
Data[5]	Port number low byte	port_low
Data[6]	End frame	0XFA

Assume that the port number is set to 7000

Serial port sending example: FE FE 04 b2 1b 58 FA

port_high: port number hexadecimal high byte

port_low: port number hexadecimal low byte

No return value

Set tool coordinate system

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X0E
Data[3]	Command frame	0X81
Data[4]	Specify the high bit of the x coordinate	x_high
Data[5]	Specify the low bit of the x coordinate	x_low
Data[6]	Specify the high bit of the y coordinate	y_high
Data[7]	Specify the low bit of the y coordinate	y_low
Data[8]	Specify the high bit of the z coordinate	z_high
Data[9]	Specify the low bit of the z coordinate	z_low
Data[10]	Specify the high bit of the rx coordinate	rx_high
Data[11]	Specify the low bit of the rx coordinate	rx_low
Data[12]	Specify the high bit of the ry coordinate	ry_high
Data[13]	Specify the low bit of the ry coordinate	ry_low
Data[14]	Specify the high bit of the rz coordinate	rz_high
Data[15]	Specify the low bit of the rz coordinate	rz_low
Data[16]	End frame	0XFA

Assume that (0, 0, 50, 0, 0, 0) is set as the tool coordinate system

Serial port sending example: FE FE 0E 81 00 00 00 00 13 88 00 00 00 00 00 00 FA

No return value

Get tool coordinate system

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X82
Data[6]	End frame	0XFA

Serial port sending example: FE FE 02 82 FA

Return data structure

Data field	Description	Data
Data[0]	Return frame header	0XFE
Data[1]	Return frame header	0XFE
Data[2]	Return length frame	0X0E
Data[3]	Return command frame	0X82
Data[4]	Specify the high bit of the x coordinate	x_high
Data[5]	Specify the low bit of the x coordinate	x_low
Data[6]	Specify the high bit of the y coordinate	y_high
Data[7]	Specify the low bit of the y coordinate	y_low
Data[8]	Specify the high bit of the z coordinate	z_high
Data[9]	Specify the low bit of the z coordinate	z_low
Data[10]	Specify the high bit of the rx coordinate	rx_high
Data[11]	Specify the low bit of the rx coordinate	rx_low
Data[12]	Specify the high bit of the ry coordinate	ry_high
Data[13]	Specify the low bit of the ry coordinate	ry_low
Data[14]	Specify the high bit of the rz coordinate	rz_high
Data[15]	Specify the low bit of the rz coordinate	rz_low
Data[16]	End frame	0XFA

Serial port return example: FE FE 0E 82 00 00 00 00 13 88 00 00 00 00 00 00 FA

How to get the x coordinate

temp = x_low + x_high*256

x coordinate = (temp \ 33000 ? (temp – 65536) : temp) / 10

Calculation method: x coordinate value low + x coordinate value high multiplied by 256 First determine whether it is greater than 33000 If it is greater than 33000, subtract 65536 and finally divide by 10. If it is less than 33000, directly divide by 10

(The same applies to y coordinate and z coordinate)

How to get the rx coordinate

temp = rx_low + rx_high*256

x coordinate = (temp \ 33000 ? (temp – 65536) : temp）/100

Calculation method: x coordinate value low bit + x coordinate value high bit multiplied by 256 First determine whether it is greater than 33000 If it is greater than 33000, subtract 65536 and finally divide by 100. If it is less than 33000, divide by 100 directly

(ry coordinate and rz coordinate are the same)

Set the world coordinate system

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X0E
Data[3]	Instruction frame	0X83
Data[4]	Specify x coordinate high bit	x_high
Data[5]	Specify x coordinate low bit	x_low
Data[6]	Specify y coordinate high bit	y_high
Data[7]	Specify the low bit of the y coordinate	y_low
Data[8]	Specify the high bit of the z coordinate	z_high
Data[9]	Specify the low bit of the z coordinate	z_low
Data[10]	Specify the high bit of the rx coordinate	rx_high
Data[11]	Specify the low bit of the rx coordinate	rx_low
Data[12]	Specify the high bit of the ry coordinate	ry_high
Data[13]	Specify the low bit of the ry coordinate	ry_low
Data[14]	Specify the high bit of the rz coordinate	rz_high
Data[15]	Specify the low bit of the rz coordinate	rz_low
Data[16]	End frame	0XFA

Assume that (0, 0, 50, 0, 0, 0) is set as the world coordinate system

Serial port sending example: FE FE 0E 83 00 00 00 00 13 88 00 00 00 00 00 00 FA

No return value

Get the world coordinate system

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Instruction frame	0X84
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 82 FA

Return data structure

Data field	Description	Data
Data[0]	Return frame header	0XFE
Data[1]	Return frame header	0XFE
Data[2]	Return length frame	0X0E
Data[3]	Return command frame	0X84
Data[4]	Specify x coordinate high	x_high
Data[5]	Specify x coordinate low	x_low
Data[6]	Specify y coordinate high	y_high
Data[7]	Specify y coordinate low	y_low
Data[8]	Specify z coordinate high	z_high
Data[9]	Specify z coordinate low	z_low
Data[10]	Specify rx coordinate high	rx_high
Data[11]	Specify rx coordinate low	rx_low
Data[12]	Specify ry coordinate high	ry_high
Data[13]	Specify ry coordinate low	ry_low
Data[14]	Specify rz coordinate high	rz_high
Data[15]	Specify the low bit of the rz coordinate	rz_low
Data[16]	End frame	0XFA

Serial port return example: FE FE 0E 84 00 00 00 00 13 88 00 00 00 00 00 00 FA

How to get the x coordinate

temp = x_low + x_high*256

x coordinate = (temp \ 33000 ?(temp – 65536) : temp)/10

Calculation method: x coordinate value low bit + x coordinate value high bit multiplied by 256 First determine whether it is greater than 33000 If it is greater than 33000, subtract 65536 and finally divide by 100. If it is less than 33000, directly divide by 10

(The same applies to the y coordinate and the z coordinate)

How to get the rx coordinate

temp = rx_low + rx_high*256

x coordinate = (temp \ 33000 ? (temp – 65536) : temp) / 100

Calculation method: x coordinate value low bit + x coordinate value high bit multiplied by 256 First determine whether it is greater than 33000 If it is greater than 33000, subtract 65536 and finally divide by 100. If it is less than 33000, directly divide by 100

(ry coordinate and rz coordinate are the same)

Set base coordinate system

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Instruction frame	0X85
Data[4]	Base coordinate/world coordinate	00/01
Data[5]	End frame	0XFA

Assume that the coordinate system is set to the world coordinate system

Serial port sending example: FE FE 03 85 01 FA

No return value

Get the base coordinate system

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Instruction frame	0X86
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 86 FA

Return data structure

Data field	Description	Data
Data[0]	Return frame header	0XFE
Data[1]	Return frame header	0XFE
Data[2]	Return length frame	0X03
Data[3]	Return command frame	0X86
Data[4]	Base coordinates/world coordinates	00/01
Data[4]	End frame	0XFA

Serial port return example: FE FE 03 86 01 FA

Set end coordinate system

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X03
Data[3]	Command frame	0X89
Data[4]	Flange/tool	00/01
Data[5]	End frame	0XFA

Assume that the end coordinate system is set to tool

Serial port sending example: FE FE 03 89 01 FA

No return value

Get the end coordinate system

Data field	Description	Data
Data[0]	Identification frame	0XFE
Data[1]	Identification frame	0XFE
Data[2]	Data length frame	0X02
Data[3]	Command frame	0X8a
Data[4]	End frame	0XFA

Serial port sending example: FE FE 02 8a FA

Return data structure

Data field	Description	Data
Data[0]	Return frame header	0XFE
Data[1]	Return frame header	0XFE
Data[2]	Return length frame	0X03
Data[3]	Return command frame	0X8a
Data[4]	Flange/Tool	00/01
Data[4]	End frame	0XFA

Serial port return example: FE FE 03 8a 01 FA

Appendix:

Added corresponding coordinate transformation programs in the ATOM library and kinematics library. The specific implementation methods are as follows:

1. Change the end coordinate system
2. The end coordinate system can be set through the setEndType and getEndType functions. EndType::FLANGE sets the end to the flange, and EndType::TOOL sets the end to the tool end.
3. The coordinate information of the tool can be set through the setToolReference and getToolReference functions. When setting, the flange coordinate system is used as the relative coordinate system, and the tool end information is relative to the flange coordinate system.
4. After setting EndType to FLANGE, the GetCoords and WriteCoords methods are calculated based on the flange position.
5. After setting EndType to TOOL, the GetCoords and WriteCoords methods are calculated based on the tool end position.
6. Change the base coordinate system

7. The base coordinate system can be set through the setReferenceFrame function. RFType::BASE uses the robot base as the base coordinate, and RFType::WORLD uses the world coordinate system as the base coordinate. The getReferenceFrame function is used to read the current base coordinate system type.
8. The setWorldReference and getWorldReference functions can be used to set and read the base coordinate system information. When setting, the world coordinate system is used as the relative coordinate system, and the position information of the robot's base relative to the world coordinate system is input.
9. When the base coordinate system is the base, the GetCoords and WriteCoords methods both use the base as the reference coordinate system.
10. When the base coordinate system is the world coordinate system, the GetCoords and WriteCoords methods both use the world coordinate system as the reference coordinate system.

Communication related changes (temporary)

Now add the setting and reading of the end coordinate system, the setting and reading of the world coordinate system, the setting and reading of the current reference coordinate system, the setting and reading of the end type, the setting and reading of the movement method, and the sending and receiving of the robot information.

These communications are temporarily set to 0x80 to 0x8A

In the ParameterList.h file, add a new roboticMessages space for adding robot communication information. Now only temporarily add the prompt of "no inverse solution", which can be added later.

The simple design idea of MOVEL function is as follows:

Calculate the Euclidean distance between the initial point and the target point, and insert an interpolation point every 10mm based on the Euclidean distance. If there is no inverse solution for the interpolation point, search for an inverse solution in the adjacent space of positive and negative PI/30 in the three directions of the unchanged position, mainly to avoid singular values and some special positions where the solution cannot be found.

The point sending interval of MOVEL and JOG is changed to dynamic time. The moving time is calculated according to the maximum joint moving distance between the two points, and then the moving time minus the specific time is used as the time interval.

Chapter 7 Successful Cases

myCobot 280 series robot arms support more than ten kinds of accessories, including bases, end extensions, peripheral products, etc. Multiple accessories can be stacked to complete complex project applications and meet the needs of commercial exhibitions, such as robot application model display, educational teaching package display, and industrial 4.0 application scenario display. Supports multiple mainstream programming languages such as python and C++ to meet the diverse needs of developers.

User case display video

【Application Case】Elephant Robot myCobot Elephant Robot Arm Creative Video Collection

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280 PLC IO Interactive Control Case

1. Functional Effect Description

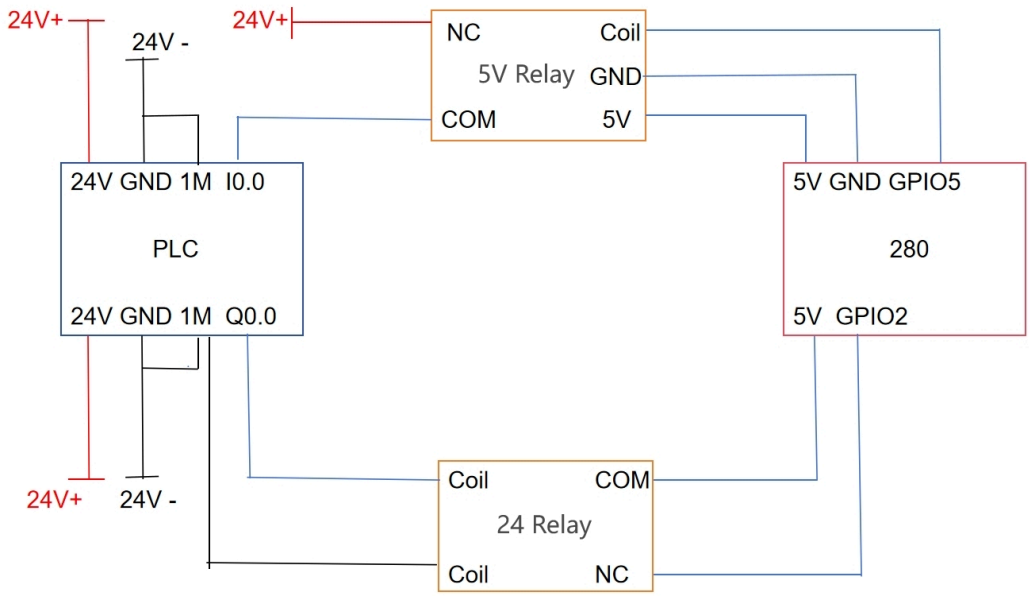
After receiving the IO signal from the PLC, the robot arm will perform an action to return each joint to zero position

2. Principle Description

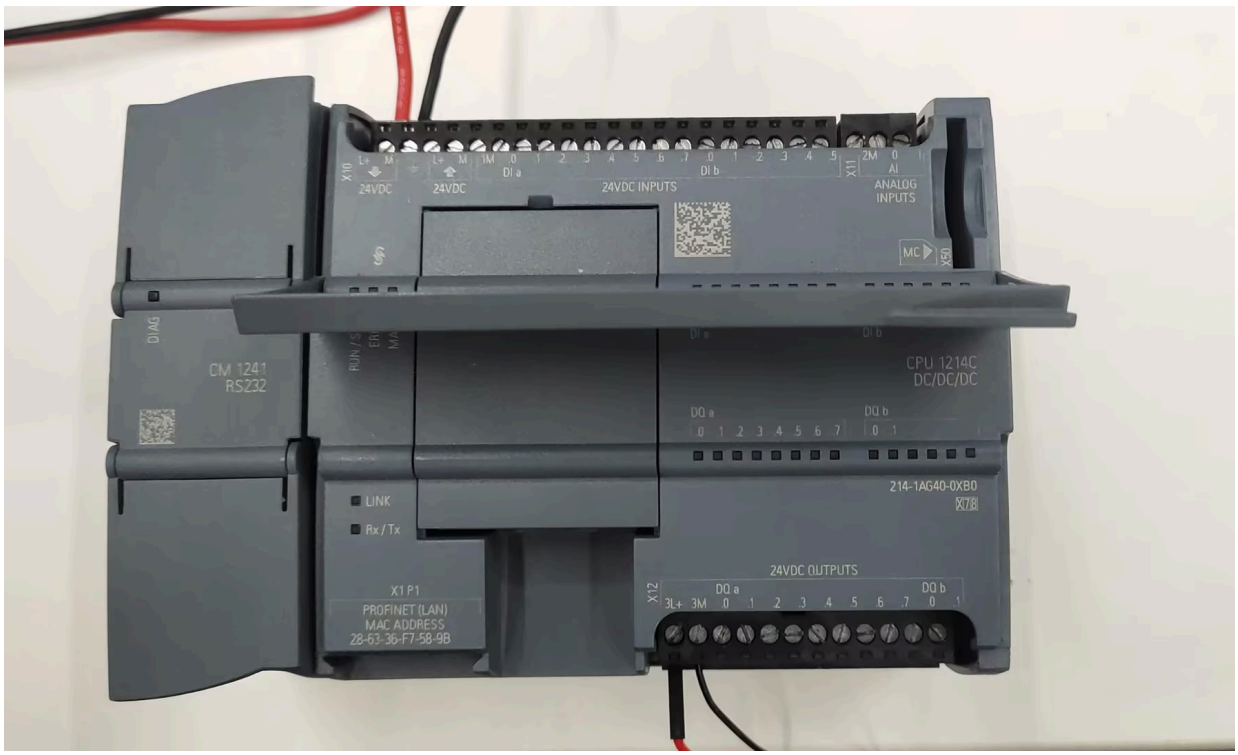
Since the input and output of the robot arm is 3.3V and the input and output of the PLC is 24V, a 5V relay and a 24V relay are required. The output end of the robot arm will first output a signal to energize the 5V relay coil, connect the normally open contacts, and pass the 24V signal to the input end of the PLC. After the PLC collects the input signal, the PLC output end will output a signal to energize the 24V relay coil, connect the normally open contacts, and pass the 3.3V signal to the input end of the robot arm. After the robot arm collects the input signal, it will perform an action of returning each joint to zero position

3. Hardware Link

Overall connection diagram



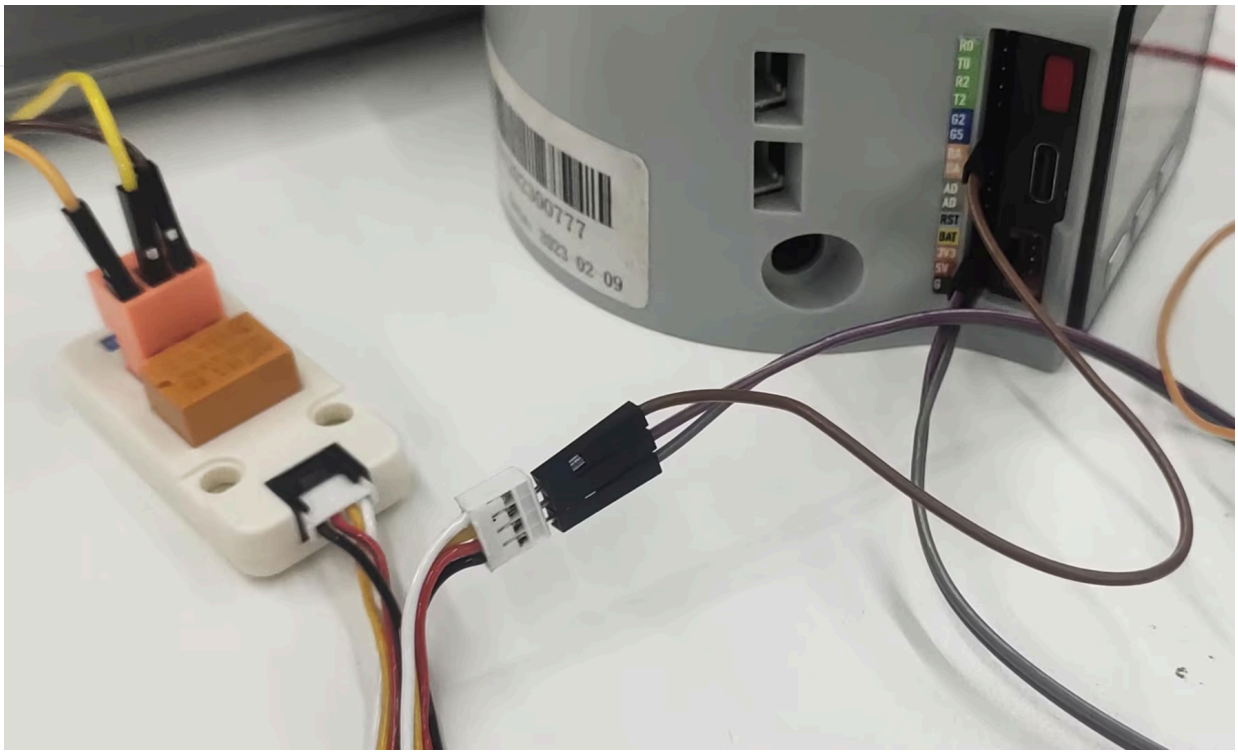
Wiring of the input of the robot arm and the output of the PLC First connect the PLC to a 24V power supply



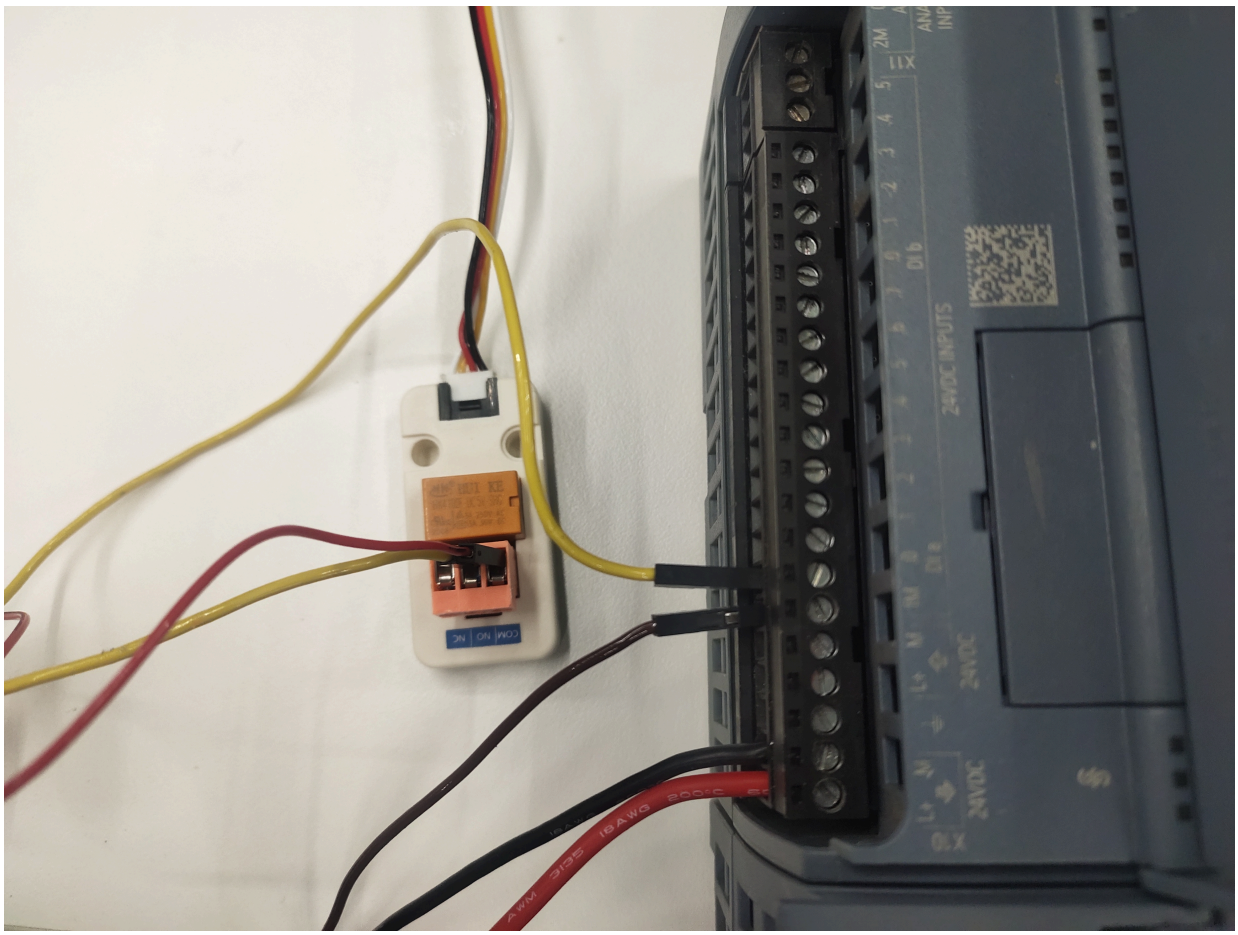
Then connect the PLC output to the 24V relay coil

Connect the robot's GPIO2 and 3.3V to the normally open contact of the 24V relay

Connect the robot's output to the PLC's input Connect the 5v, GND and GPIO5 of the robot to the coil of the 5V relay



Then connect the positive pole of 24V to the COM terminal of the 5V relay, the negative pole of 24V to the 1M terminal of the PLC, and NO to the input of the PLC

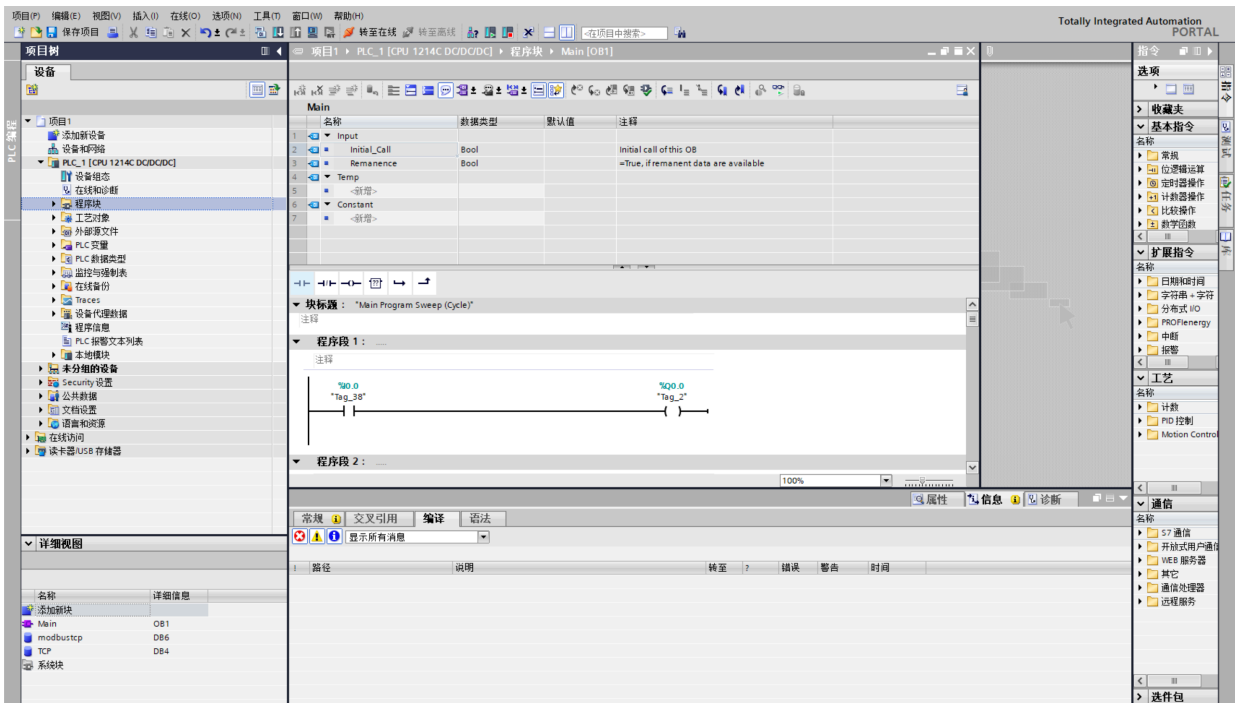


4 Software Programming

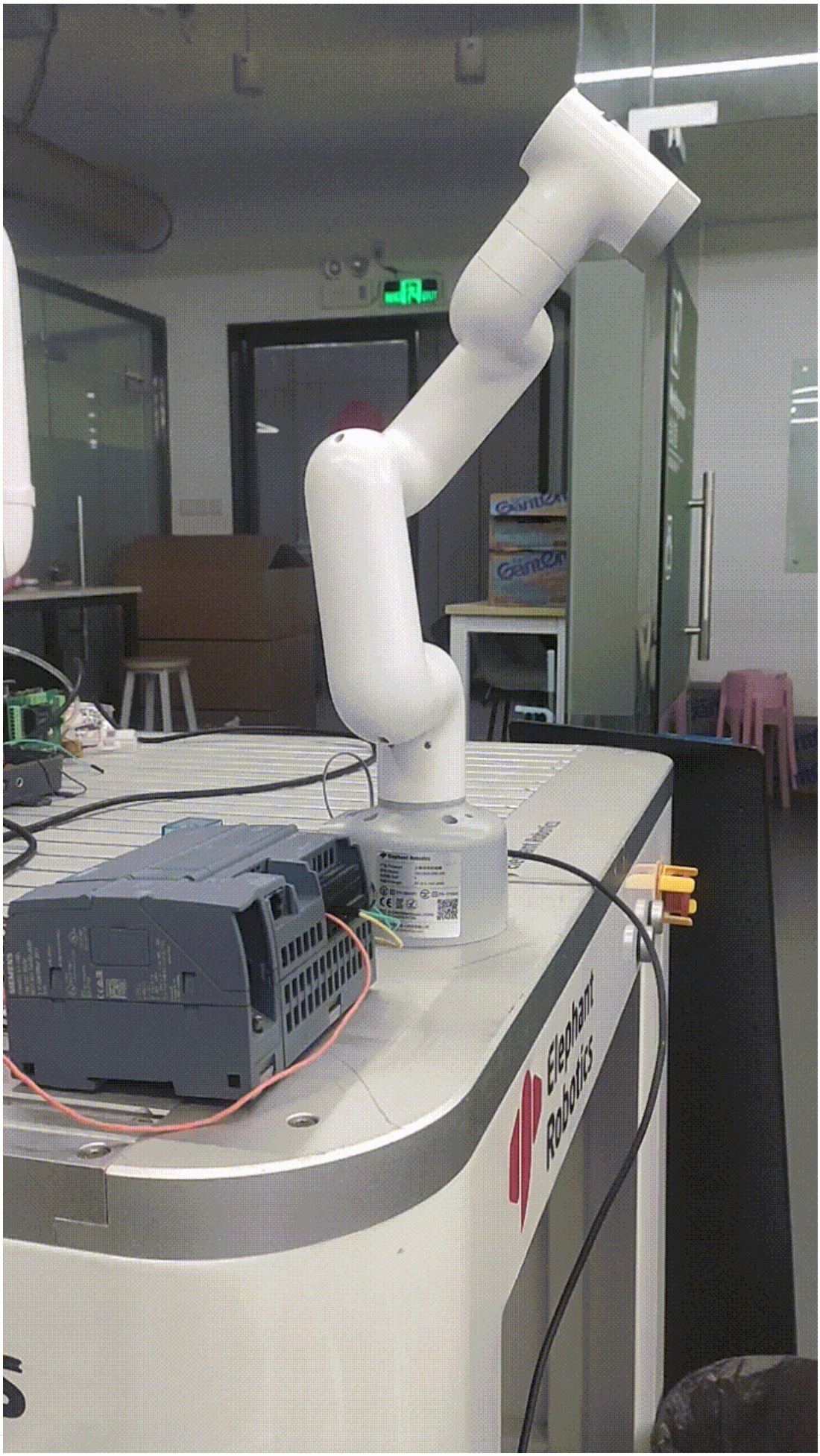
Robot Program

```
import time
mc=MyCobot("COM6")
mc.set_basic_output(5,1)
while 1:
if mc.get_basic_input(2)==1:
mc.sync_send_angles([0,0,0,0,0,0],50)
break
else:
pass
mc.set_basic_output(5,0)
```

PLC program



5. Effect display


Elephant
Robotics

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Robot gripper carrying wooden block example

1 Functional description

The robot will use the gripper to carry the wooden block from point A to point B

2 Hardware installation

Insert the Lego connector into the reserved socket of the gripper

Align the gripper with the connector inserted into the socket at the end of the robot arm and insert it

Connect the extension cable to the gripper

Insert the robot arm control interface

3 Gripper test

Run the following program, the gripper will repeat the closing and opening action twice

```
from pymycobot import MyCobot280,utils
import time


arm=MyCobot280(utils.get_port_list()[0])
for i in range(2):
    arm.set_gripper_state(1,100)
    time.sleep(1)
    arm.set_gripper_state(1,100)
    time.sleep(1)
```

4 Software Usage

Use the fast movement function of myblockly to teach the grabbing point and placement point of the wooden block, and record the position information. After teaching, you need to disconnect the serial port connection, otherwise the serial port will be reported when running the python script. The error is that the serial port is occupied.

5 Composite application

```
from pymycobot import MyCobot280,utils
import time

init_angles=[-3.25, -2.46, -95.09, 9.22, 86.39, 93.33]#6 joint angles at the initial position
grab_point=[214.5, -189.9, 185.5, -177.5, 1.91, 173.49]#Coordinates of the gripping point
place_point=[214.5, -50.9, 185.5, -177.5, 1.91, 173.49]#Coordinates of the placement point

arm=MyCobot280(utils.get_port_list()[0])
if __name__=="__main__":
    arm.set_gripper_state(0,100)#Open the gripper first
    time.sleep(1)
    arm.send_angles(init_angles,100)#Initial position of movement
    time.sleep(2)
    arm.send_coords([grab_point[0],grab_point[1],grab_point[2]+70,grab_point[3],grab_point[4],grab_point[5]],100,1)#Move t
    time.sleep(2)
    arm.send_coords([grab_point[0],grab_point[1],grab_point[2],grab_point[3],grab_point[4],grab_point[5]],100,1)#Move to t
    time.sleep(2)
    arm.set_gripper_state(1,100)#Clamp the gripper
    time.sleep(1)
    arm.send_coords([grab_point[0],grab_point[1],grab_point[2]+70,grab_point[3],grab_point[4],grab_point[5]],100,1)#Move t
    time.sleep(2)

    arm.send_coords([place_point[0],place_point[1],place_point[2]+70,place_point[3],place_point[4],place_point[5]],100,1)#
    time.sleep(2)
    arm.send_coords([place_point[0],place_point[1],place_point[2],place_point[3],place_point[4],place_point[5]],100,1)#Mov
    time.sleep(2)
    arm.set_gripper_state(0,100)#Open the gripper
    time.sleep(1)
    arm.send_coords([place_point[0],place_point[1],place_point[2]+70,place_point[3],place_point[4],place_point[5]],100,1)#
    time.sleep(2)
```

6 Effect display

Robot suction pump to carry wooden blocks

1 Functional description

The robot will use the suction pump to carry wooden blocks from point A to point B

2 Hardware installation

Insert the Lego connector into the reserved socket on the suction pump

Align the suction pump with the connector inserted into the socket at the end of the robot arm

Select the male-female DuPont wire, and insert the female end into the socket marked with pins on the suction pump box

Then connect the wire to the base IO of the robot arm

> The left side is the suction pump pin, and the right side is the robot arm pin GND -> GND 5V -> 5V G2 -> 2 G5 -> 5

3 Pump test

Run the following program, the pump will repeat the opening and closing action twice

```
from pymycobot import MyCobot280,utils
import time


arm = MyCobot280(utils.get_port_list()[0])


# Turn on the pump
def pump_on():
    arm.set_basic_output(5, 0)
    time.sleep(0.05)


# Stop the pump
def pump_off():
    arm.set_basic_output(5, 1)
    time.sleep(0.05)
    arm.set_basic_output(2, 0)
    time.sleep(1)
    arm.set_basic_output(2, 1)
    time.sleep(0.05)


for i in range(2):
    pump_on()
    time.sleep(2)
    pump_off()
    time.sleep(2)
```

4 Software Usage

Use the fast movement function of myblockly to teach the grab and place points of the wooden block, and record the position information. After teaching, you need to disconnect the serial port, otherwise the serial port will be reported when running the python script.

5 Composite Application

```
from pymycobot import MyCobot280,utils
import time
init_angles=[-3.25, -2.46, -95.09, 9.22, 86.39, 93.33]#6 joint angles at the initial position
grab_point=[196.9, -197.1, 124.5, -178.8, 1.25, 173.32]#Coordinates of the grab point
place_point=[196.9, -97.1, 124.5, -178.8, 1.25, 173.32]# Coordinates of the placement point

arm = MyCobot280(utils.get_port_list()[0])

# Turn on the suction pump
def pump_on():
    arm.set_basic_output(5, 0)
    time.sleep(0.05)



def pump_off():
    arm.set_basic_output(5, 1)
    time.sleep(0.05)
    arm.set_basic_output(2, 0)
    time.sleep(1)
    arm.set_basic_output(2, 1)
    time.sleep(0.05)

if __name__=="__main__":
    pump_off()#Turn off the suction pump first
    time.sleep(1)
    arm.send_angles(init_angles,100)#Move to the initial position
    time.sleep(2)
    arm.send_coords([grab_point[0],grab_point[1],grab_point[2]+70,grab_point[3],grab_point[4],grab_point[5]],100,1)#Move t
    time.sleep(2)
    arm.send_coords([grab_point[0],grab_point[1],grab_point[2],grab_point[3],grab_point[4],grab_point[5]],100,1)#Move to t
    time.sleep(2)
    pump_on() #Turn on the suction pump
    time.sleep(1)
    arm.send_coords([grab_point[0],grab_point[1],grab_point[2]+70,grab_point[3],grab_point[4],grab_point[5]],100,1)#Move t
    time.sleep(2)

    arm.send_coords([place_point[0],place_point[1],place_point[2]+70,place_point[3],place_point[4],place_point[5]],100,1)#
    time.sleep(2)
    arm.send_coords([place_point[0],place_point[1],place_point[2],place_point[3],place_point[4],place_point[5]],100,1)#Mov
    time.sleep(2)
    pump_off() #Turn off the pump
    time.sleep(1)
    arm.send_coords([place_point[0],place_point[1],place_point[2]+70,place_point[3],place_point[4],place_point[5]],100,1)#
    time.sleep(2)
```

6 Effect display

Chapter 8 Supporting Resources

This chapter will introduce various supporting resources of the product in detail, aiming to help users fully understand and use our products efficiently. Whether it is product information, drawings, software information and source code, or system information and promotional materials, we provide detailed information and download links to ensure that users can make full use of these resources for product development, operation and promotion

Download Product Information

The product information includes detailed specifications, technical parameters and instructions for use of the 280 M5 robot arm. This section aims to help users fully understand the performance and functions of the robot arm and ensure the best experience during use

Product Drawings

The product drawings section provides detailed 3D and 2D drawings of the 280 M5 robot arm. These drawings are particularly important for engineers who need to perform customized designs or maintenance, and can help them better understand the structure of the robot arm.

Software Information and Source Code

The software information and source code section contains the software installation package, driver and related open source code that are compatible with the 280 M5 robot. Users can use these materials to install, upgrade and perform secondary development of the software to enhance the functions and application scenarios of the robot

System Information

The system information provides the system architecture and working principle of the 280 M5 robot, covering the collaborative working mode of hardware and software. This section helps users to quickly locate and solve problems during integration and debugging to ensure stable operation of the system

Promotional Materials

The promotional materials section contains the product brochure, demonstration video and customer cases of the 280 M5 robot. These materials not only show the core advantages and application scenarios of the robot, but also provide successful cases in actual applications to help potential customers understand the value of the product more intuitively.

Product Information Download

The product information includes detailed specifications, technical parameters and instructions for use of the 280 M5 robot arm. This section is designed to help users fully understand the performance and functions of the robot arm and ensure the best experience during use

Download Link

You can download all relevant product information through the following link: Product Information Download

Product Drawings

The product drawings section provides detailed 3D and 2D drawings of the 280 M5 robot. These drawings are particularly important for engineers who need to make customized designs or perform maintenance, and can help them better understand the structure of the robot.

Machine 3D Model

Machine	3D Model File
myCobot 280 M5	Download

Machine 2D Drawings

Machine	Machine 2D Drawings
myCobot 280 Atom	Download
myCobot 280 M5 Base	Download

Accessories 3D Models

- myCobot Series

Accessories	3D Model Files
Adaptive Gripper	Download
Parallel Gripper	Download
Flexible Gripper	Download
G-type base	Download
Large suction cup base	Download
Flat base	Download
Vertical Suction Pump	Download
Double-head suction pump	Download
Camera flange	Download
Spring bamboo shoots flange	Download
Dexterous Hand	Download
Pen holder	Download
Mobile Phone Gripper	Download

Software information and source code

The software information and source code section includes the software installation package, driver and related open source code for the 280 M5 robot arm. Users can use these materials to install, upgrade and perform secondary development of the software to enhance the functions and application scenarios of the robot arm

You can download all relevant product information through the following link: Software Information Download

The software download link includes the following commonly used software

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- myStudio 2.0 The one-stop service platform myStudio integrates myCobot software resources and various materials. Main functions:
- Support firmware download and update;
- Provide product use video tutorials;
- Maintenance/repair information;

- RoboFlow RoboFlow is a human-computer interactive operation software developed by our company to facilitate users to quickly master the operation and use of the robot arm. Through simple operation procedures, it helps users to efficiently complete robot arm control and programming work.

- myBlockly myBlockly is a fully visual modular programming software, a graphical programming language, suitable for beginners to get familiar with programming. Users can create simple and complex functions by dragging and dropping puzzles to develop applications.

- Meta Care Meta Care is an interesting pet simulation game that combines elements such as pet raising, story and achievement collection.
- The game requires full Internet access.
- You need to own Meta Dog and connect to your device via Bluetooth.
- The game is only supported on Android devices.

- Elephant Luban Elephant Luban is a G-Code trajectory generation and use platform that provides user-based use cases, selects writing and painting, laser engraving use scenarios, and quickly opens up DIY creative space.

- MyCobot Controllerle MyCobot Controller is an APP that controls the MyCobot series of robotic arms via Bluetooth. You can use your phone to move the robotic arm. If you are an Android user, please go to [Google Play Store] If you are an IOS user, please wait for the software to be released before searching and downloading.

System Information

The system information provides the system architecture and working principle of the 280 M5 robot, covering the collaborative working mode of hardware and software. This section helps users to quickly locate and solve problems during integration and debugging to ensure stable operation of the system

(Information to be updated)

Promotional Materials

The promotional materials section includes the product brochure, demonstration video and customer cases of the 280 M5 robot arm. These materials not only show the core advantages and application scenarios of the robot arm, but also provide successful cases in actual applications to help potential customers understand the value of the product more intuitively.

Machine	Product Brochure
myCobot 280 M5	Download

Product unboxing video Product unboxing video

Product promotion video

Product promotion video

User Case User Case

Elephant Robotics

1. Company Introduction

Based in Shenzhen, China, Elephant Robotics is a high-tech enterprise focusing on robot R&D, design and automation solutions.

We are committed to providing highly flexible collaborative robots, easy-to-learn operating systems and intelligent automation solutions for robot education and scientific research institutions, commercial scenarios and industrial production. Its product quality and smart solutions have been unanimously recognized and praised by several factories from the world's top 500 companies in South Korea, Japan, the United States, Germany, Italy, Greece and other countries.

Elephant Robotics adheres to the vision of "Enjoy Robots World" and advocates the collaborative work of people and robots, making robots a good helper for human work and life, helping people to be liberated from simple, repetitive and boring work, giving full play to the advantages of human-machine collaboration, thereby improving work efficiency and helping humans create a better new life.

In the future, Elephant Robotics hopes to promote the development of the robot industry through a new generation of cutting-edge technology, and work with customers and partners to open a new era of automation and intelligence.

Company History

2. Development History

- 2016.08 -----Elephant Robotics Co., Ltd. was officially established
- 2016.08 -----Entered HAX incubator and received seed round investment from SOSV
- 2016.08 -----Started research and development of Elephant S industrial collaborative robot
- 2017.01 -----Rated as "Top 10 Most Innovative Companies in China at CES"
- 2017.04 -----Attended Hannover Industrial Fair and Korea Automation Exhibition
- 2017.07 -----Two founders were selected as "30 Business Elites Under 30" by Forbes Asia
- 2017.10 -----The fifth-generation single-arm industrial collaborative robot Elephant S was launched

- 2018.04 -----Received angel round investment from "Yun Angel Fund"
- 2018.06 -----First public appearance 2018 Hannover World Industrial Fair
- 2018.06 -----Won the "Smart Manufacturing Entrepreneurship MBA Award" from Cheung Kong Graduate School of Business
- 2018.06 -----Won the "Entrepreneurship Accelerator X-elerator Award" from Tsinghua School of Economics and Management
- 2018.11 -----Won the second place in the Shenzhen Division of the Asian Smart Hardware Competition
- 2018.11 -----Won the "Most Investment Enterprise Award" of the Gaogong Golden Globe Award
- 2019.03 -----Won the "Leadership Award" of the Gaogong Golden Globe Award
- 2019.04 -----In March 2019, Catbot won the "Industrial Robot Innovation Award"
- 2019.09 -----Attended the Huawei European Ecosystem Conference (HCE) and officially became a member of Huawei's ecological partner
- 2019.11 -----Elephant Robotics and Harbin Institute of Technology attended the IROS International Intelligent Robots and Systems Conference
- 2019.12 -----Elephant Robotics-South China University of Technology "Intelligent Robot Joint Development Laboratory" was officially unveiled
- 2019.12 -----Won the "Innovation Technology Award" of Gaogong in 2019
- 2019.12 -----Won the "Top Ten Fast-Growing Enterprises" of Gaogong in 2019
- 2019.12 -----Won the "New Enterprise Award" in the Industrial Robot Segment of Shenzhen Equipment Industry
- 2019.12 -----The world's first bionic robot cat MarsCat was launched
- 2020.05 -----The founder won the 2019 Shenzhen Robotics Newcomer Award
- 2020.10 -----The world's lightest and smallest six-axis collaborative robot myCobot was launched
- 2021.03 -----The smallest collaborative robot for scientific research myCobotPro 320 was launched
- 2021.05 -----Mars bionic cat MarsCat Received coverage from Xinhua Finance, China Daily, Nanjing Daily, Harbin Daily and other media
- 2021.07 -----Released the smallest composite robot chassis - Elephant Mobile Robot myAGV
- 2021.09 -----The world's first fully enclosed four-axis robotic arm - Elephant palletizing robotic arm myPalletizer was launched

3. Related links

Purchase link

- Taobao: https://shop504055678.taobao.com
- Shopify: https://shop.elephantrobotics.com/
- AliExpress: https://elephantrobotics.aliexpress.com/store/1101941423

Other information

- Official website: https://www.elephantrobotics.com
- Video
- Bilibili: https://space.bilibili.com/2126215657
- Youtube: https://www.youtube.com/c/Elephantrobotics
- Facebook: https://www.facebook.com/mycobotcreator/
- Linkedin: https://www.linkedin.com/company/18319865
- X (Twitter): https://twitter.com/CobotMy
- Discord: https://discord.gg/2MAherp7nt
- Hackster: https://www.hackster.io/elephant-robotics

4. Contact Us

> Our working hours are China working days, 10 am to 6 pm Beijing time.

- If you have any other questions, please contact us via the following methods. E-mail :

```
support@elephantrobotics.com
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- If you have any purchase intention or any parameter questions, please send an email to this mailbox. [E-mail](sales@elephantrobotics.com) :

```
sales@elephantrobotics.com
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- If you encounter any problems in the use of this product, please read Chapter 9 of the manual first. If the problems listed cannot help you solve them, and you have more after-sales problems, please send an email to this mailbox. E-mail :

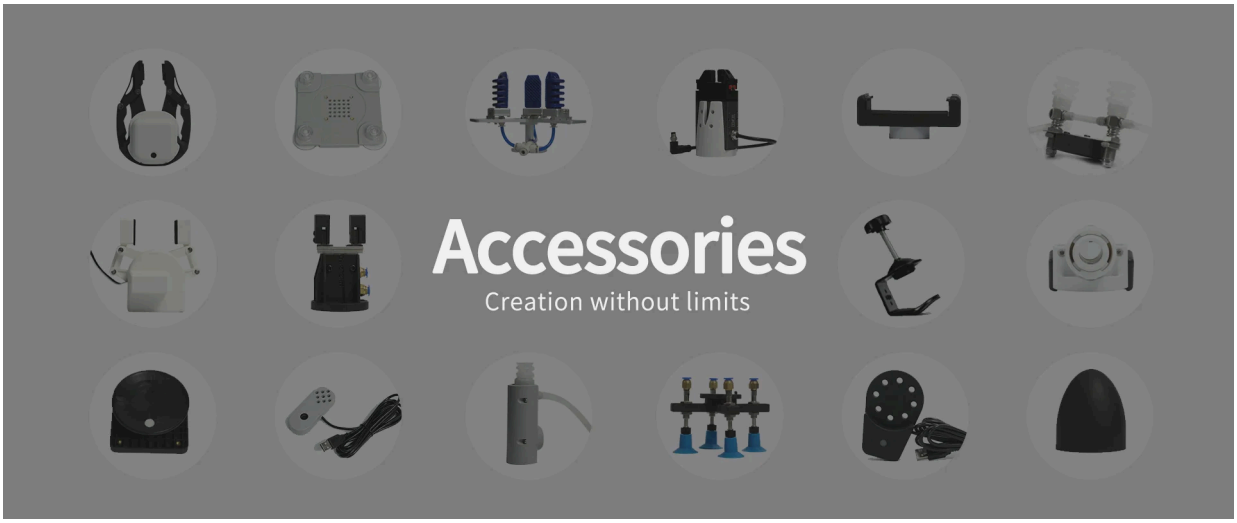
```
support@elephantrobotics.com
```

We will respond within 1-2 working days;

WeChat: We only provide one-to-one service for users who purchase mycobot products through WeChat.

← Previous Chapter | Next Chapter →

Product Accessories



In the real world, different accessories can enhance the capabilities of robots in various ways. For example, accessories such as grippers, sensors, and tools can help robots perform various tasks, thereby increasing their versatility and flexibility.

Elephant Robotics is committed to making robots and these accessories easy for everyone to use, freeing users from the complexity of choosing the right accessories and enabling them to quickly start using robots.

Accessory Types

In order to meet the needs of customers in different scenarios, we have designed various types of accessories, including grippers, suction cups, camera modules, and other gripping devices, so that users can directly choose the right end effector

Base

- Flat Base

Suitable for fixing the robot arm on a flat and smooth surface.

- G-Base

Suitable for fixing the robot arm on the edge of a table.

Gripper

- Adaptive Gripper

The gripper is a robot component that can achieve functions similar to human hands. It has the advantages of complex structure, firm gripping of objects, not easy to fall, and easy operation. The gripper kit includes gripper accessories and Lego technology parts. The end effector of the robot arm is controlled by a programmable system to achieve functions such as object grasping and multi-point positioning.

- Parallel Gripper

Driven by a motor, the finger surface of the gripper makes a linear reciprocating motion to achieve the opening or closing action. The acceleration and deceleration of the electric gripper can be controlled, the impact on the workpiece can be minimized, the positioning point can be controlled, and the clamping can be controlled

- Flexible Gripper-Open Foot Type

The fingertips are made of rubber and rely on air pressure deformation to grasp objects. Pneumatic manipulators are widely used and are favored for their softness, adaptability and efficiency. These advantages make them powerful tools in automation and robotic applications, capable of effectively handling a wide range of objects and tasks

Suction Pumps

- Vertical Suction Pumps

With one suction nozzle and one exhaust nozzle, the suction pump kit is controlled as the end effector of the robot arm to perform the function of sucking objects.

- Double-head Suction Pumps

Compared with single-head suction pumps, it is more stable, with simple structure, small size, easy to use, low noise, and good self-priming ability.

- Integrated Suction Pumps

The integrated suction pump has the advantages of simple structure, small size, easy to use, low noise, and good self-priming ability.

Holder

- Pen Holder

The overall solid color design can be used for writing, drawing and other applications.

- Phone Holder

Suitable for devices that require physical clamping, such as photography, and can clamp a variety of mobile phones. It has a simple structure and is easy to install and disassemble.

Other functional accessories

- Dexterous Hand

A robot component that can achieve functions similar to human hands. It has the advantages of a complex structure, firm gripping of objects, not easy to fall, and easy operation. The gripper kit includes gripper accessories and Lego technology parts. The end effector of the robot arm is controlled by a programmable system to achieve functions such as object grasping and multi-point positioning.

- USB Camera

The USB high-definition camera can be used with suction pumps, adaptive grippers, artificial intelligence kits, etc., and eye in hand can achieve precise positioning and calibration.

- Bamboo Flange

Suitable for devices with physical travel such as click buttons and keyboards. The overall solid color design, simple structure, and easy installation and disassembly.

Flat base

Applicable models: myCobot 280

Specifications:

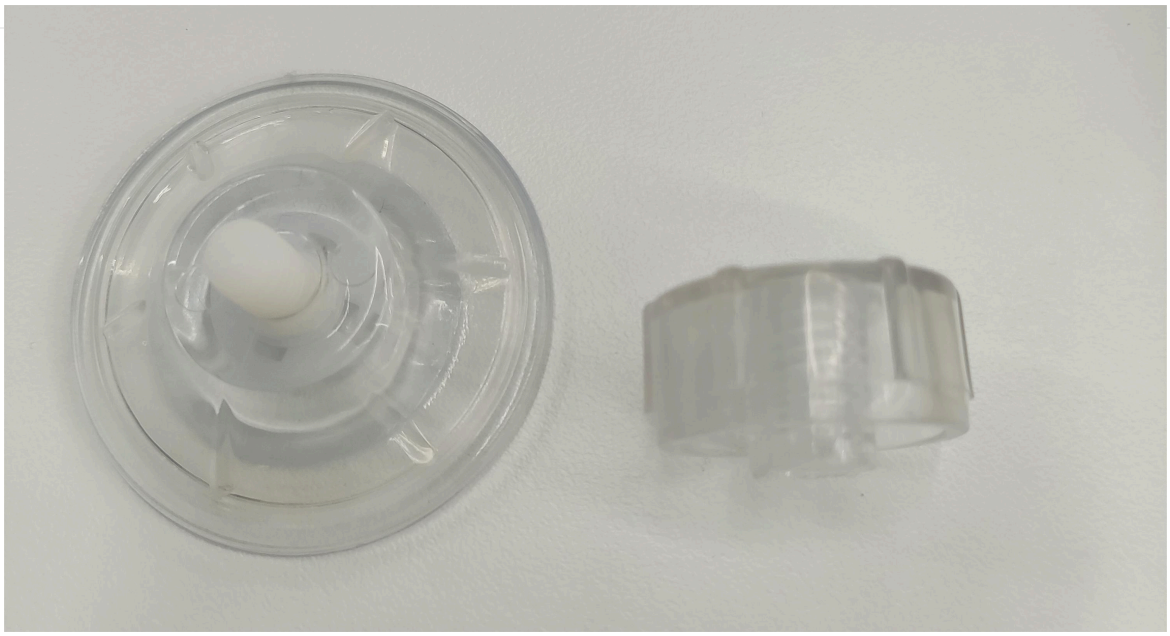
Name	Flat base
Model	myCobot_Fstand_grey
Color	Gray, black
Process	ABS compression molding
Size	145×145×13
Weight	60g
Fixed	Lego connector/screw fixation
Environment requirements	Normal temperature and pressure
Applicable equipment Fit	ER myCobot 280 M5, ER myCobot 280 Pi

Instructions for use:

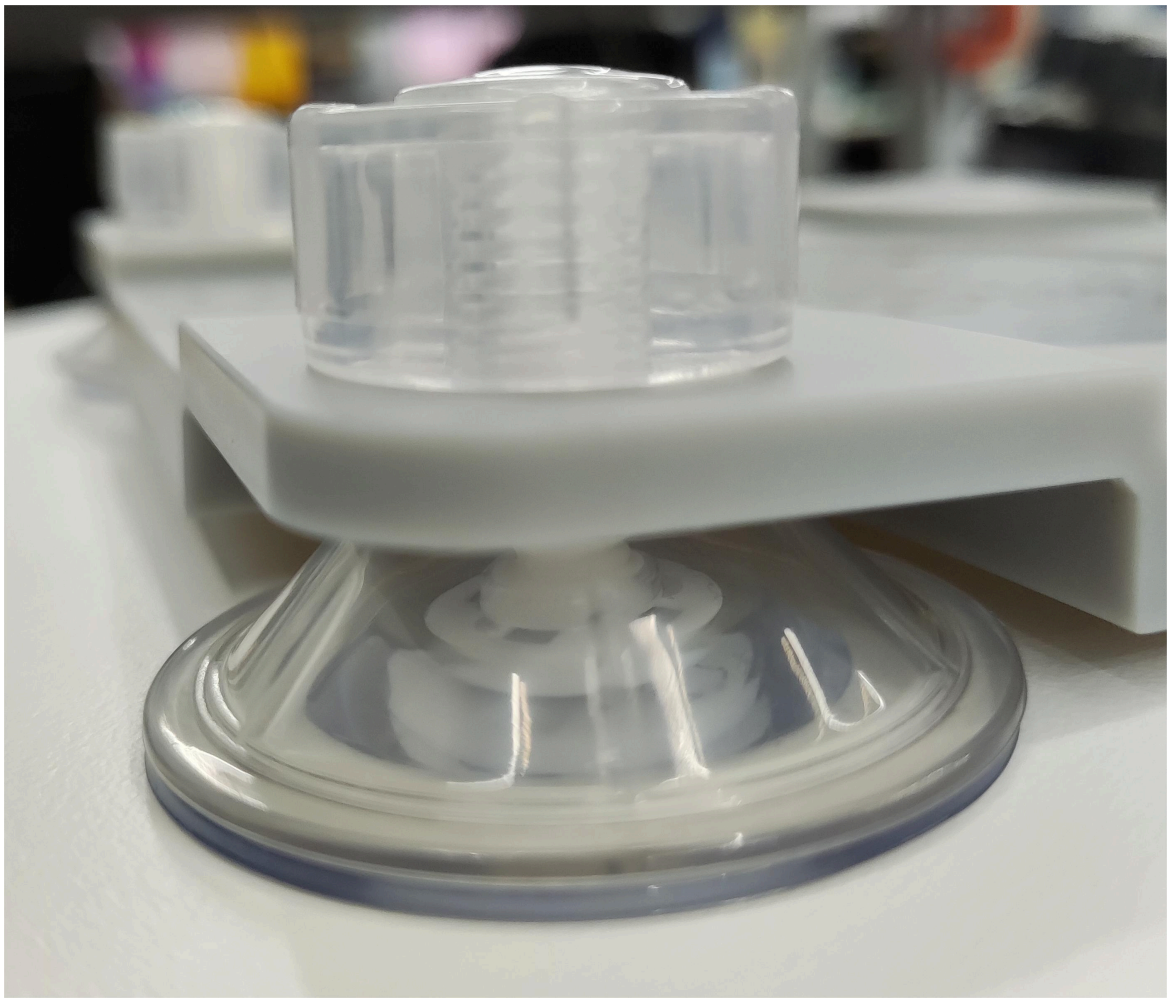
Applicable to flat and smooth surfaces

- 1. Install the suction cups at the four corners of the base and tighten them.
- 1. Use the included Lego tech parts to connect the flat base and the bottom of the robot arm.
- 1. Fix the four suction cups on a flat and smooth surface before starting to use.

Remove the nut:



Tighten through the holes at the four corners:



> Adjust the number of Lego connectors as needed. It is recommended to use a sufficient number of connectors to ensure the stability of the machine:

Tips

You can add a small amount of **non-conductive** liquid under the suction cup to fill the gap between the suction cup and the desktop to obtain the best adsorption effect.


myCobot

G-type stand 2.0

Applicable models: myCobot 280, myPalletizer 260, mechArm 270

Specifications:

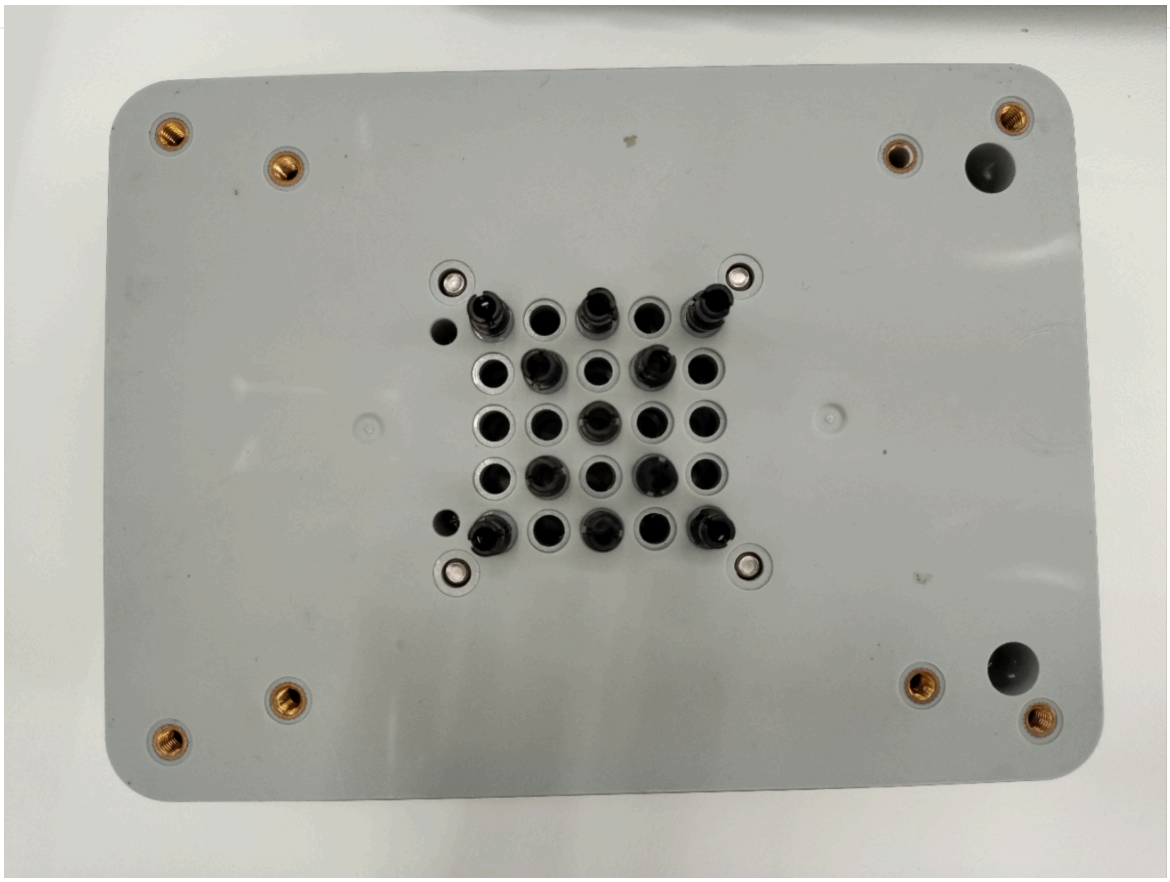
Name	G-type stand 2.0
Model	myCobot_Gstand_grey_V2
Color	Gray, black
Process	ABS compression molding
Size	174.8x166x31
Fixed	Lego connector/screw fixation
Environment requirements	Normal temperature and pressure
Applicable equipment Fit	ER myCobot 280 series, ER myPalletizer 260 series, mecharm 270 series, myBuddy 280 series

Instructions:

G-type base - fixed to the edge of the table

- 1. Use the G-shaped clamp to fix the base to the edge of the table
- 1. Use the included Lego connector to connect the base and the bottom of the robot arm
- 1. Make sure it is stable before starting to use

Insert the Lego connector as needed



Adaptive gripper

Applicable models: myCobot 280, myPalletizer 260, mechArm 270

Product image

Specifications:

Name	mycobot280 Adaptive Gripper
Model model	myCobot_gripperAg_white
Process	ABS injection molding
Color	White
Gripping range	20-45mm
Maximum gripping force	150g
Repeatability	1mm
Service life	One year
Drive mode	Electric
Transmission mode	Gear + connecting rod
Dimensions	112×94×50mm
Weight	110g
Fixing method	Lego connector
Environment requirements	Normal temperature and pressure
Control interface	Serial control
Applicable equipment	ER myCobot 280 series, ER myPalletizer 260 series, ER mechArm 270 series, ER myBuddy 280 series

Adaptive gripper: Used to grip objects

Introduction

- The gripper is a robot component that can achieve functions similar to human hands. It has the advantages of complex structure, firm gripping of objects, not easy to fall, and easy operation. The gripper kit includes gripper accessories and Lego technology parts. The end effector of the robot arm is controlled by a programmable system to realize functions such as object gripping and multi-point positioning. The gripper can be used in all development environments, such as ROS, Arduino, Roboflow, etc.

Working Principle

- Driven by a motor, the gripper's finger surface makes linear reciprocating motion to achieve opening or closing. The acceleration and deceleration of the electric gripper are controllable, the impact on the workpiece can be minimized, the positioning point is controllable, and the clamping is controllable.

Applicable objects

- Small cubes
- Small balls
- Long objects

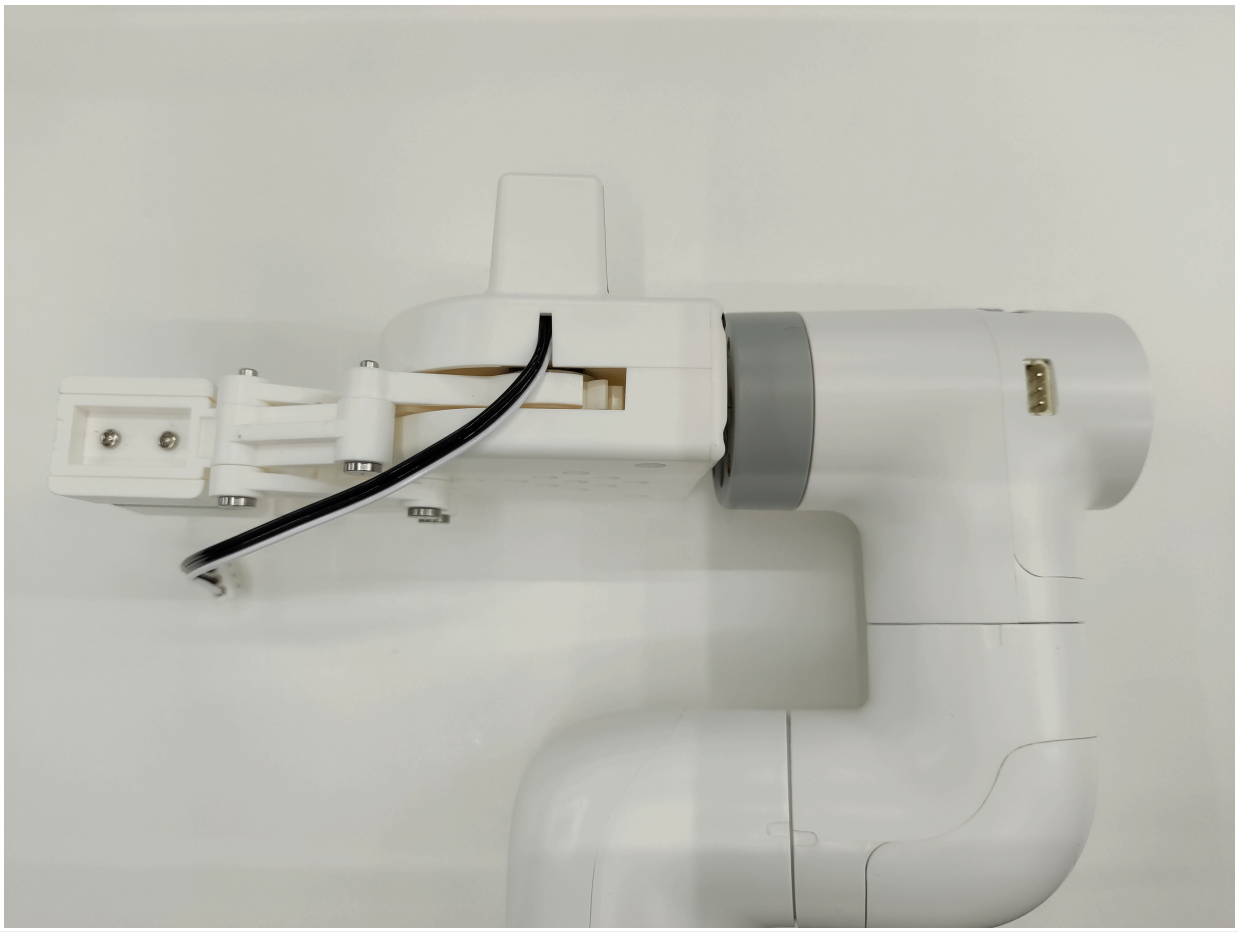
Installation and use

- Check whether the accessories package is complete: Lego connectors, grippers with connecting wires, and connecting wire extension wires

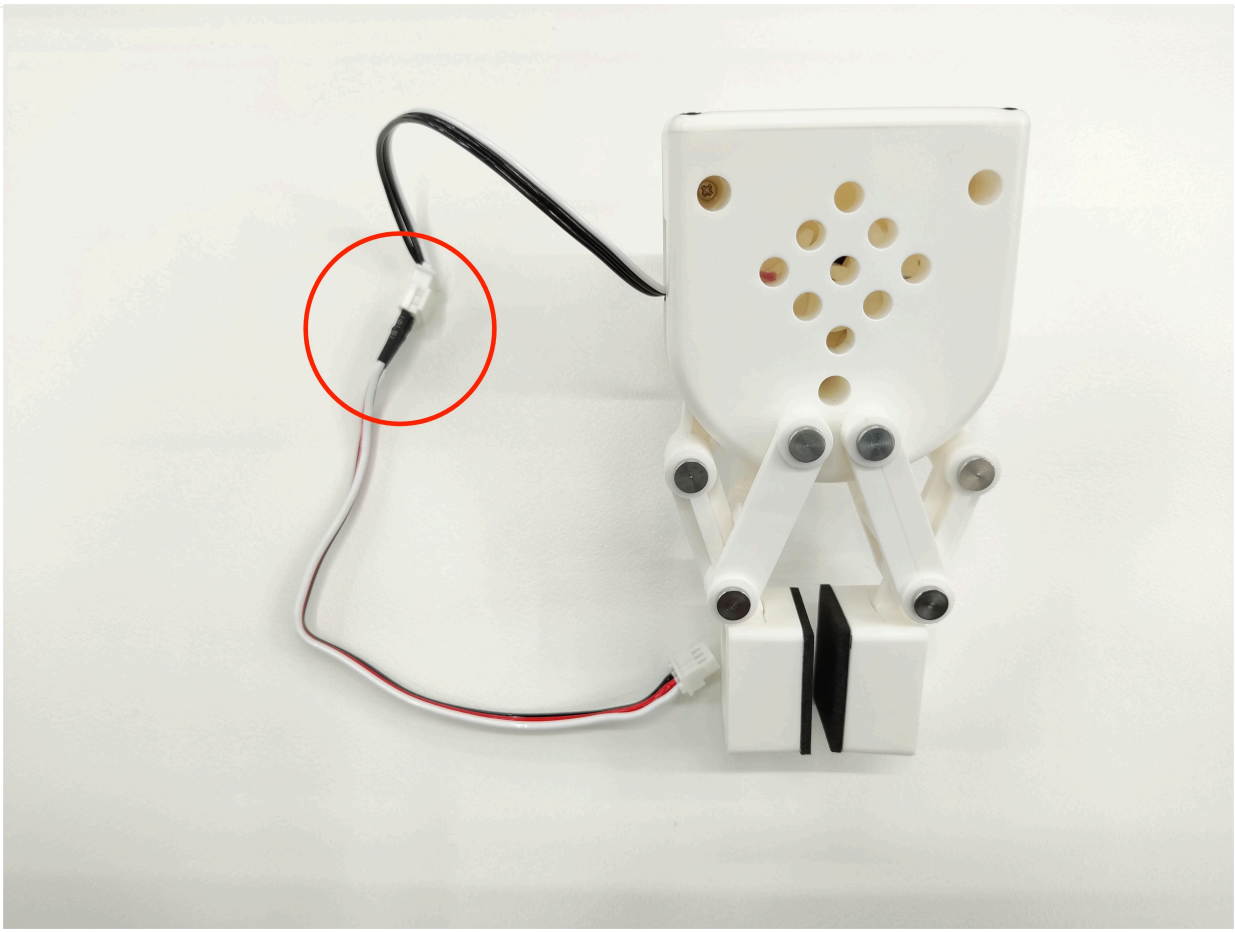
- Gripper installation:
- Structural installation:

Insert the Lego connector into the socket reserved for the gripper. You can choose two different directions for installation as needed:

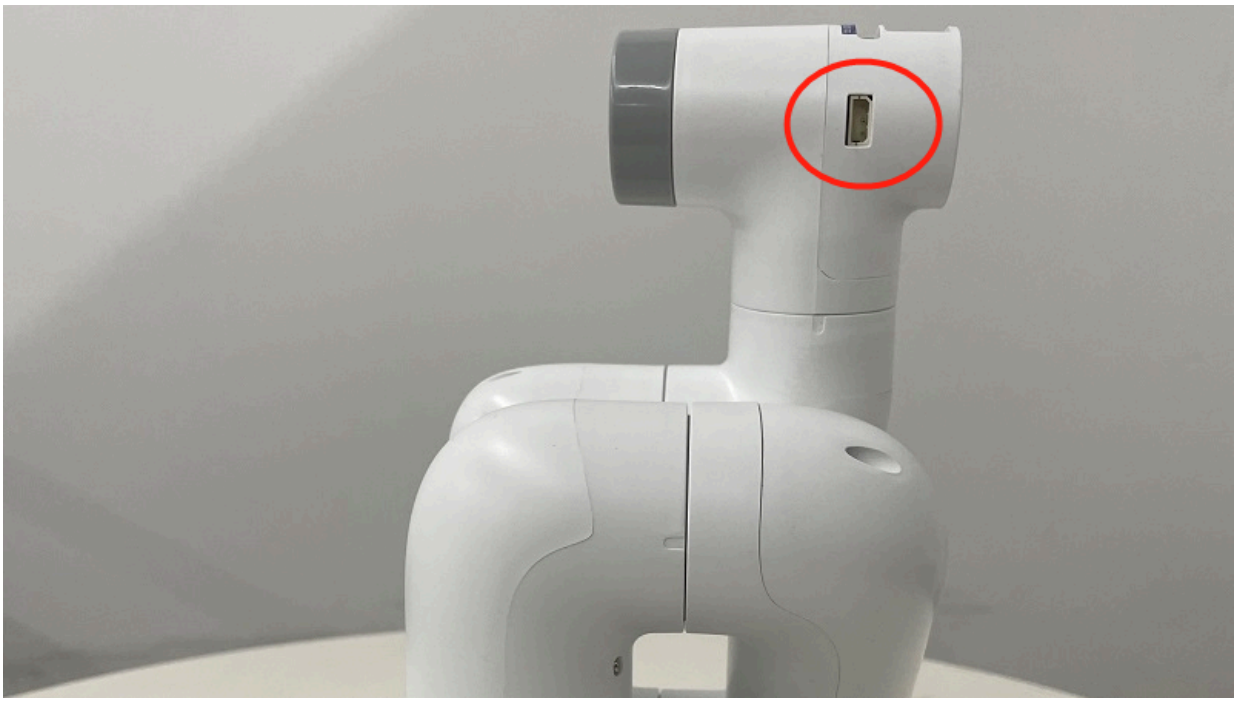
Align the gripper with the connector inserted into the socket at the end of the robot arm and insert it:

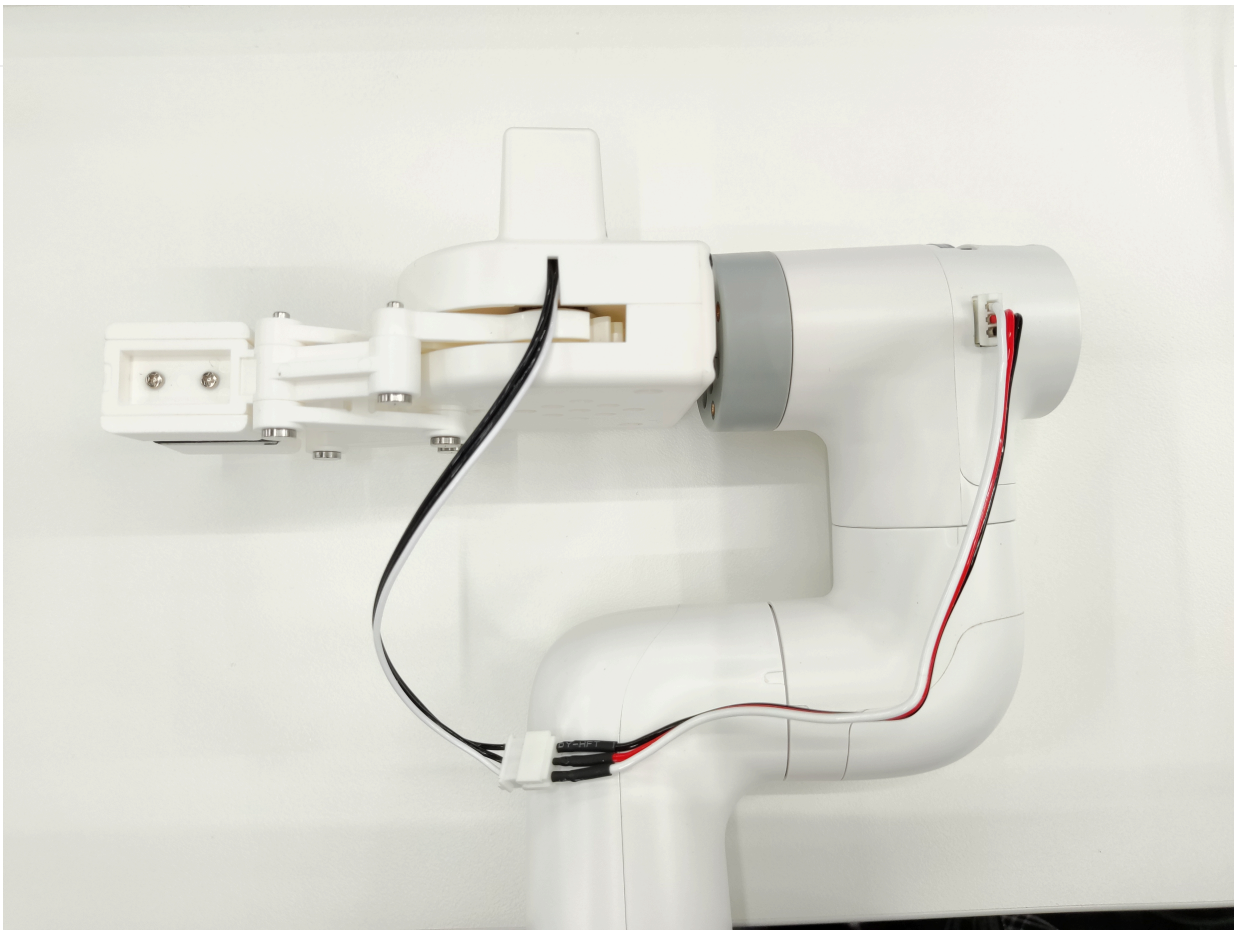


- Electrical connection Connect the extension cord to the gripper:



Insert the robot control interface:





Programming development:

> Use python to program the gripper

- M5 version:

```
from pymycobot import MyCobot280
import time


# Initialize a MyCobot object
mc = MyCobot280("COM3", 115200)


# The following three methods can control the gripper to open-close-open
# Method 1:
mc.set_gripper_state(0, 80)
time.sleep(3)
mc.set_gripper_state(1, 80)
time.sleep(3)
mc.set_gripper_state(0, 80)
time.sleep(3)


# Method 2:
# mc.set_gripper_value(100, 80)
# time.sleep(3)
# mc.set_gripper_value(0, 80)
# time.sleep(3)
# mc.set_gripper_value(100, 80)
# time.sleep(3)
# Method three:
# mc.set_encoder(7, 2048, 20)
# time.sleep(3)
# mc.set_encoder(7, 1500, 20)
# time.sleep(3)
# mc.set_encoder(7, 2048, 20)
# time.sleep(3)
```

- Pi version:

```
from pymycobot import MyCobot280
from pymycobot import PI_PORT, PI_BAUD # When using the Raspberry Pi version of mycobot, you can reference these two varia
import time


# Initialize a MyCobot object
mc = MyCobot280(PI_PORT, PI_BAUD)


# The following three methods can control the gripper to open-close-open
# Method 1:
mc.set_gripper_state(0, 80)
time.sleep(3)
mc.set_gripper_state(1, 80)
time.sleep(3)
mc.set_gripper_state(0, 80)
time.sleep(3)
# Method 2:
# mc.set_gripper_value(100, 80)
# time.sleep(3)
# mc.set_gripper_value(0, 80)
# time.sleep(3)
# mc.set_gripper_value(100, 80)
# time.sleep(3)
# Method 3:
# mc.set_encoder(7, 2048, 20)
# time.sleep(3)
# mc.set_encoder(7, 1500, 20)
# time.sleep(3)
# mc.set_encoder(7, 2048, 20)
# time.sleep(3)
```

Save the file and close it. Return to the command line terminal and enter:

```
python grip.py
```

> You can see the gripper open-close-open

Parallel gripper

Applicable models: myCobot 280, myPalletizer 260, mechArm 270

Product image

Specifications:

Name	mycobot280 parallel gripper
Model model	myCobot_gripper_parallel
Process	ABS injection molding
Color	White
Gripping range	<20mm (effective 15mm)
Maximum gripping force	150g
Repeatability	1mm
Service life	One year
Drive mode	Electric
Transmission mode	Gear + connecting rod
Dimensions	66×78×46mm
Weight	84g
Fixing method	Lego connector
Environment requirements	Normal temperature and pressure
Control interface	Serial control
Applicable equipment	ER myCobot 280 series, ER myPalletizer 260 series, ER mechArm 270 series, ER myBuddy 280 series

Parallel gripper: Used to grip objects

Introduction

- The gripper is a robot component that can achieve functions similar to human hands. It has the advantages of complex structure, firm gripping of objects, not easy to fall, and easy operation. The gripper kit includes gripper accessories and Lego technology parts. The end effector of the robot arm is controlled by a programmable system to realize functions such as object gripping and multi-point positioning. The gripper can be used in all development environments, such as ROS, Arduino, Roboflow, etc.

Working Principle

- Driven by a motor, the gripper's finger surface makes linear reciprocating motion to achieve opening or closing. The acceleration and deceleration of the electric gripper are controllable, the impact on the workpiece can be minimized, the positioning point is controllable, and the clamping is controllable.

Applicable objects

- Small cubes
- Small balls
- Long objects

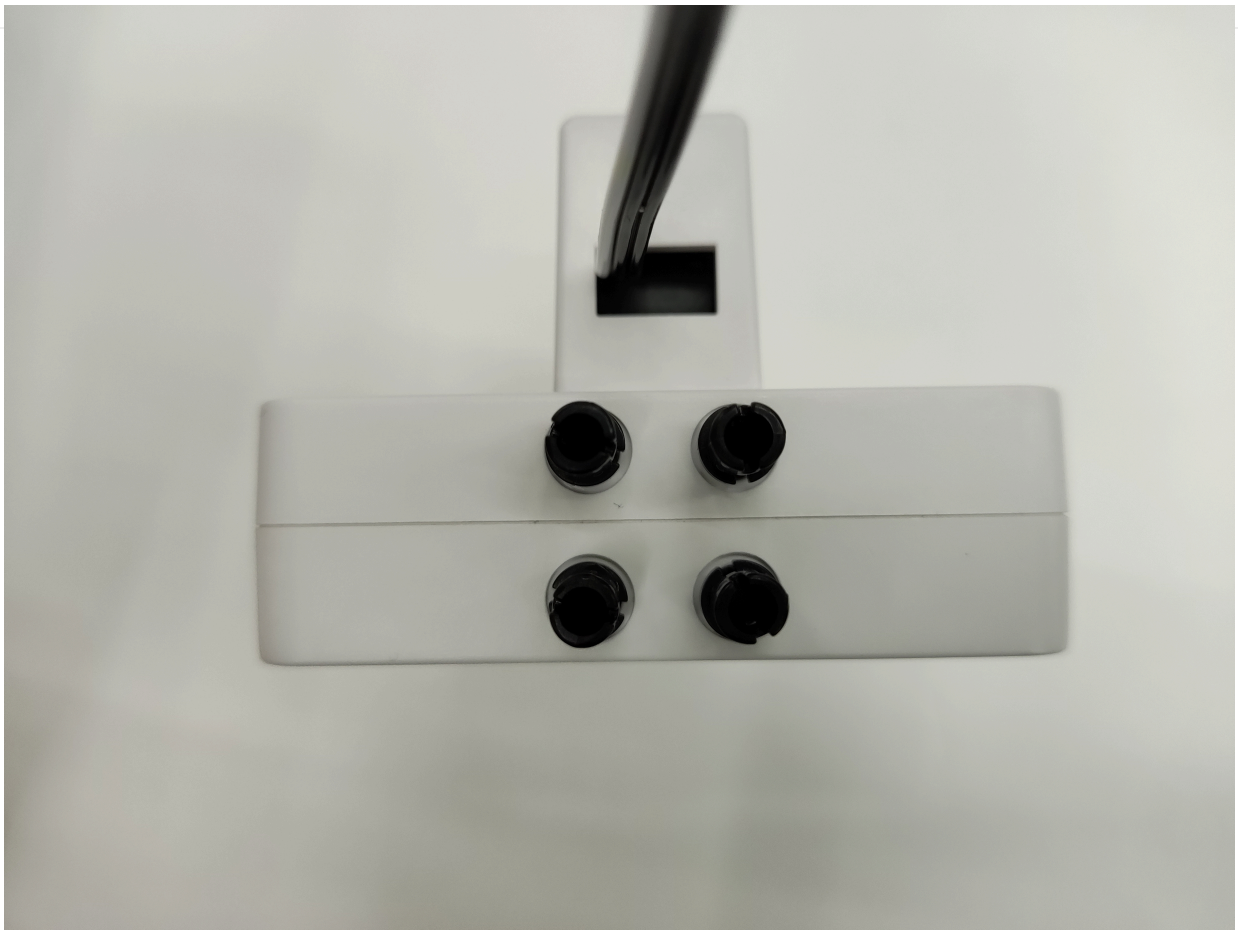
Installation and use

- Check whether the accessories package is complete: Lego connectors, grippers with connecting wires

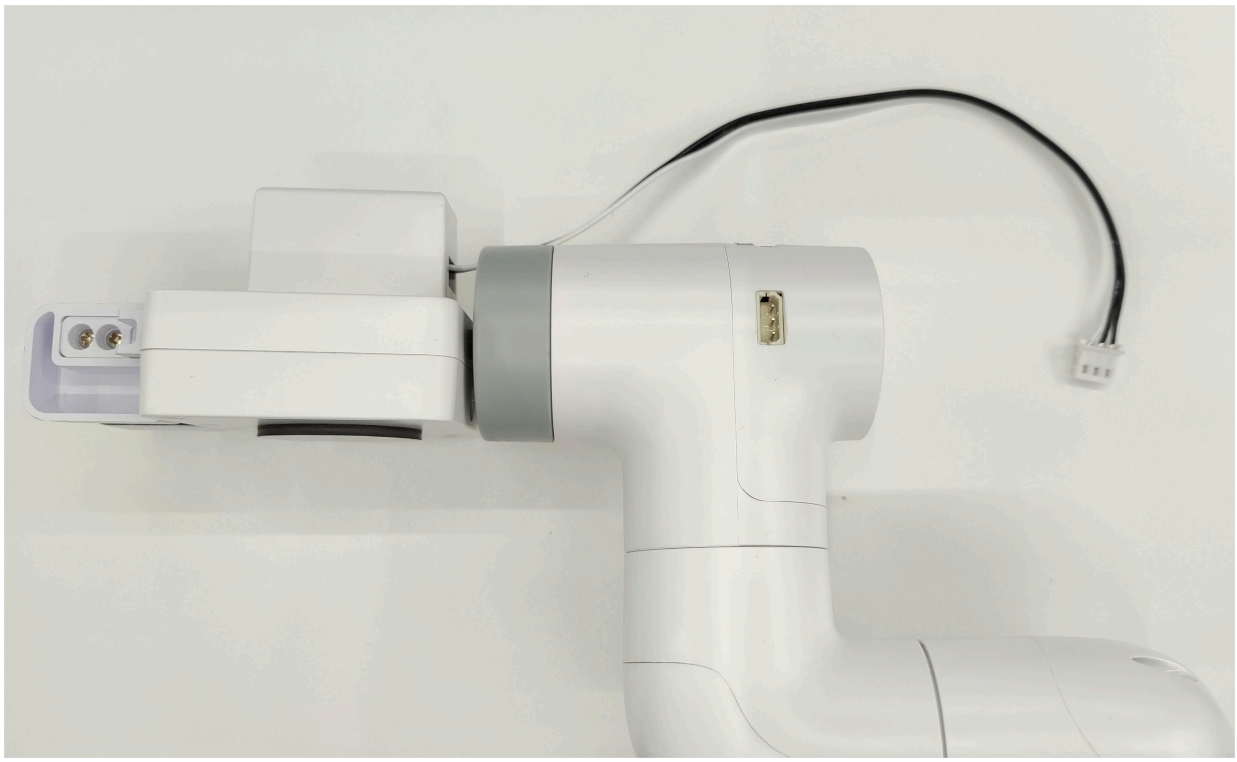
- Gripper installation:

Structural installation:

Insert the Lego connector into the reserved socket of the gripper:

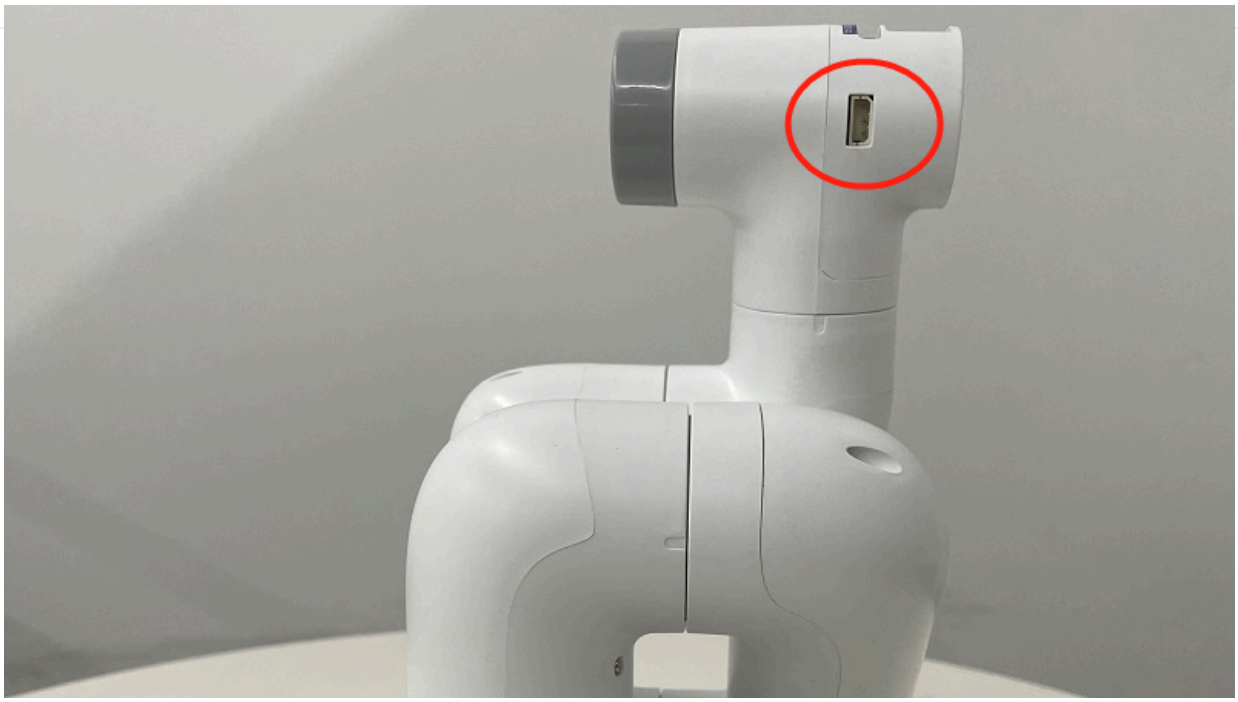


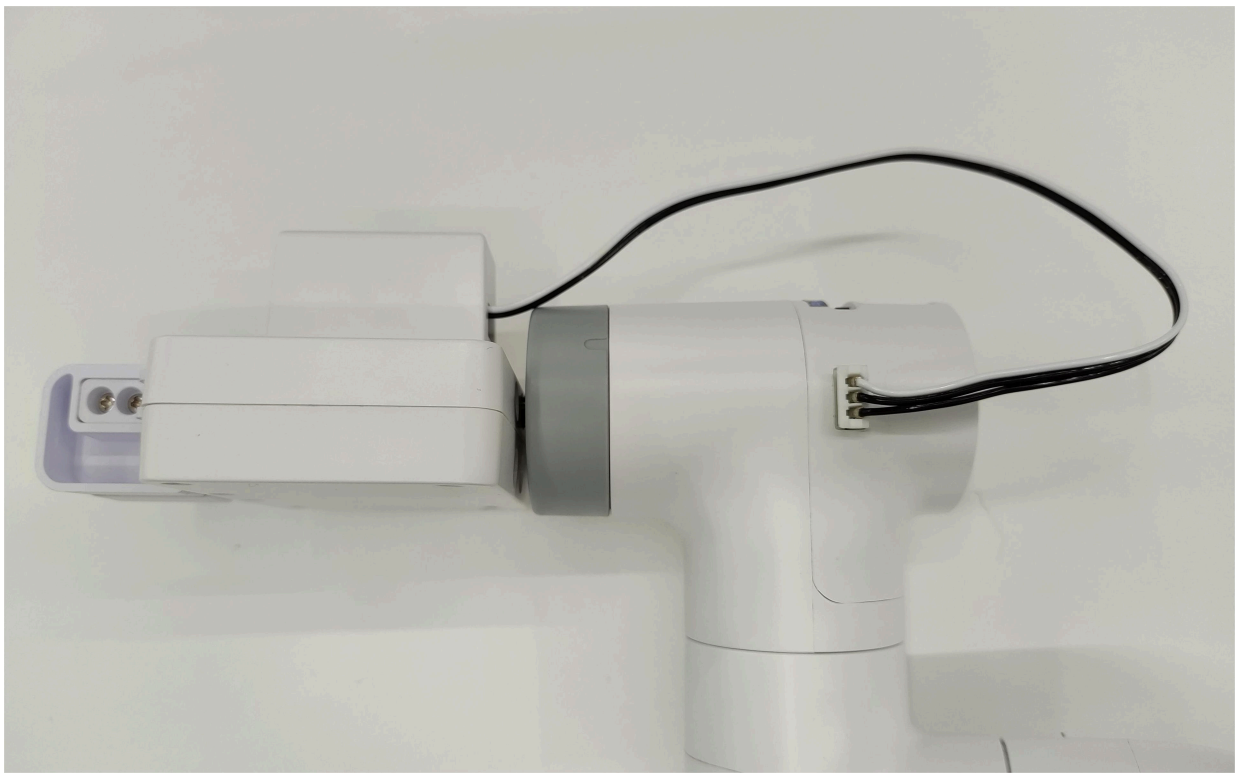
Align the gripper with the connector inserted into the socket at the end of the robot arm and insert it:



Electrical connection:

Insert the robot arm control interface:





Programming and development:

> Use python to program the gripper

- M5 version:

```
from pymycobot import MyCobot280
import time


# Initialize a MyCobot280 object
mc = MyCobot280("COM3", 115200)


# The following three methods can control the gripper to open-close-open
# Method 1:
mc.set_gripper_state(0, 80)
time.sleep(3)
mc.set_gripper_state(1, 80)
time.sleep(3)
mc.set_gripper_state(0, 80)
time.sleep(3)


# Method 2:
# mc.set_gripper_value(100, 80)
# time.sleep(3)
# mc.set_gripper_value(0, 80)
# time.sleep(3)
# mc.set_gripper_value(100, 80)
# time.sleep(3)
# Method three:
# mc.set_encoder(7, 2048, 20)
# time.sleep(3)
# mc.set_encoder(7, 1500, 20)
# time.sleep(3)
# mc.set_encoder(7, 2048, 20)
# time.sleep(3)
```

- Pi version:

```
from pymycobot import MyCobot280
from pymycobot import PI_PORT, PI_BAUD # When using the Raspberry Pi version of mycobot, you can reference these two varia
import time

# Initialize a MyCobot280 object
mc = MyCobot280(PI_PORT, PI_BAUD)

# The following three methods can control the gripper to open-close-open
# Method 1:
mc.set_gripper_state(0, 80)
time.sleep(3)
mc.set_gripper_state(1, 80)
time.sleep(3)
mc.set_gripper_state(0, 80)
time.sleep(3)

# Method 2:
# mc.set_gripper_value(100, 80)
# time.sleep(3)
# mc.set_gripper_value(0, 80)
# time.sleep(3)
# mc.set_gripper_value(100, 80)
# time.sleep(3)

# Method 3:
# mc.set_encoder(7, 2048, 20)
# time.sleep(3)
# mc.set_encoder(7, 1500, 20)
# time.sleep(3)
# mc.set_encoder(7, 2048, 20)
# time.sleep(3)
```

Save the file and close it, return to the command line terminal, and enter:

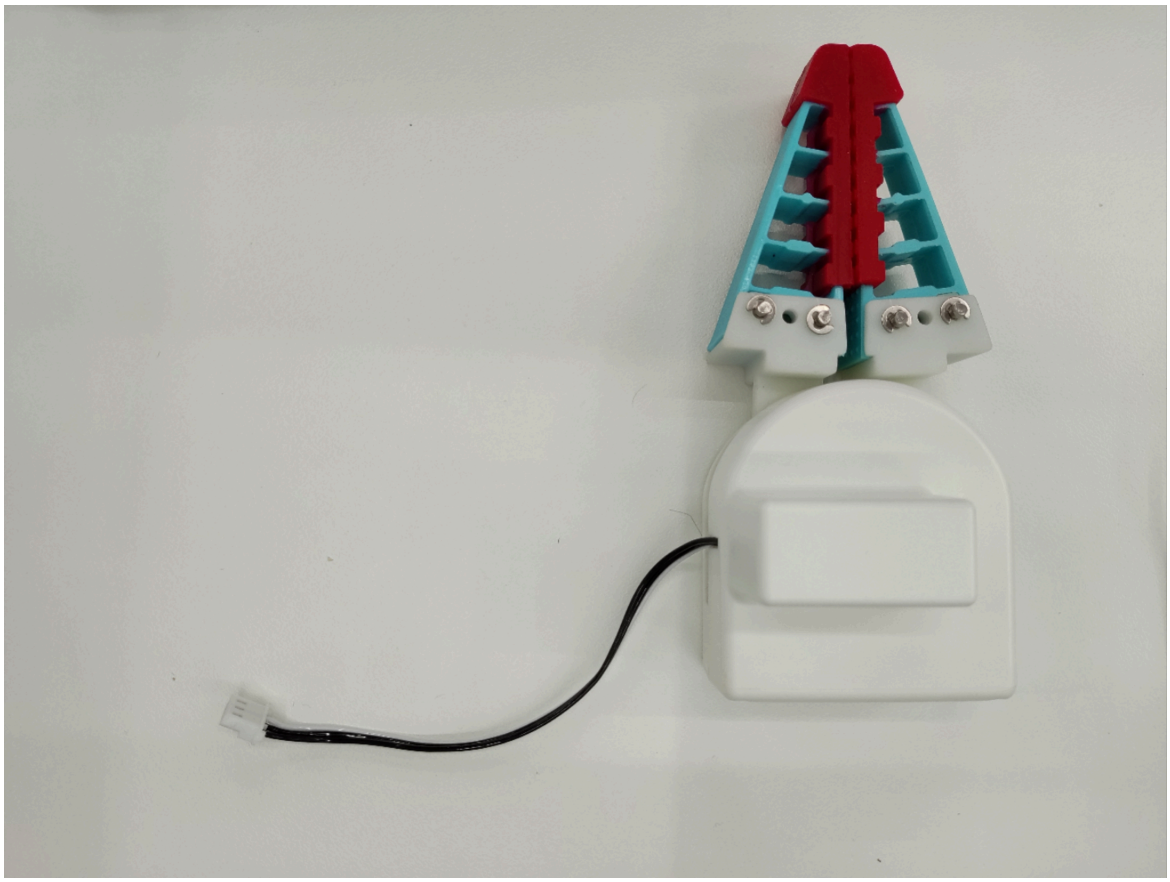
```
python grip.py
```

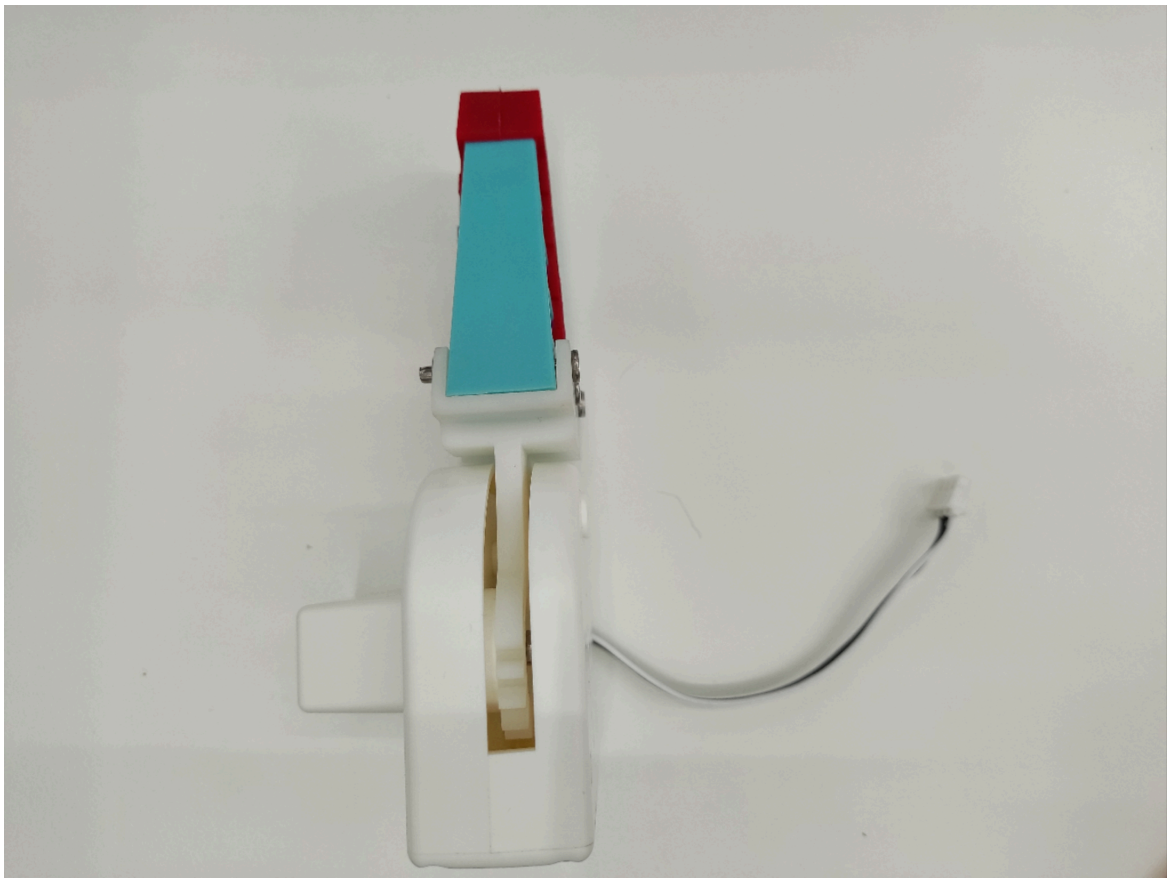
> You can see the gripper open-close-open

Flexible Gripper - Open-leg Type

Applicable models: myCobot 280, myPalletizer 260, mechArm 270, myBuddy 280

Product Image





Specifications:

Name	mycobot280 Open-leg Gripper
Model model	myCobot Open-leg Gripper
Process	Photosensitive resin
Color	White
Repeatability	±1mm
Service life	One year
Drive mode	Electric
Fixing mode	Lego connector
Environmental requirements	Normal temperature and pressure
Control interface	Serial control
Applicable equipment	ER myCobot 280 series, ER myPalletizer 260 series, ER mechArm 270 series, ER myBuddy 280 series

Flexible gripper: Used to grip objects

Introduction

- Traditional industrial suction cups need to suck the flat surface of the material. In more and more working conditions, the suction surface is easy to damage the panel or components. The soft-touch gripper grabs the edge and easily transports the panel without marks or damage, ensuring that the product surface is flawless and improving the yield rate.
- The modular design of the soft-touch gripper is light in weight and can be freely arranged and combined according to the size of the panel.
- The clamping force of traditional cylinders is generally large, and the force is difficult to control. The edge of the clamped panel is easy to be clamped and warped. The single-finger clamping force of the flexible gripper is precisely controllable and will not clamp fragile workpieces.

Working Principle

- The flexible gripper is an innovative bionic flexible gripper developed by researchers imitating the shape of the arms and legs of a starfish. The "fingers" of the soft gripper are made of flexible polymer silicone material, which can bend and deform by inflation. It can adaptively wrap around the target object like a starfish, and can complete the flexible and non-destructive grasping of irregular and fragile objects.

Applicable objects

- Any object of any shape within a reasonable size

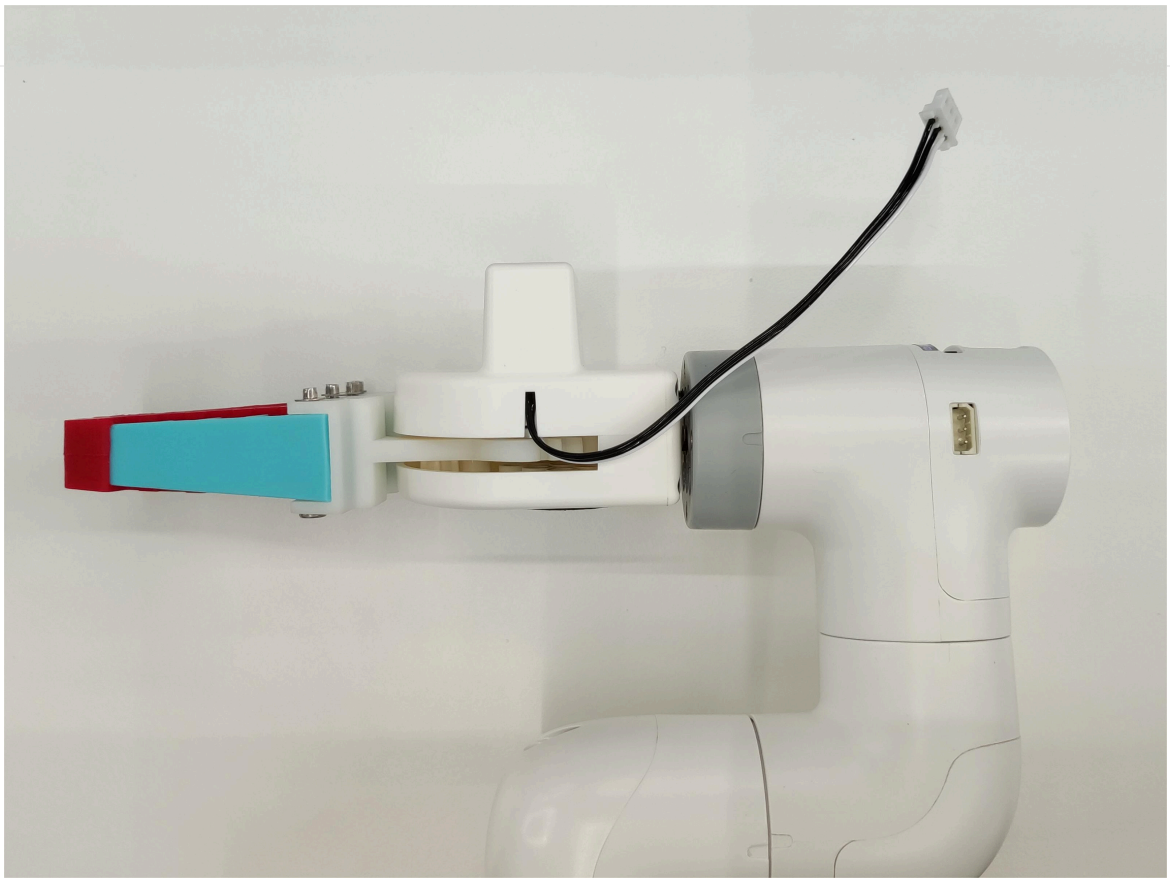
Installation and use

- Check whether the accessories package is complete: Lego connector, gripper with connecting wire, extension wire

- Gripper installation:

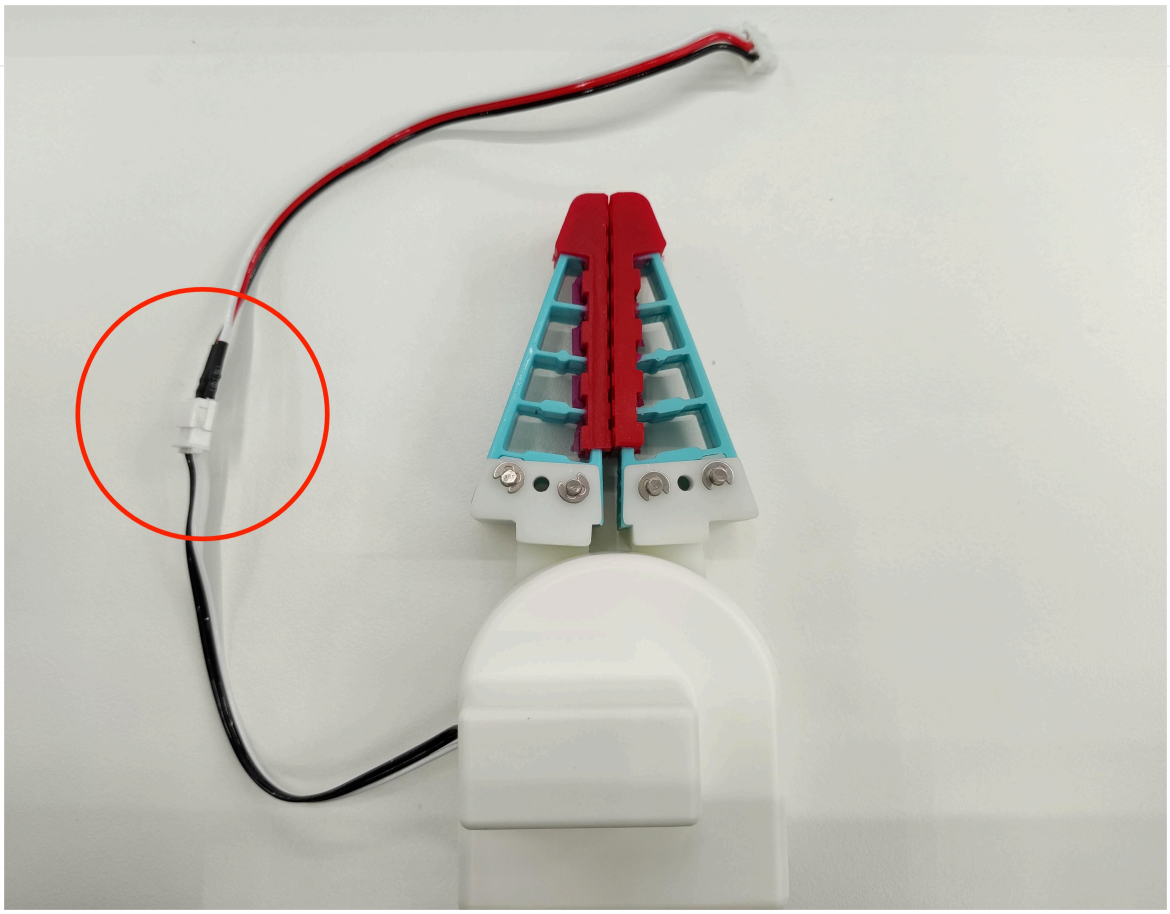
Structural installation: Insert the Lego connector into the reserved socket of the gripper. You can choose two different directions for installation as needed:

Align the gripper with the connector inserted into the socket at the end of the robot arm and insert it:

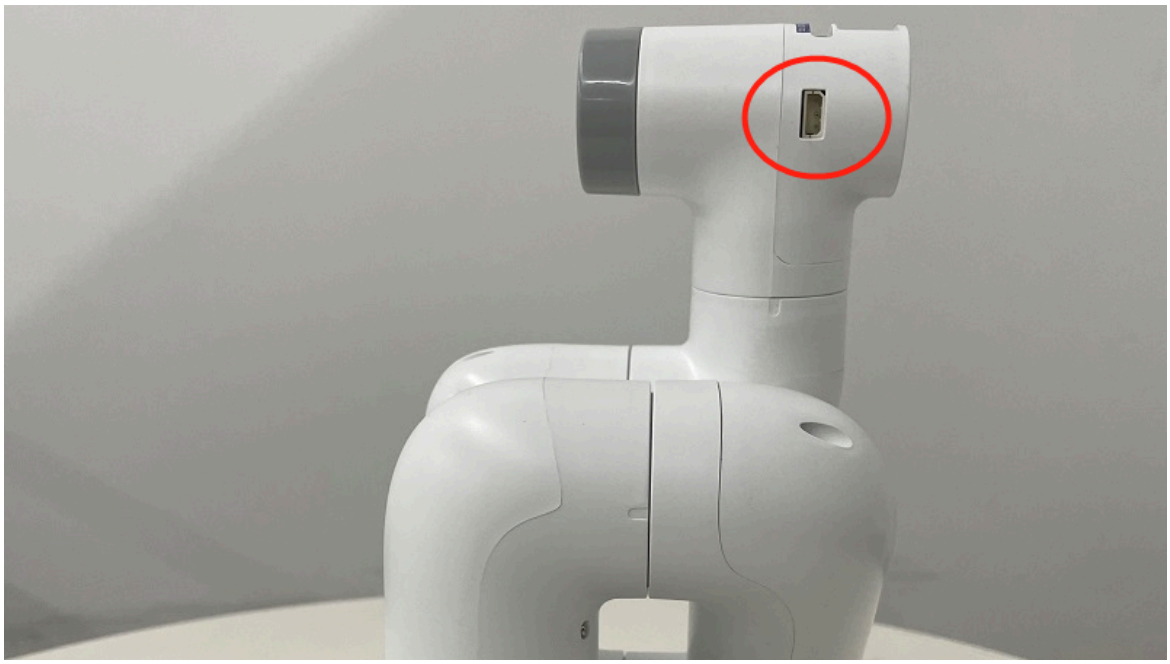


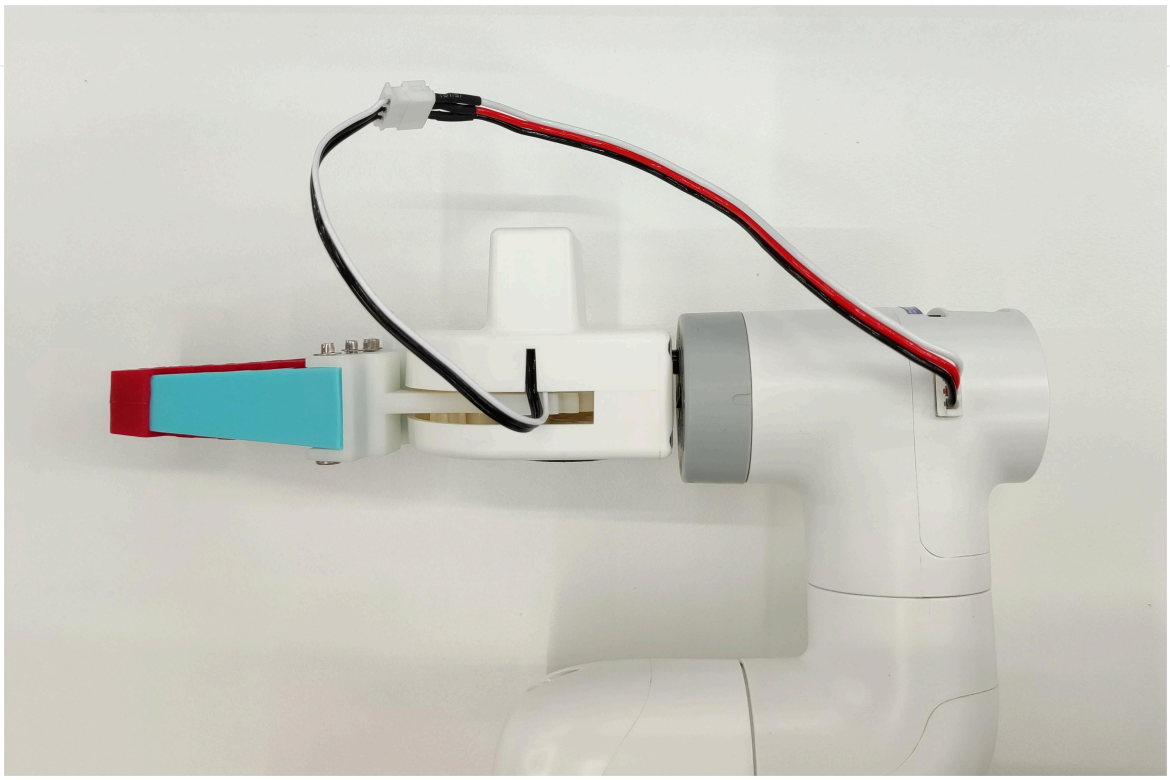
- Electrical connection:

Connect the extension wire to the gripper:



Insert the robot control interface:





Programming development

- M5 version:

```
from pymycobot import MyCobot280
import time


# Initialize a MyCobot280 object
mc = MyCobot280("COM3", 115200)


# The following three methods can control the gripper to open-close-open
# Method 1:
mc.set_gripper_state(0, 80)
time.sleep(3)
mc.set_gripper_state(1, 80)
time.sleep(3)
mc.set_gripper_state(0, 80)
time.sleep(3)


# Method 2:
# mc.set_gripper_value(100, 80)
# time.sleep(3)
# mc.set_gripper_value(0, 80)
# time.sleep(3)
# mc.set_gripper_value(100, 80)
# time.sleep(3)
# Method three:
# mc.set_encoder(7, 2048, 20)
# time.sleep(3)
# mc.set_encoder(7, 1500, 20)
# time.sleep(3)
# mc.set_encoder(7, 2048, 20)
# time.sleep(3)
```

- Pi version:

```
from pymycobot import MyCobot280
from pymycobot import PI_PORT, PI_BAUD # When using the Raspberry Pi version of mycobot, you can reference these two varia
import time


# Initialize a MyCobot280 object
mc = MyCobot280(PI_PORT, PI_BAUD)


# The following three methods can control the gripper to open-close-open
# Method 1:
mc.set_gripper_state(0, 80)
time.sleep(3)
mc.set_gripper_state(1, 80)
time.sleep(3)
mc.set_gripper_state(0, 80)
time.sleep(3)
mc.set_gripper_state(0, 80)
time.sleep(3)
# Method 2:
# mc.set_gripper_value(100, 80)
# time.sleep(3)
# mc.set_gripper_value(0, 80)
# time.sleep(3)
# mc.set_gripper_value(100, 80)
# time.sleep(3)

# Method 3:
# mc.set_encoder(7, 2048)
# time.sleep(3)
# mc.set_encoder(7, 1500)
# time.sleep(3)
# mc.set_encoder(7, 2048)
# time.sleep(3)
```

Save the file and close it, return to the command line terminal, and enter:

```
python grip.py
```

> You can see the gripper open-close-open

Vertical Suction Pump V2.0

Applicable models: myCobot 280, myPalletizer 260, mechArm 270

Product Image

Specifications

Name	myCobot Vertical Suction Pump V2.0
Model	myCobot_suctionPump_V2.0_grey
Material	ABS injection molding
Color	White
Dimensions	Suction Pump Box: 72x52x37 Suction Pump End: 63x24.5x26.7
Number of Suction Cups	1
Suction Cup Size	Diameter 20mm
Suction Weight	150g
Power Source Equipment	Suction pump box
Service life	One year
Fixing method	Lego connector
Control interface	IO control
Use environment requirements	Normal temperature and pressure
Applicable equipment	ER myCobot 280 series, ER myPalletizer 260 series, ER mechArm 270 series, ER myBuddy 280 series

Suction pump: Used for adsorbing objects

Introduction

- Suction pump, that is, vacuum adsorption pump, has one suction nozzle and one exhaust nozzle. It has the advantages of simple structure, small size, easy use, low noise, and good self-priming ability. By controlling the suction pump kit as the end effector of the robot arm, the function of adsorbing objects is performed.
- Suction pump accessories: power cord x1, Dupont wire x10, one-input and two-output connection wire x1, several Lego tech parts

Working principle

- When sucking objects: the air pump starts to suck air and adsorbs the objects and then stops, and there will be no air leakage in a short time.
- When putting down the objects: the electronic valve starts, the air release valve opens, and air enters the vacuum suction cup to separate from the sucked objects.

Applicable objects

- Paper/plastic sheets
- Flat and smooth objects
- Cards, etc.

Installation and use

- Check whether the accessories package is complete: Lego connectors, Dupont wires, double-head suction pump

- Double-head suction pump installation:

Structural installation:

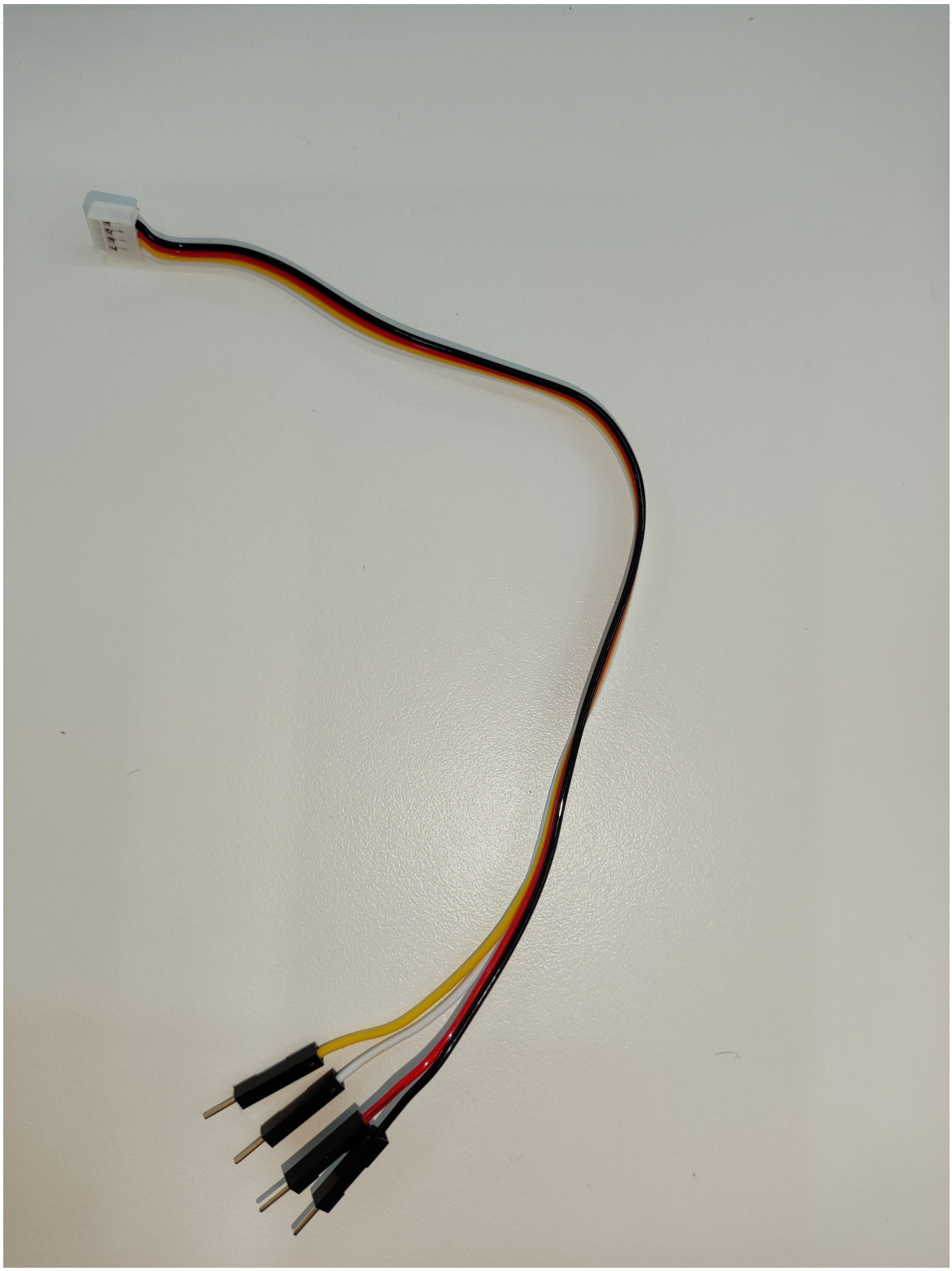
Insert the Lego connector into the reserved socket on the suction pump:

Align the suction pump with the connector plugged in with the socket at the end of the robotic arm and insert it:

- Electrical connection:

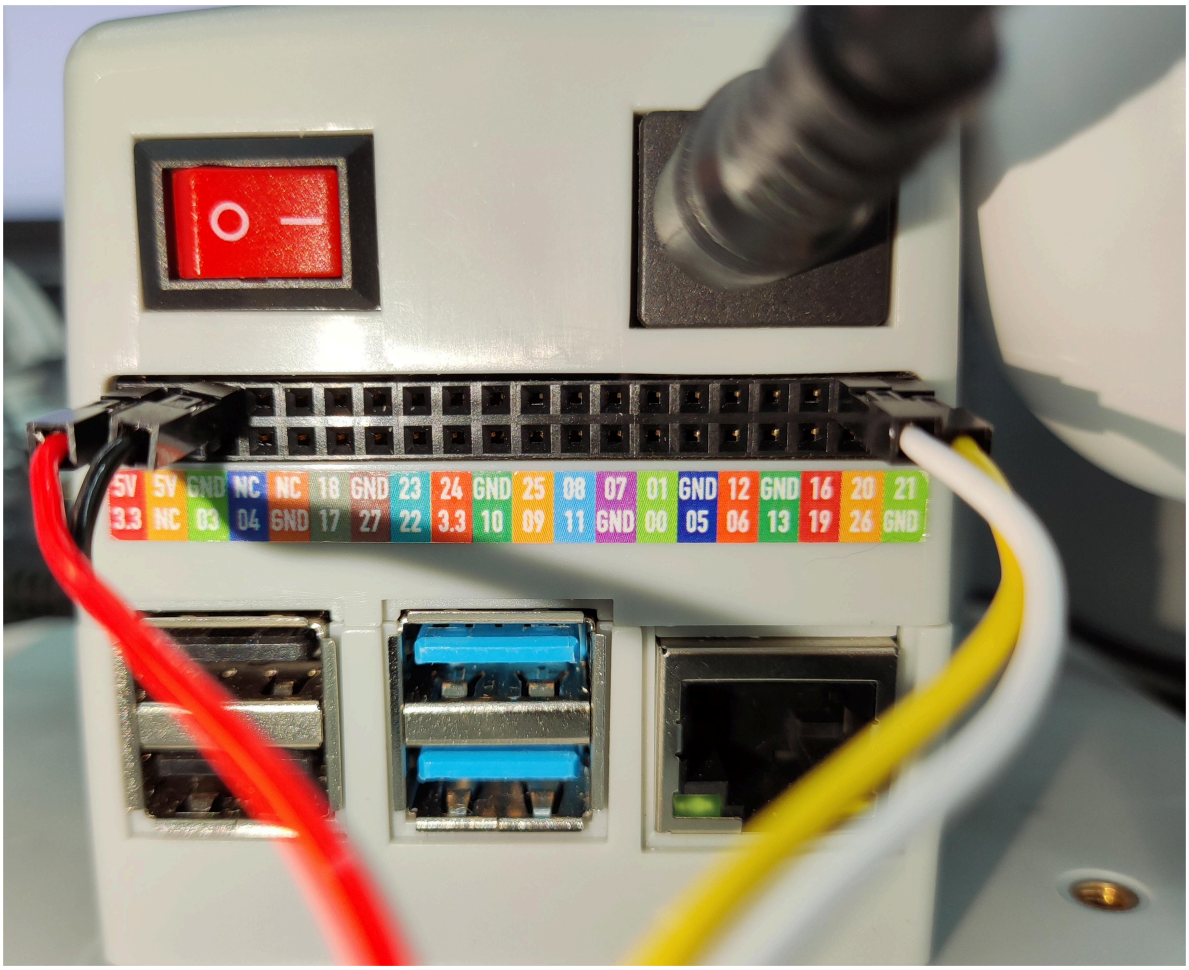
Select the male-female DuPont wire and insert the female end into the socket marked with pins on the suction pump box:

Male-female DuPont wire:



Note the correspondence between the DuPont wire colors and pins in the figure:

1. Insert the male end into the robot base pin according to the given correspondence:



> The left side is the suction pump pin and the right side is the robot pin GND -> GND 5V -> 5V G2 -> 21 G5 -> 20

- Programming development:

  > Use python to program the suction pump

> The code is as follows:

- 280-M5 version:

```
from pymycobot import MyCobot280
import time

# Initialize a MyCobot280 object
mc = MyCobot280("COM3", 115200)

# Turn on the suction pump
def pump_on():
# Open the solenoid valve
mc.set_basic_output(5, 0)
time.sleep(0.05)

# Stop the suction pump
def pump_off():
# Close the solenoid valve
mc.set_basic_output(5, 1)
time.sleep(0.05)
# The deflation valve starts working
mc.set_basic_output(2, 0)
time.sleep(1)
mc.set_basic_output(2, 1)
time.sleep(0.05)

pump_off()
time.sleep(3)
pump_on()
time.sleep(3)
pump_off()
time.sleep(3)
GPIO.cleanup() # Release pin channel
```

- 280-Pi version:

```
from pymycobot import MyCobot280
from pymycobot import PI_PORT, PI_BAUD # When using the Raspberry Pi version of mycobot, you can reference these two varia
import time
import RPi.GPIO as GPIO

# Initialize a MyCobot object
mc = MyCobot280(PI_PORT, PI_BAUD)

# Initialize
GPIO.setmode(GPIO.BCM)
# Pins 20/21 control the solenoid valve and the deflation valve respectively
GPIO.setup(20, GPIO.OUT)
GPIO.setup(21, GPIO.OUT)

# Turn on the suction pump
def pump_on():
# Open the solenoid valve
GPIO.output(20, 0)

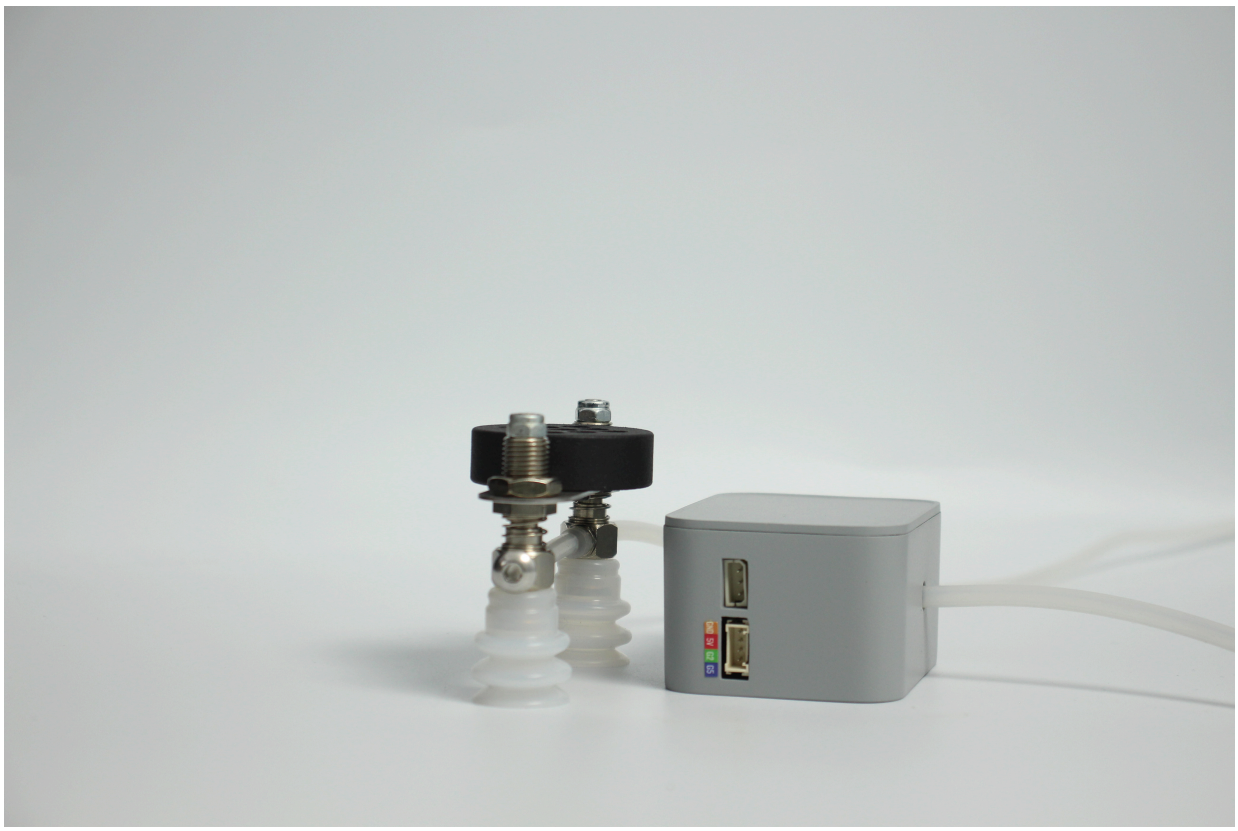
# Stop the suction pump
def pump_off():
# Close the solenoid valve
GPIO.output(20, 1)
time.sleep(0.05)
# Open the deflation valve
GPIO.output(21, 0)
time.sleep(1)
GPIO.output(21, 1)
time.sleep(0.05)

pump_off()
time.sleep(3)
pump_on()
time.sleep(3)
pump_off()
time.sleep(3)
GPIO.cleanup() # Release the pin channel
```

Dual-head suction pump

Applicable models: myCobot 280, myPalletizer 260, mechArm 270

Product image



Specifications

Name	Dual-head suction pump
Model	myCobot_DualPump_grey
Material	Photosensitive resin/nylon 7100
Color	White+black
Size	Pump end: 63x24.5x26.7
Number of suction cups	2
Suction cup size	Diameter 20mm
Suction weight	150g
Power source equipment	Pump box
Service life	One year
Fixing method	Lego connector
Control interface	IO control
Environment requirements	Normal temperature and pressure
Applicable equipment	ER myCobot 280 series, ER myPalletizer 260 series, ER mechArm 270 series, ER myBuddy 280 series

Suction pump: Used for adsorbing objects

Introduction

- Suction pump, that is, vacuum adsorption pump, has two suction nozzles and two exhaust nozzles for one inlet and one outlet. It is more stable than single-head suction pump. It has the advantages of simple structure, small size, easy use, low noise, and good self-priming ability. By controlling the suction pump kit as the end effector of the robot arm, the function of adsorbing objects is performed.
- Suction pump accessories: power cord x1, DuPont line x10, one-input and two-output connection line x1, Lego technology parts x several

Working principle

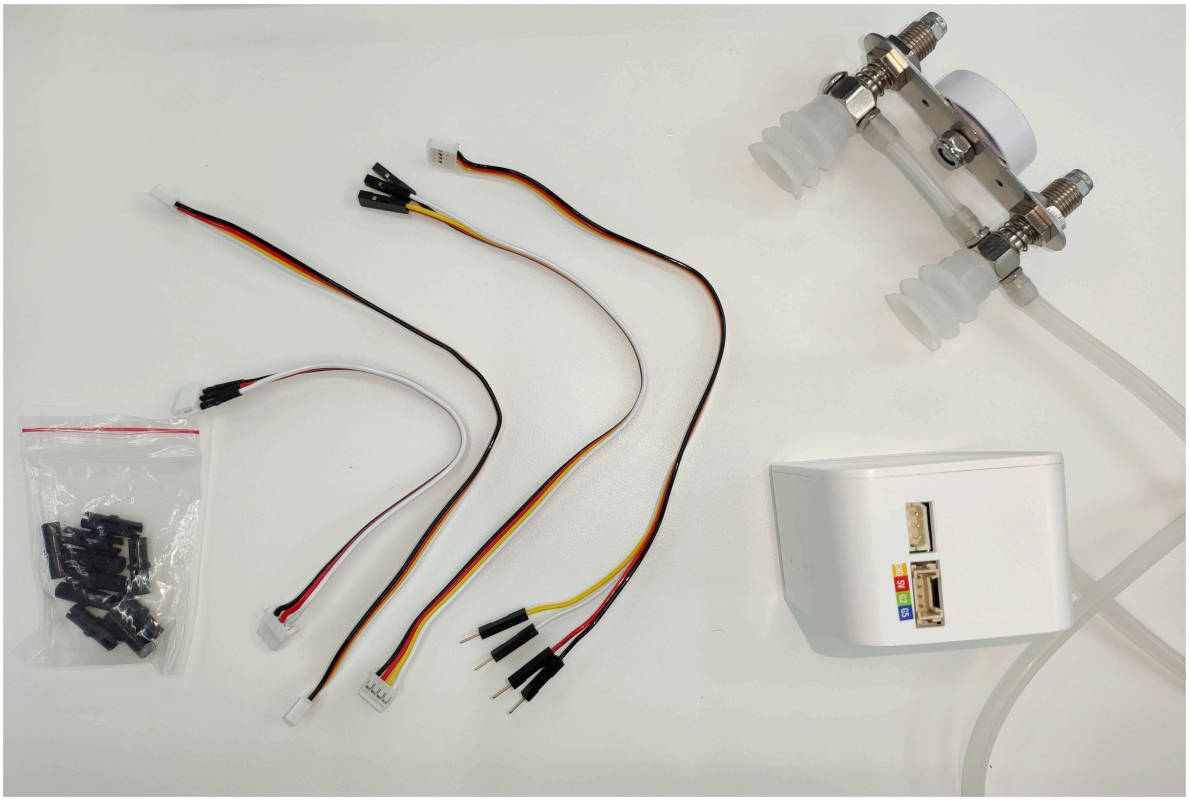
- When sucking objects: the air pump starts to suck air and adsorb objects and then stops, and there will be no leakage in a short time.
- When putting down the object: the electronic valve starts, the air release valve opens, and air enters the vacuum suction cup to separate from the sucked object.

Applicable objects

- Paper/plastic sheets
- Flat and smooth objects
- Cards, etc.

Installation and use

- Check whether the accessories package is complete: Lego connectors, Dupont wires, double-head suction pump



- Double-head suction pump installation:

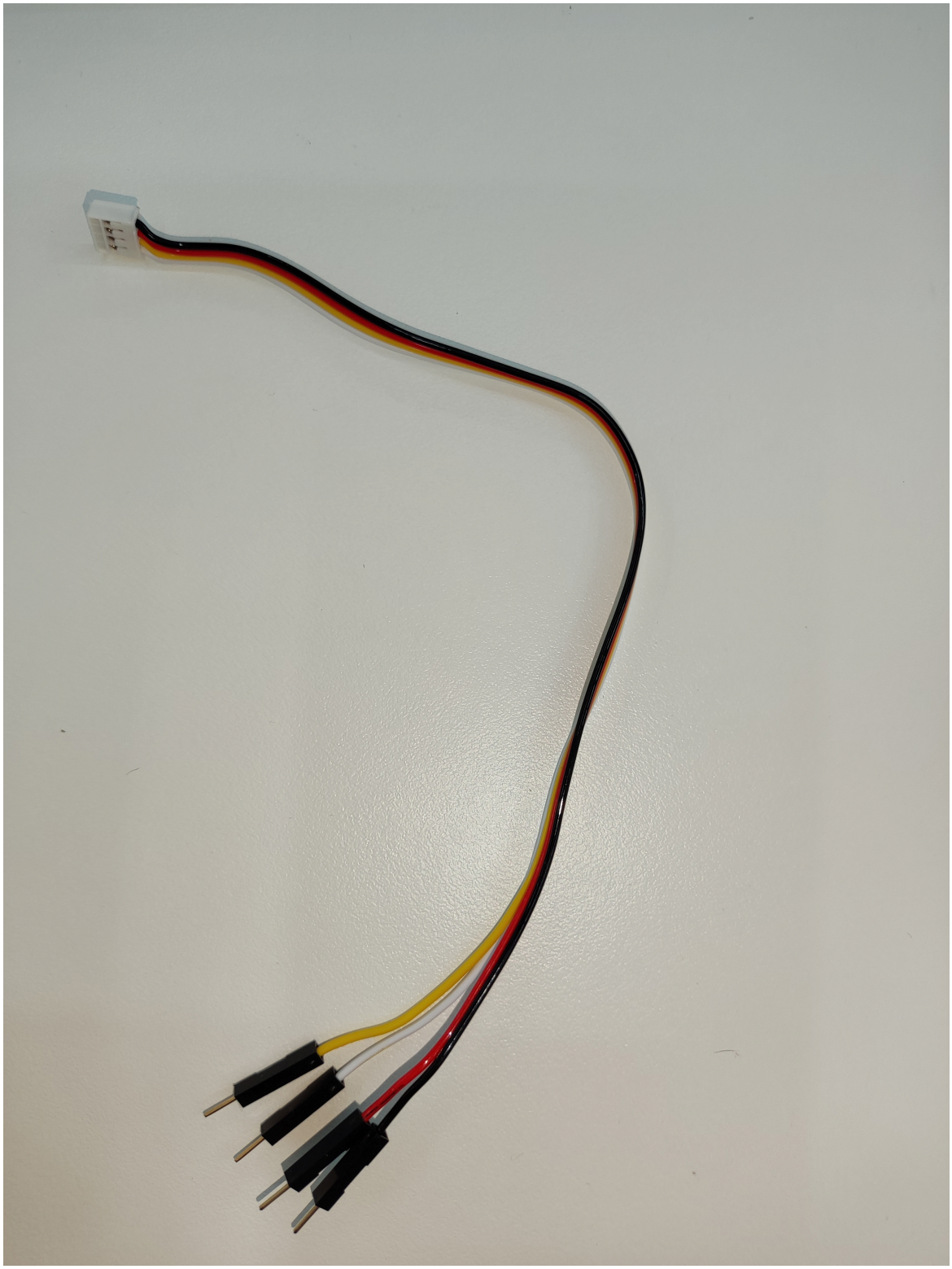
Structural installation:

Insert the Lego connector into the reserved socket on the suction pump:

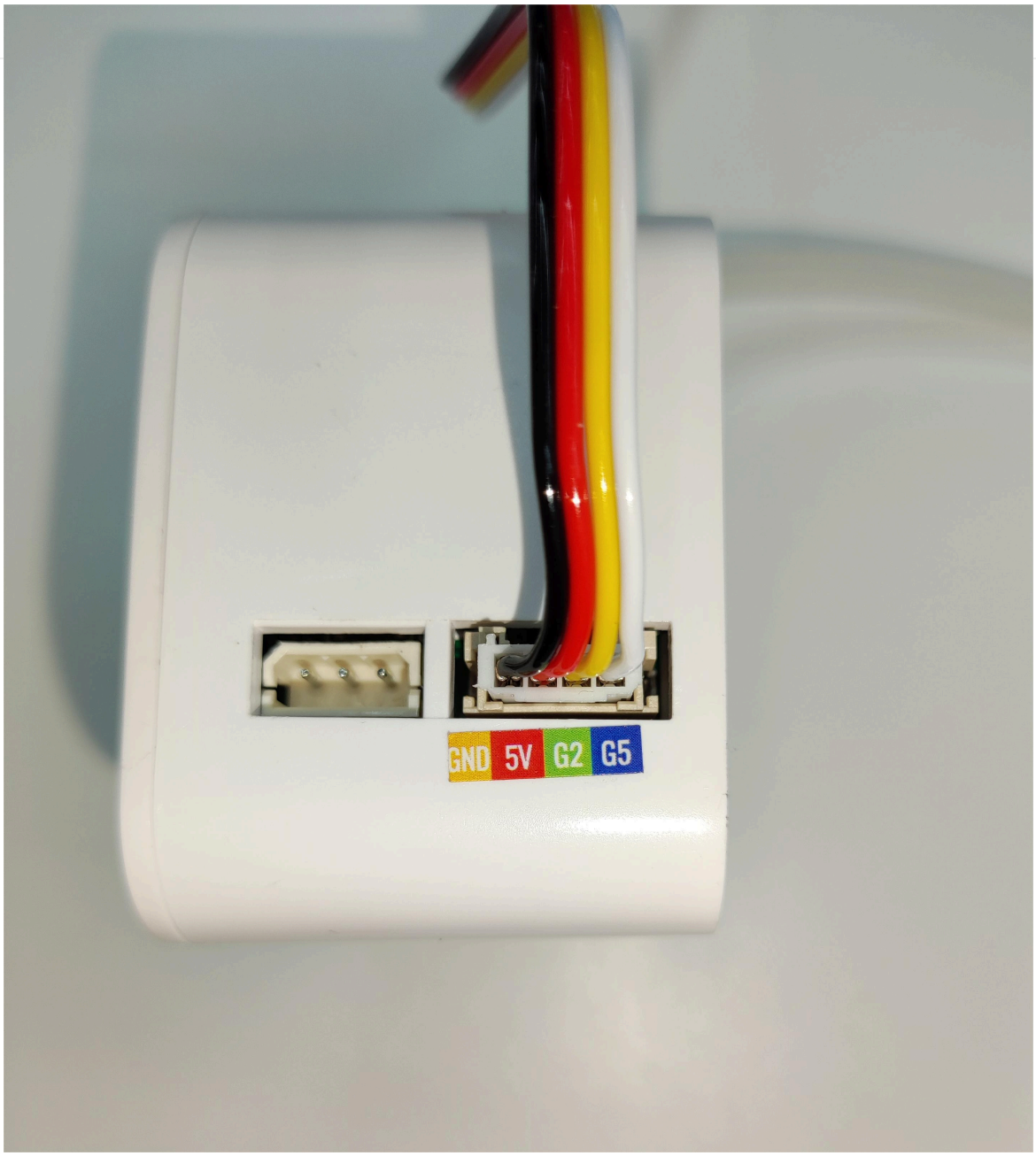
Align the suction pump with the connector plugged in with the socket at the end of the robotic arm and insert it:

- Electrical connection:

Select the male-female DuPont wire, and insert the female end into the socket marked with pins on the suction pump box:



Note the correspondence between the DuPont wire colors and pins in the figure:



Insert the male end into the robot base pin according to the given correspondence:

The left side is the suction pump pin, and the right side is the robot arm pin GND -> GND 5V -> 5V G2 -> 21 G5 -> 20

Programming development:

The code is as follows:

- 280-M5 version:

```
from pymycobot import MyCobot280
import time

# Initialize a MyCobot object
mc = MyCobot280("COM3", 115200)

# Turn on the suction pump
def pump_on():
# Open the solenoid valve
mc.set_basic_output(5, 0)
time.sleep(0.05)

# Stop the suction pump
def pump_off():
# Close the solenoid valve
mc.set_basic_output(5, 1)
time.sleep(0.05)
# The exhaust valve starts working
mc.set_basic_output(2, 0)
time.sleep(1)
mc.set_basic_output(2, 1)
time.sleep(0.05)

pump_off()
time.sleep(3)
pump_on()
time.sleep(3)
pump_off()
time.sleep(3)

GPIO.cleanup() # Release pin channel
```

- 280-Pi version:

```
from pymycobot import MyCobot280
from pymycobot import PI_PORT, PI_BAUD # When using the Raspberry Pi version of mycobot, you can reference these two varia
import time
import RPi.GPIO as GPIO

# Initialize a MyCobot280 object
mc = MyCobot280(PI_PORT, PI_BAUD)

# Initialization
GPIO.setmode(GPIO.BCM)
# Pins 20/21 control the solenoid valve and the exhaust valve respectively
GPIO.setup(20, GPIO.OUT)
GPIO.setup(21, GPIO.OUT)

# Turn on the suction pump
def pump_on():
# Open the solenoid valve
GPIO.output(20,0)

# Stop the suction pump
def pump_off():
# Close the solenoid valve
GPIO.output(20,1)
time.sleep(0.05)
# Open the vent valve
GPIO.output(21,0)
time.sleep(1)
GPIO.output(21,1)
time.sleep(0.05)

pump_off()
time.sleep(3)
pump_on()
time.sleep(3)
pump_off()
time.sleep(3)

GPIO.cleanup() # Release the pin channel
```

Save the file and close it, return to the command line terminal, and enter:

```
python pump_double.py
```

> You can see that the suction pump opens after 3 seconds and closes after working for 3 seconds

Integrated suction pump

Applicable models: myCobot 280, myPalletizer 260, mechArm 270

Specifications

Name	myCobot integrated suction pump
Model	myCobot integrated suction pump
Material	ABS injection molding
Color	White
Size	Diameter 20mm
Number of suction cups	1
Suction weight	50g
Power source equipment	Suction pump box
Service life	One year
Fixing method	Lego connector
Control interface	IO control
Use environment requirements	Normal temperature and pressure
Applicable equipment	ER myCobot 280 Series, ER myPalletizer 260 Series, ER mechArm 270 Series, ER myBuddy 280 Series

Suction pump: Used for adsorbing objects

Introduction

- Suction pump, that is, vacuum adsorption pump, has one suction nozzle and one exhaust nozzle. It has the advantages of simple structure, small size, easy use, low noise, and good self-priming ability. By controlling the suction pump kit as the end effector of the robot arm, the function of adsorbing objects is performed.
- Suction pump accessories: power cord x1, DuPont line x10, one-input and two-output connection line x1, Lego technology parts x several

Working principle

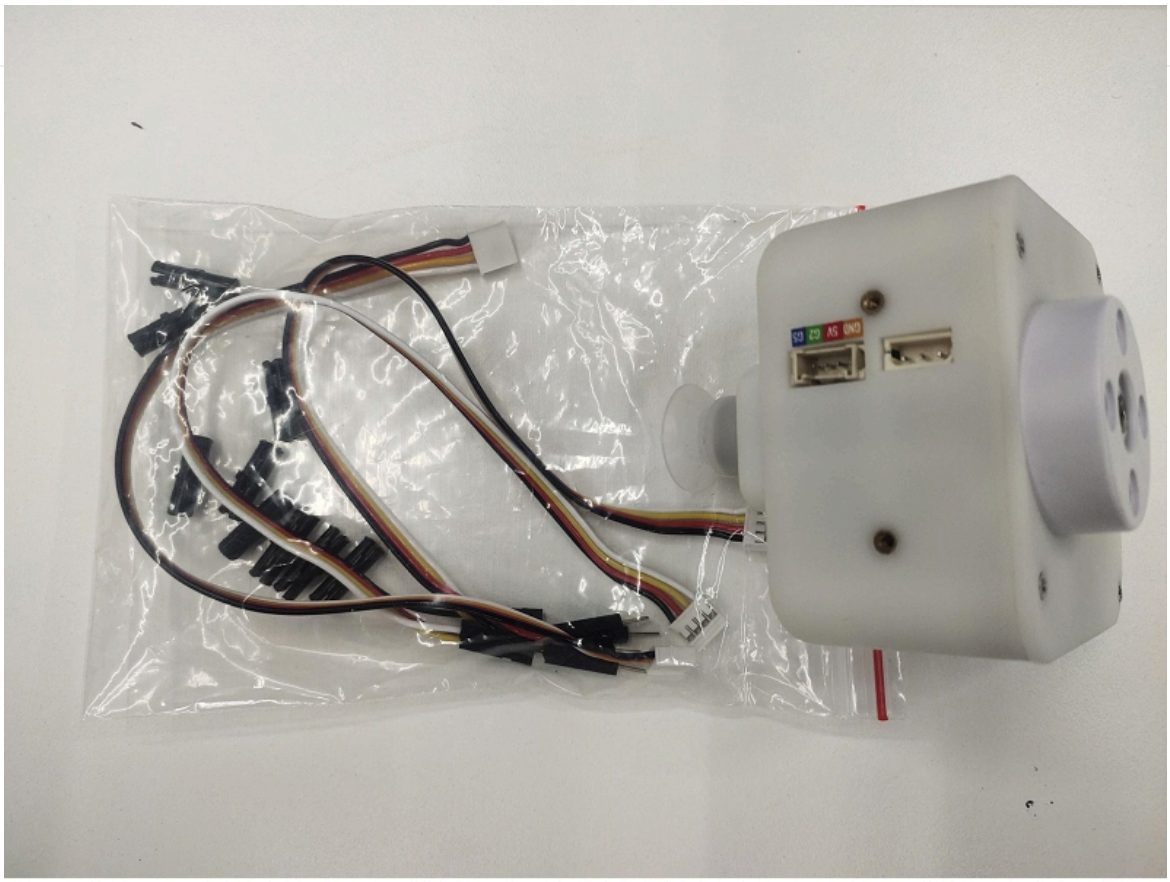
- When sucking objects: the air pump starts to suck air and adsorb objects and then stops, and there will be no air leakage in a short time.
- When putting down objects: the electronic valve starts, the air release valve opens, and air enters the vacuum suction cup to separate from the sucked objects.

Applicable objects

- Paper/plastic sheets
- Flat and smooth objects
- Cards, etc.

Installation and use

Check whether the accessories package is complete: Lego connectors, Dupont wires, double-head suction pump



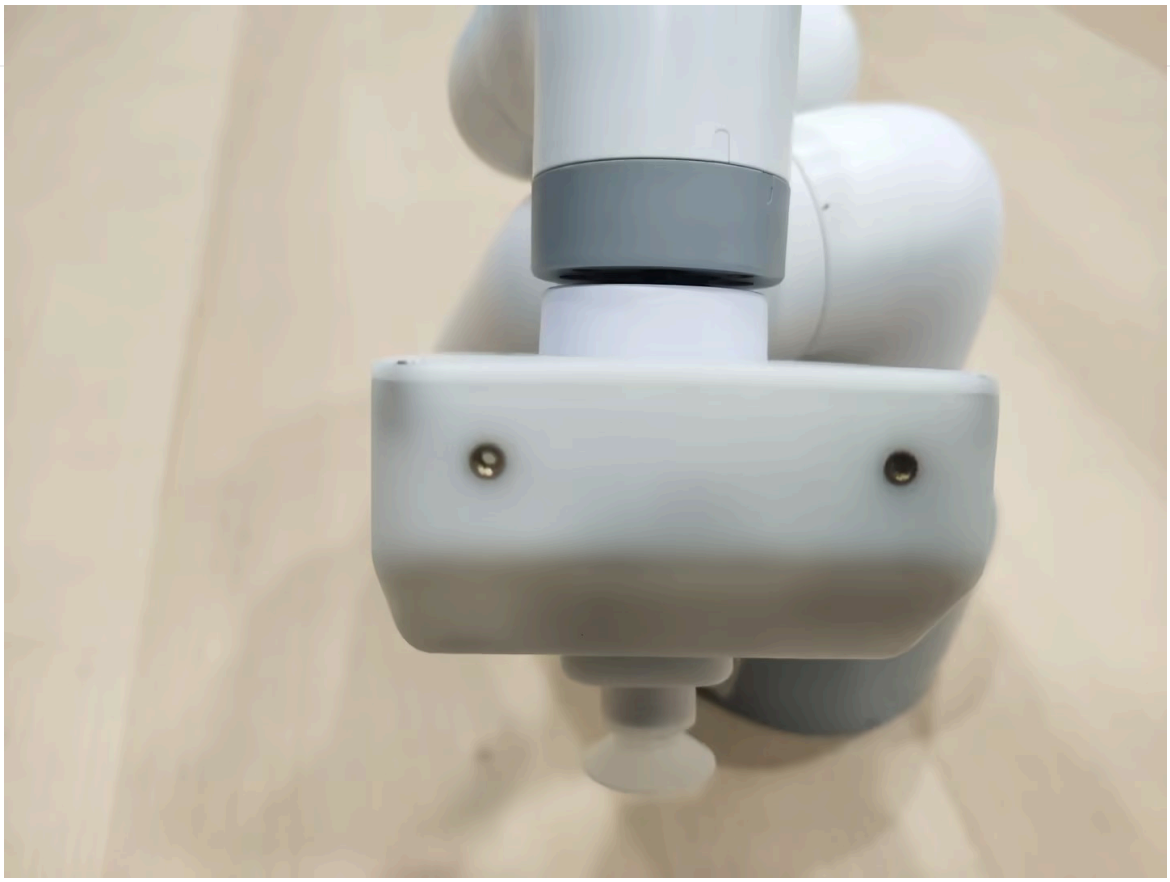
Suction pump installation

Structural installation:

Insert the Lego connector into the reserved socket on the suction pump:

1. Align the suction pump with the connector plugged in with the socket at the end of the robot arm and insert it:

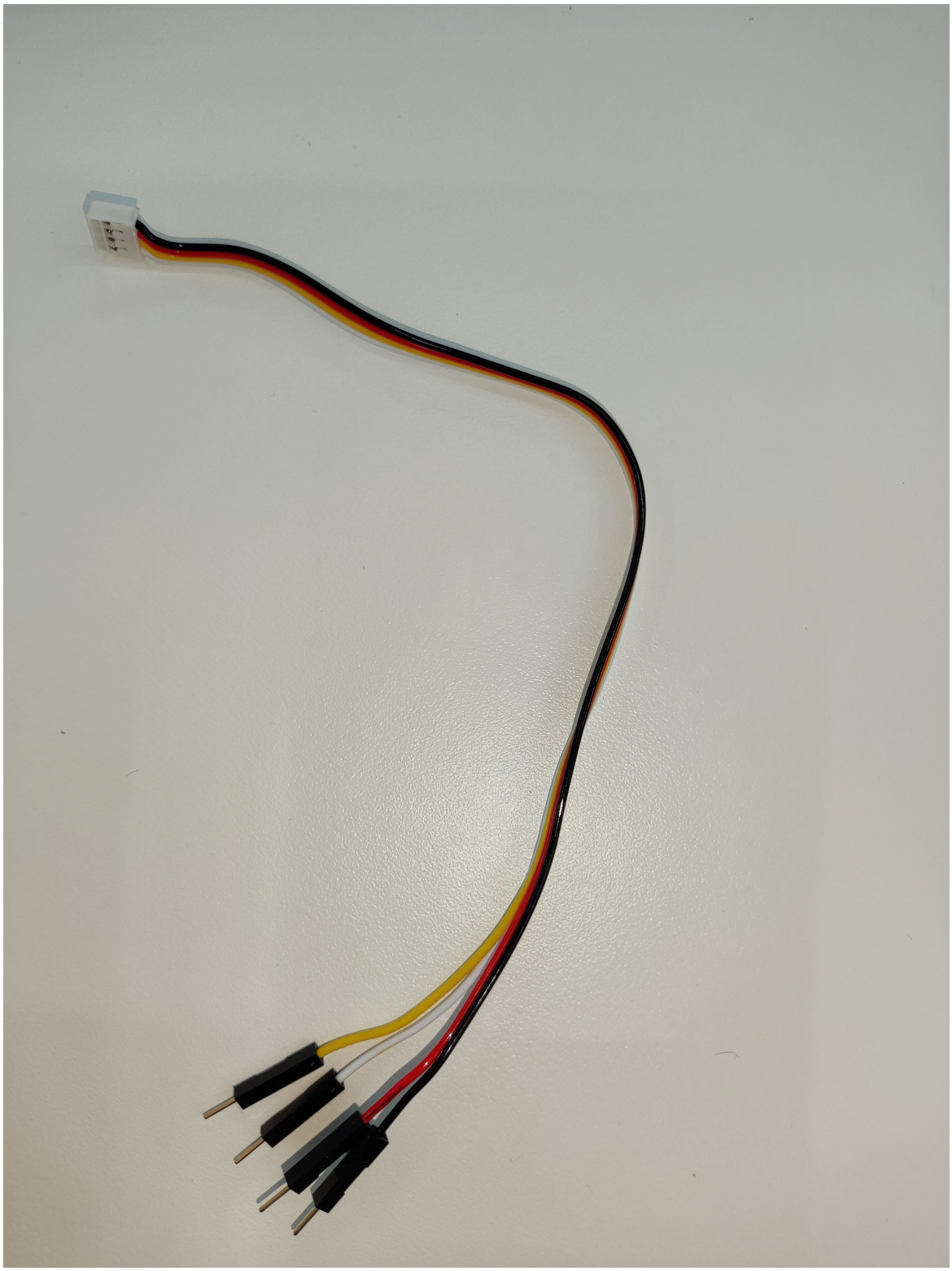
>



- Electrical connection:

Select the male-female DuPont wire, and insert the female end into the socket marked with pins on the suction pump box:

Male-female DuPont wire:



Note the correspondence between the DuPont wire colors and pins in the figure:

Insert the male end into the robot base pin according to the given correspondence:

The left side is the suction pump pin, and the right side is the robot arm pin GND -> GND 5V -> 5V G2 -> 21 G5 -> 20

Programming development:

280-M5 Version:

```
from pymycobot import MyCobot280
import time

# Initialize a MyCobot280 object
mc = MyCobot280("COM3", 115200)

# Turn on the suction pump
def pump_on():
# Open the solenoid valve
mc.set_basic_output(5, 0)
time.sleep(0.05)

# Stop the suction pump
def pump_off():
# Close the solenoid valve
mc.set_basic_output(5, 1)
time.sleep(0.05)
# The exhaust valve starts working
mc.set_basic_output(2, 0)
time.sleep(1)
mc.set_basic_output(2, 1)
time.sleep(0.05)

pump_off()
time.sleep(3)
pump_on()
time.sleep(3)
pump_off()
time.sleep(3)

GPIO.cleanup() # Release pin channel
```

- 280-Pi version:

```
from pymycobot import MyCobot280
from pymycobot import PI_PORT, PI_BAUD # When using the Raspberry Pi version of mycobot, you can reference these two varia
import time
import RPi.GPIO as GPIO

# Initialize a MyCobot280 object
mc = MyCobot280(PI_PORT, PI_BAUD)

# Initialization
GPIO.setmode(GPIO.BCM)
# Pins 20/21 control the solenoid valve and the bleed valve respectively
GPIO.setup(20, GPIO.OUT)
GPIO.setup(21, GPIO.OUT)

# Turn on the suction pump
def pump_on():
# Open the solenoid valve
GPIO.output(20,0)

# Stop the suction pump
def pump_off():
# Close the solenoid valve
GPIO.output(20,1)
time.sleep(0.05)
# Open the exhaust valve
GPIO.output(21,0)
time.sleep(1)
GPIO.output(21,1)
time.sleep(0.05)

pump_off()
time.sleep(3)
pump_on()
time.sleep(3)
pump_off()
time.sleep(3)
GPIO.cleanup() # Release the pin channel
```

myCobot Pen Holder

Applicable models: ER myCobot 280 series, ER myPalletizer 260 series, ER mechArm 270 series, ER myBuddy 280 series

Product image

Specifications:

Name	myCobotPro Pen Holder
Model	myCobot_penHolder_J6
Material	Photosensitive resin (painted white)
Dimensions	47.5 x 25.0 x 45.5 mm
Weight	Approx. 35g (excluding pen weight)
Pen tip clearance	±1 mm
Service life	One year
Fixing method	Lego connector
Environment requirements	Normal temperature and pressure
Applicable equipment	Support ER myCobot 280 series ER myPalletizer 260 series ER mechArm 270 series ER myBuddy 280 series

myCobot pen holder: Used when writing and drawing with a robotic arm

Introduction

- Overall solid color design, supports 15mm large stroke extension and retraction, effectively reduces errors, and can be used for writing, drawing and other applications.

Applicable objects

- Whiteboard pen

Installation and use

- Installation

Insert the Lego connector into the holder hole:

Insert the holder with the connector installed into the end of the robot arm

- Use Insert the pen into the round hole and tighten the four screws to fix it.

myCobot Phone Holder

Applicable models: ER myCobot 280 series, ER myPalletizer 260 series, ER mechArm 270 series

Product image

Specifications:

Name	myCobot Phone Holder
Model	myCobot_PhoneHolder_J6
Material	ABS injection molding
Size	Diameter 34*10
Color	White+Black
Clamping weight	50g
Service life	Two years
Fixing method	LEGO connector
Environmental requirements	Normal temperature and pressure
Applicable equipment	ER myCobot 280 series ER mechArm 270 series ER myPalletizer 260 series

myCobot mobile phone holder: Used to hold mobile phones or objects

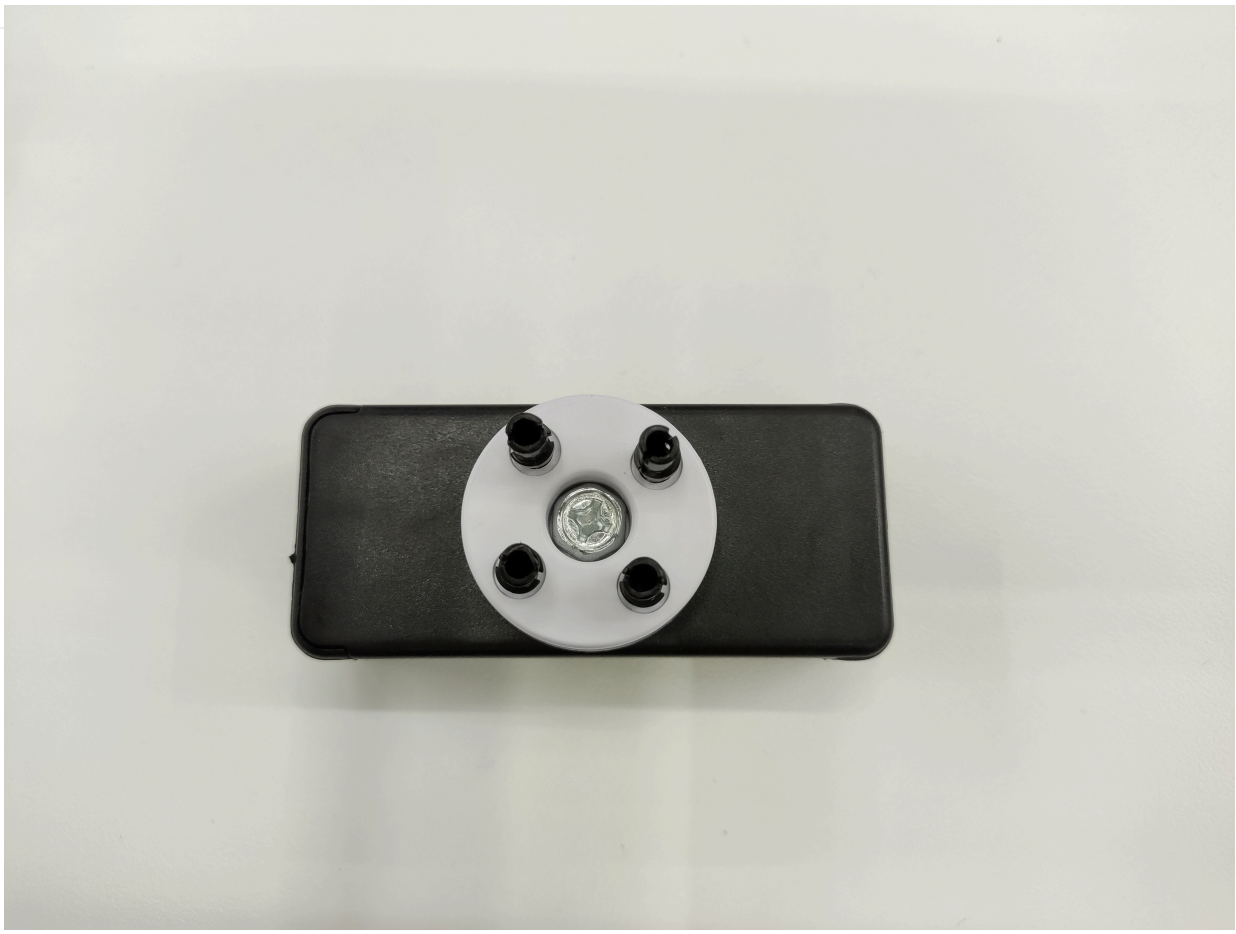
Introduction

- Suitable for devices that require physical clamping, such as photography, and can hold a variety of mobile phones. It has a simple structure and is easy to install and disassemble.

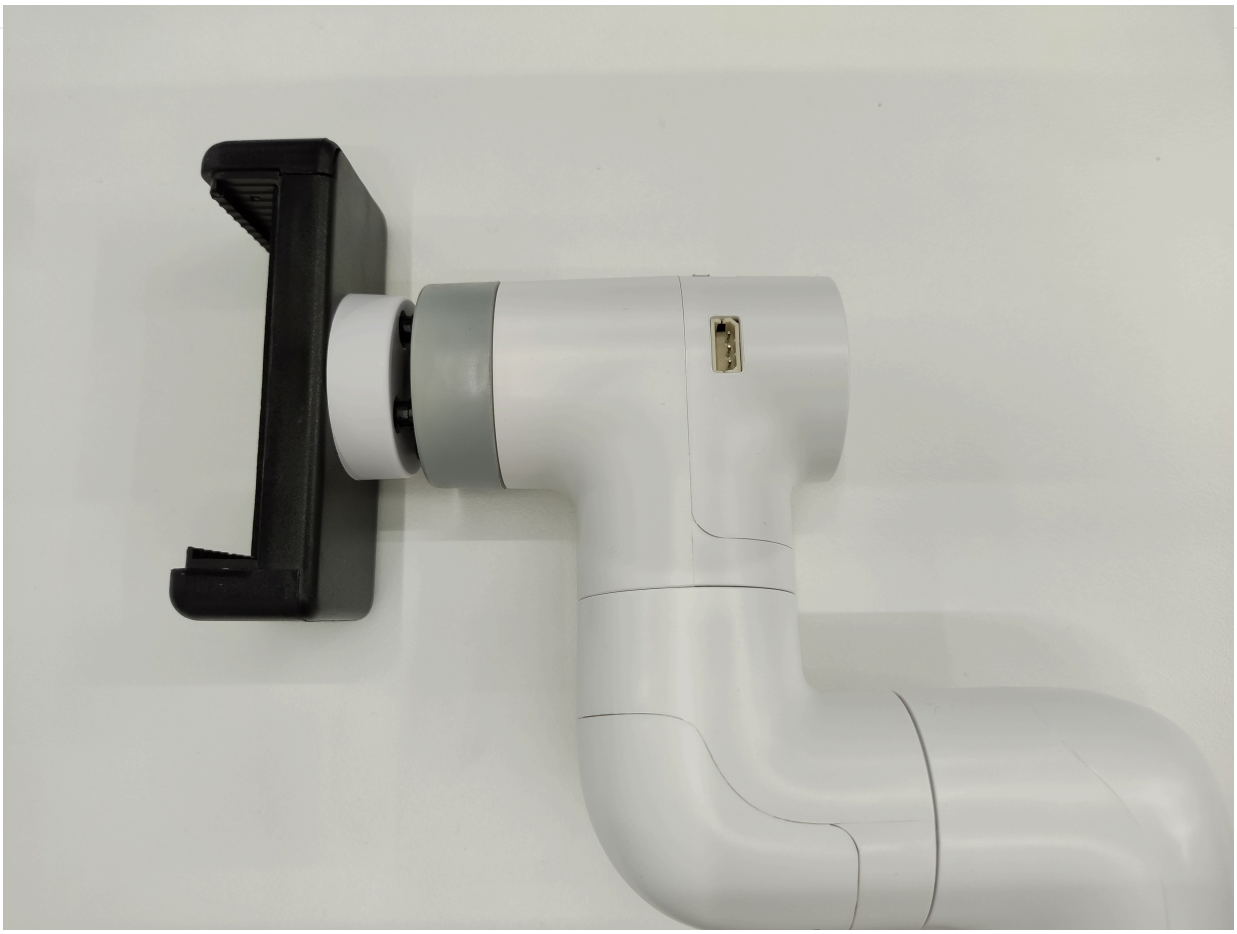
Applicable objects

- Camera equipment
- Installation

Insert the LEGO connector into the holder hole:



Insert the holder with the connector installed into the end of the robot arm



- Use Pull the holder open, put the camera in, and let go. After confirming that the device is fixed, it can be used.

Dexterous Hand

Applicable models: myCobot 280, myPalletizer 260, mechArm 270

Product Image

Specifications:

Name	mycobot Dexterous Claw
Model	Dexterous Hand
Material	3D Printing
Size	112×94×50mm
Color	White
Transmission Mode	Gear + Connecting Rod
Clamping Range	20-45mm
Maximum Clamping Force	100g
Fixing Mode	Screw Fixing
Environment Requirements	Normal Temperature and Pressure
Control Interface	Serial Control
Applicable Equipment	ER myCobot 280 Series, ER mechArm 270 Series, ER myPalletizer 260 Series

Dexterous Hand: Used when gripping objects

Introduction

- The gripper is a robot component that can achieve functions similar to human hands. It has the advantages of a complex structure, firm gripping of objects, not easy to drop, and easy operation. The gripper kit includes gripper accessories and LEGO technology parts. The end effector of the robot arm is controlled by a programmable system to achieve functions such as object gripping and multi-point positioning.

Working principle

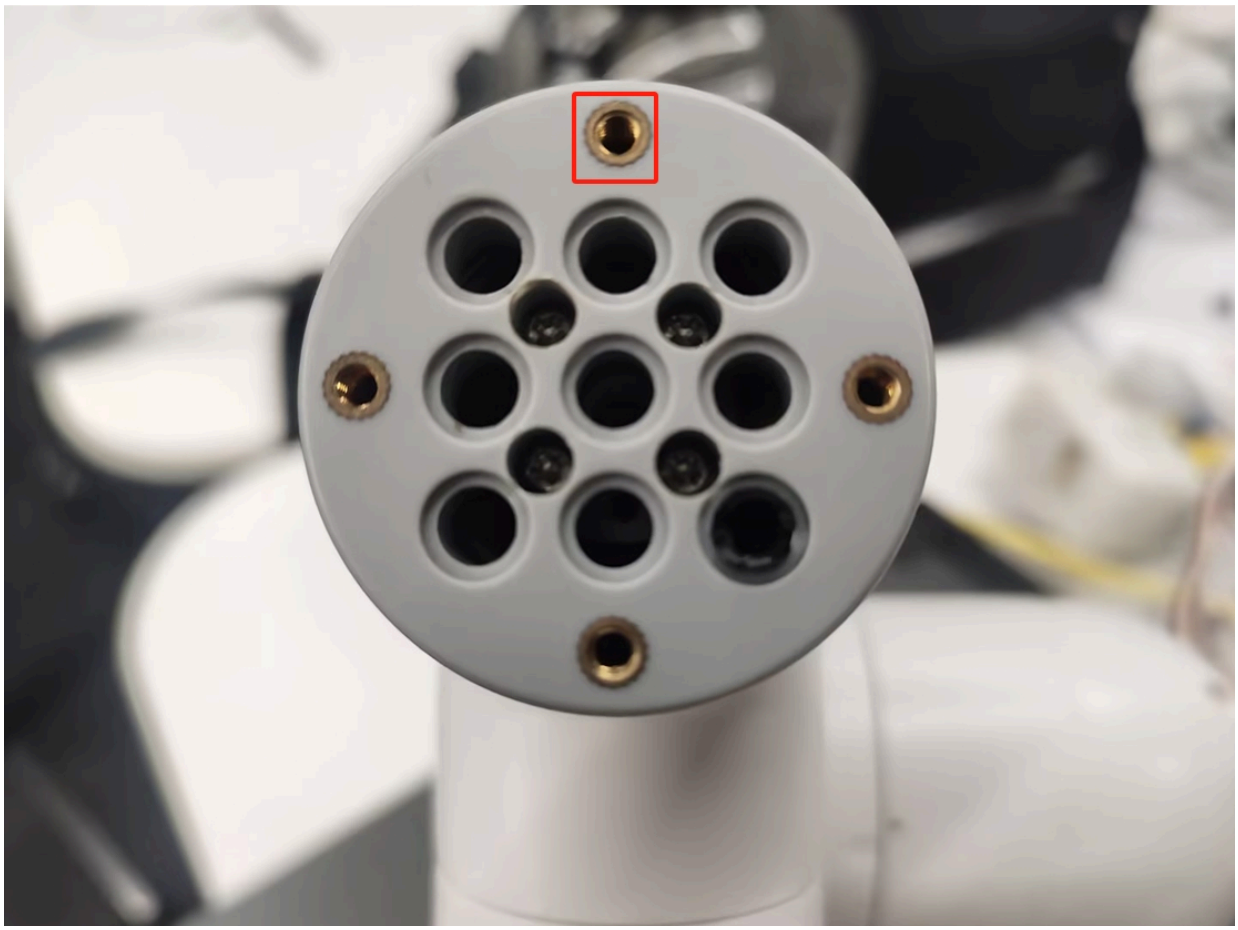
- Driven by a motor, the gripper's finger surface makes linear reciprocating motion to achieve opening or closing. The acceleration and deceleration of the electric gripper can be controlled, the impact on the workpiece can be minimized, the positioning point can be controlled, and the clamping can be controlled

Applicable objects

- Small cubes
- Small balls
- Long objects

Gripper installation:

Insert the Lego connector into the gripper hole:



Electrical connection Insert the gripper with the connector installed into the end of the robot arm

Python programming control

- M5 Version

```
from pymycobot import MyCobot280
import time


# Initialize a MyCobot280 object
mc = MyCobot280("COM3", 115200)


mc.set_encoder(7,2048,40)#Open
time.sleep(2)
mc.set_encoder(7,2300,40)#Hold
time.sleep(2)
mc.set_encoder(7,2048,40)#Hold
```

- Pi version ```python from pymycobot import MyCobot280 from pymycobot import PI_PORT, PI_BAUD # When using the Raspberry Pi version of mycobot, you can reference these two variables to initialize MyCobot280 import time

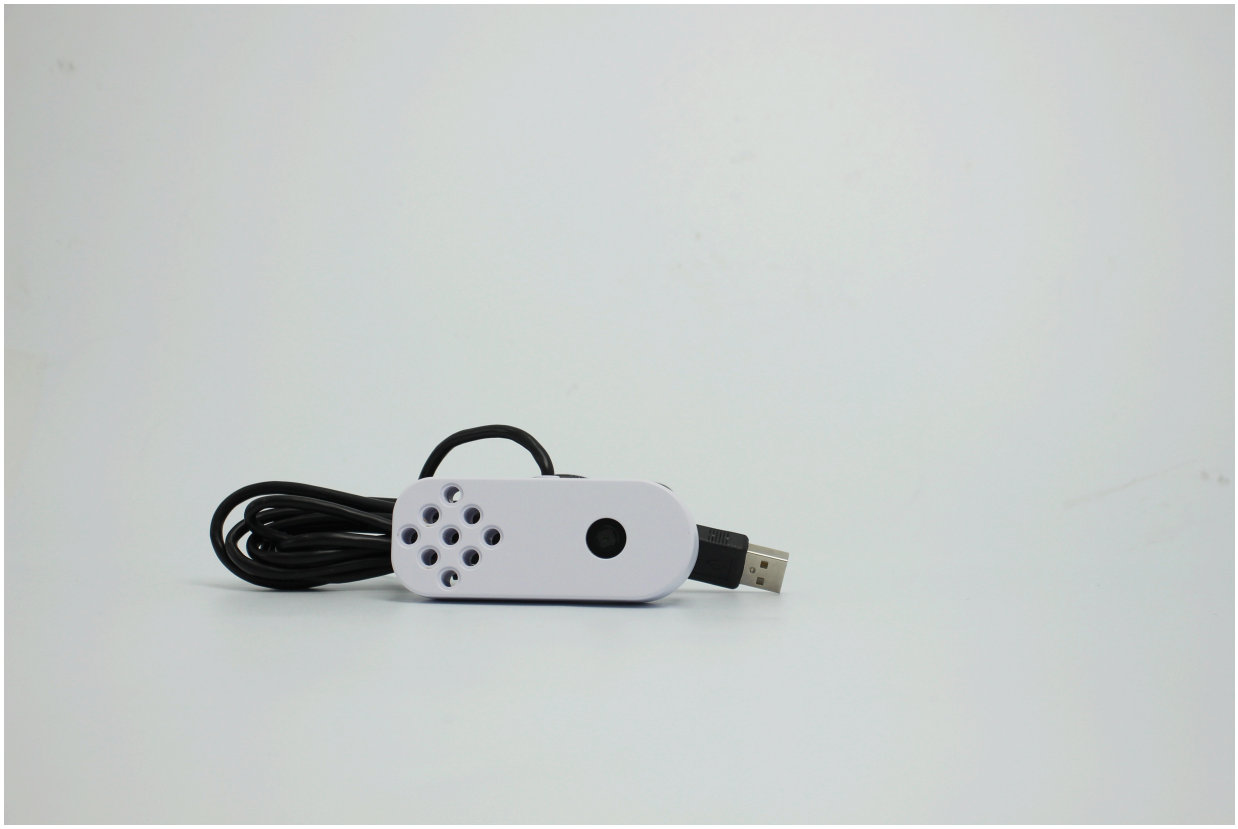
Initialize a MyCobot280 object

mc = MyCobot280(PI_PORT, PI_BAUD) mc.set_encoder(7,2048,40)#Open time.sleep(2) mc.set_encoder(7,2300,40)#Hold tight time.sleep(2) mc.set_encoder(7,2048,40)#Hold tight ```

myCobot camera module v2.0

Applicable models: myCobot 280, myPalletizer 260, mechArm 270

Product image



Specifications:

Name	myCobot camera module v2.0
Model	myCobot_cameraHolder_J6
Color	White (default)
Material	ABS injection molding
Size	836416
USB protocol	USB2.0 HS/FS
Lens focal length	Standard 1.7mm
Field of view	About 60°
Supported systems	Win7/8/10, Linux, MAC
Supported resolutions	2592x1944, 2560x1440, 2048x1536, 1920x1080, 1280x72, 1024x768, 800x600, 640x480, 640x360, 352x288, 320x240, 176x144
Service life	Two years
Fixing method	Lego connector
Environment requirements	Normal temperature and pressure
Applicable equipment support	ER myCobot 280 series, ER myPalletizer 260 series, ER mechArm 270 series, ER myBuddy 280 series

Camera flange: Machine vision

Introduction

- USB high-definition camera can be used with suction pump, adaptive gripper, artificial intelligence kit, etc., to achieve precise positioning and calibration with eye in hand.

Installation and Use

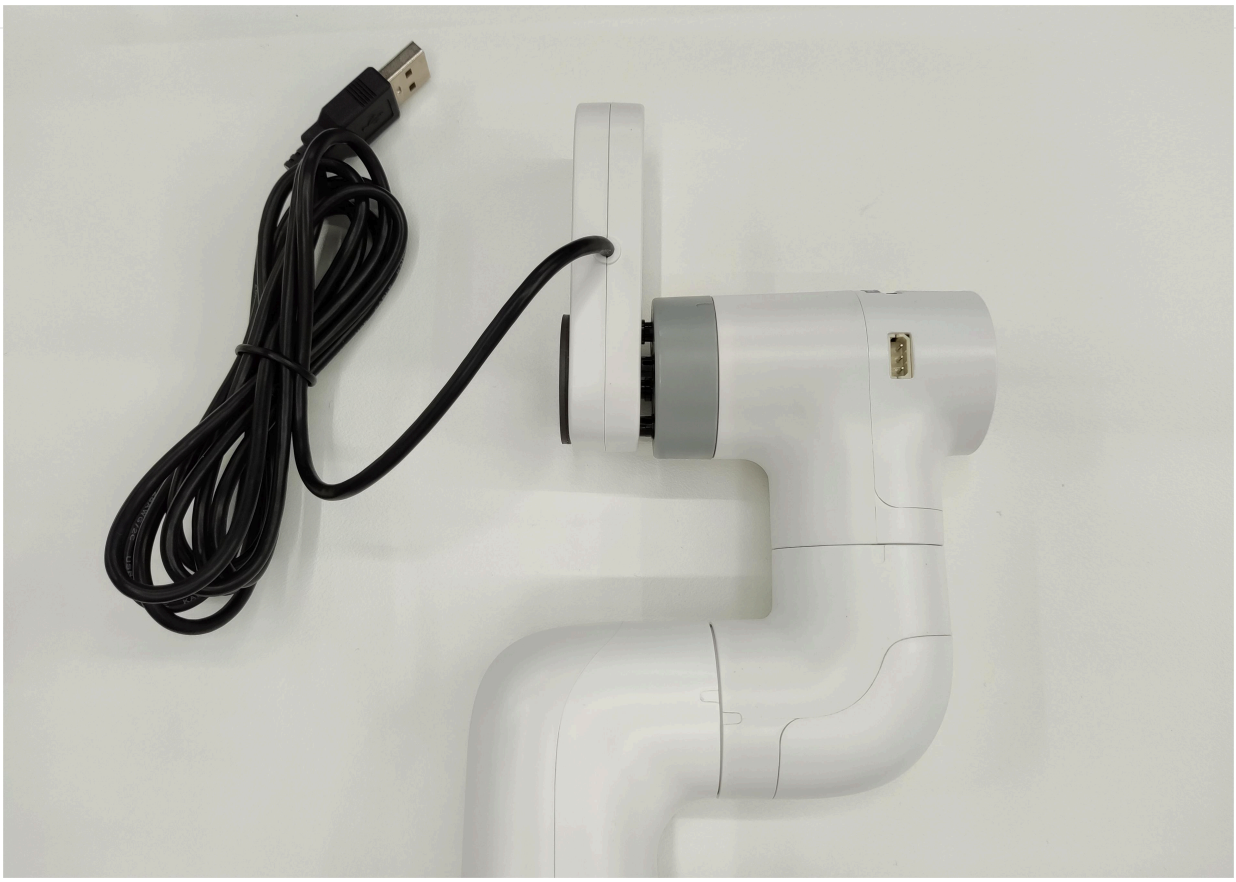
- Check if the accessories package is complete: Lego connector, camera module with USB cable

- Camera installation:

Structural installation:

Insert the Lego connector into the reserved socket of the camera module:

Align the camera module with the connector into the socket at the end of the robot arm:



Electrical connection:

Insert the USB cable into the USB port of the base:

Programming development:

> The code is as follows:

```
python
import cv2
import numpy as np

cap = cv2.VideoCapture(0) # "0", determined by the camera device number queried

while(True):
ret, frame = cap.read()

# gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)

cv2.show('frame', frame)
if cv2.waitKey(1) & 0xFF == ord('q'):
break

cap.release()
cv2.destroyAllWindows()
```

Spring Bamboo Shoot Flange

Applicable models: ER myCobot 280 series, ER myPalletizer 260 series, ER mechArm 270 series

Product image

Specifications:

Name	myCobot Spring Bamboo Shoot Flange
Material	Nylon
Hardness	Fragile
Service life	Two years
Fixing method	Lego connector
Environmental requirements	Normal temperature and pressure
Applicable equipment	ER myCobot 280 series, ER myPalletizer 260 series, ER mechArm 270 series

myCobot Spring Bamboo Shoot Flange: Used for clicking buttons

Introduction

- Suitable for devices with physical travel such as click buttons and keyboards. The overall solid color design, simple structure, easy to install and disassemble.

Applicable objects

- Keyboard
- Button

Acknowledgements

We would like to express our deep gratitude to all the people who have participated in the development, testing and improvement of the myCobot series of products (including myCobot 280 pi, myCobot 280 M5, myCobot 280 JN, myCobot 280 For Arduino and kits). Every detail polished and every feature innovative is inseparable from the hard work and dedication of the team behind it.

Special thanks:

R&D Team: Thank you for your innovative thinking and countless days and nights of hard work to transform complex technology into user-friendly products. **QA & Testing Team**: Your strict control of every detail ensures the reliability of our products and the ultimate experience of users. **Customer Support Team**: Thank you for providing professional support to our users to help them solve every problem during use. **Partners & Suppliers**: Your support and service are crucial to the success of the product. Thank you for your high-quality raw materials and components, and your attitude of being ready to support. **Investors and Advisors**: Without your trust and financial support, we would not be able to bring these innovations to the market. Your insights and guidance have always been our driving force.

User Thanks:

We are especially grateful to every user who has chosen and trusted the myCobot series of products. Your feedback and suggestions are the driving force for our continuous progress and improvement. We promise to continue to listen to your voice and continuously optimize our products and services.

Future Outlook:

We look forward to continuing to explore and progress on the road of robotics with all stakeholders. Let us work together to create more possibilities and bring greater convenience and innovation to the world.

← Previous Chapter