



RealMan RM65 Robot Manual V2.8



RealMan Intelligent Technology (Beijing) Co., Ltd.



Version History

Version	Date	Comment
V1.0	2020-05-02	Init
V1.1	2020-05-24	Fix known errors
V1.2	2020-06-15	Add intro of graphic online coding
V1.3	2020-07-21	Add intro of bottom electrical board
V1.4	2020-08-20	Revise intro of aviation plug order on the electrical board of the robot arm end
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V1.7	2021-08-10	Modify product ID
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V2.0	2022-01-28	Add intro of one-axis force calibration
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V2.2	2022-03-01	Modify controller's I/O wire definition
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V2.4	2022-03-20	Add safety operation tips
V2.5	2022-04-11	Update the operation interface to increase the movement along the tool end
V2.6	2022-04-28	Add English version of the teach pendant
V2.7	2022-5-27	Optimize document format
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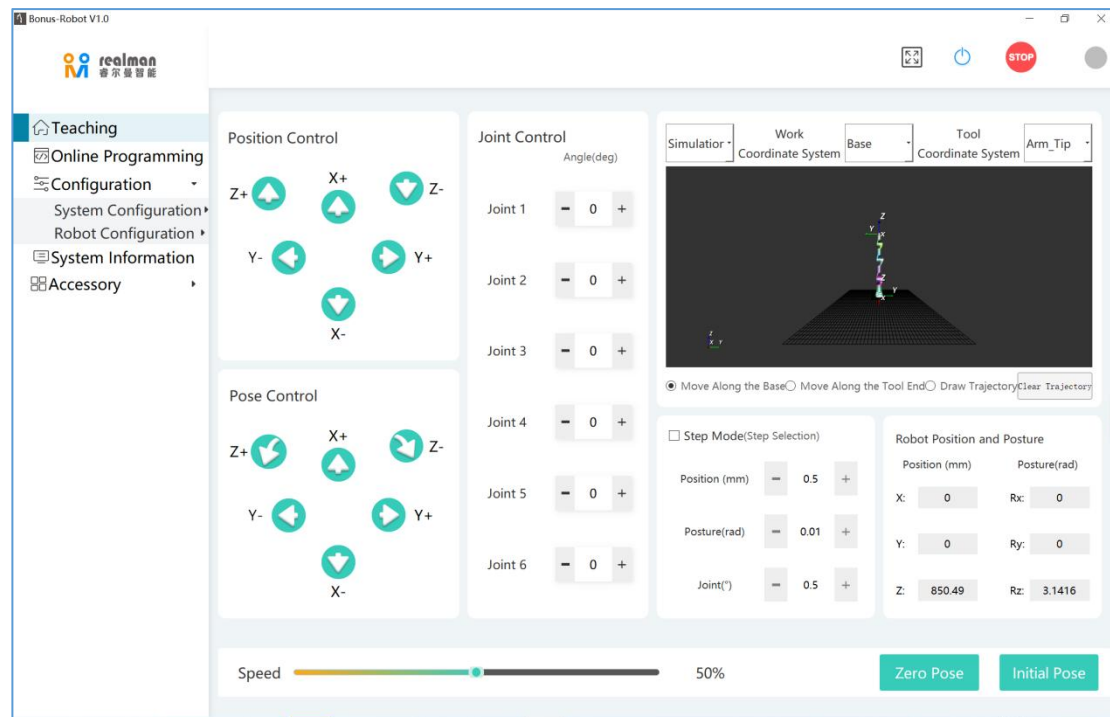
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Foreword

On behalf of RealMan Intelligent Technology (Beijing) Co., Ltd., we thank you for the purchase and use of our ultra-lightweight 6-DoF RM65 collaborative robot. The RM65 robot series include RM65-B (standard), RM65-ZF (integrated 1-axis force) and RM65-6F (integrated 6-axis force). The manual can refer to this document.

RM65 adopts modular joint design. It integrates the controller at its base therefore no extra control cabinet needed. Users can build their own robot control system by accessing the APIs of our collaborative RM65. Besides, this product also provides online programmable software through which users can monitor the real-time status of RM65, adjust the settings, and simulate offline.



Product Components

A full packaged RM65 collaborative robot includes the components as follows.

Table 1 Product Components of RM65

Name	Quantity
Robot body	1
Power cord	1
6-pin tool end IO cable	1



26-pin IO cable	1
Teach pendant tablet (optional)	1

1. Safety

1.1 Introduction

This section includes the safety principles and regulations that should be followed when operating the robot. Users and integrators must read this manual carefully before operating the robot. They need to have full security awareness. They shall always follow the principles and regulations particularly the warning signs. Since robot system is complex and could be dangerous if not properly operated, users shall always be aware of this and follow the instructions in this document.

1.2 Safety Warning Signs and Symbols

Table 2 lists all the safety warning signs and symbols of the robot. It is crucial and the instructions shall be followed.

Table 2 Warning Signs and Symbols, and Instructions

Sign/Symbol	Instruction
	An impending hazardous electrical condition that, if not avoided, can result in casualty to persons or damage to device.
	An impending hazardous high temperature, which can result in casualty to persons or damage to device if touched.
	A situation that is about to cause danger and, if not avoided, can lead to casualty to persons or damage to device.
	A warning on a hazardous electrical condition that, if not avoided, may result in casualty to persons or damage to device.



	A warning on hazards that, if not avoided, may result in casualty to persons or damage to device. Matters marked with such a sign may sometimes, depending on the circumstances, have the potential to have significant consequences.
	A condition that, if not avoided, may result in casualty to persons or damage to device. Matters marked with such a sign may, depending on the circumstances, sometimes have the possibility of significant consequences.

1.3 Safety Precautions

This manual contains safety measures to protect users and prevent device damage. Users need to read all the relevant descriptions in this manual and fully understand the safety issues. In this manual, although we've tried our best to describe various situations regarding safety, it is impossible to record all situations that users may encounter.

The following essential information needs to be understood and followed when starting the robot for the first time. Other safety-related information is introduced in other sections of the manual. However, it is impossible to cover all aspects. In practical applications, specific situations need to be analyzed accordingly.

Table 3 Safety Precautions

	1. Please be sure to install the robot and all electrical equipment in accordance with the requirements and specifications in this manual. 2. A preliminary test and inspection of the robot and its protection system should be carried out before the first use of the robot and production. 3. Before starting the robot for the first time, you must check that the hardware, software, and appearance of the robot is complete. Also, you should be aware of whether it complies with the effective
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	safety production rules and regulations of the country or region. Remember that all safety features must be tested before use. 4. Users must check and ensure that all safety-related hyperparameters and user programs are correctly set, and all safety features are working properly. A person qualified to operate the robot is required to check each safety feature. The robot can only be started after passing a comprehensive and careful safety test and reaching a certain safe level. 5. Professionals are required to install and configure the robot in accordance with the installation standards. 6. Once the robot has been installed and configured, a comprehensive risk assessment should be performed again and recorded. 7. The safety-related hyperparameters are set and changed by authorized personnel only. Passwords or isolation measures are applied to prevent unauthorized personnel from changing or setting safety-related hyperparameters. After the safety-related factors are modified, the related safety features need to be double checked. 8. In case of an accident or abnormal operation of the robot, the emergency stop switch can be pressed to immediately stop the action of the robot.
	1. The robot body and control cabinet will generate heat during operation. Please do not touch the robot when the robot is operating or just stopped. 2. Turn off the power and wait for one hour before the robot cools down. 3. Do not put your finger into the hot part of the controller.



1. Ensure that the robot and end tools are properly and securely installed in place.
2. Ensure that the robot arm has enough space to move freely.
3. Do not use the robot if it is damaged.
4. Do not connect a secure device to a normal I/O port but only the secure port.
5. Ensure a correct installation and setting (e.g., robot body installation angle, end tool weight, TCP offset, safety configuration etc.). Save the installation file and load it into the program.
6. Tools and obstacles shall not have sharp corners or twist points. Make sure all present users are out of reach of the robot.
7. Pay attention to the movement of the robot when using the teach pendant software.
8. Any collision will release a lot of kinetic energy, which is much larger than the cases of high speeds and high payloads.
9. Jointing different machinery can exacerbate a hazard or create new ones. Always conduct a comprehensive risk assessment for the entire installation. When safety levels and emergency stop criterion levels are asked, always select the highest performance level. Please read and understand the manuals for all equipment used during the installation.
10. Do not modify the robot. Non-authorized changes to the robot can create dangers that the integrator cannot predict. The authorized change of robot shall be in accordance with the latest version of relevant service manuals. If the robot is manipulated or altered in any way, we, as RealMan Intelligent Technology (Beijing) Co., Ltd., do not take full responsibility.
11. Users need to check insulation and protection measures before transporting the robot.
12. When moving the robot, follow the transportation requirements and handle it carefully to avoid bumps.



1. When a robot is connected to or collaborating with machinery that can cause damage to the robot, it is highly recommended that all functionalities and procedures of the robot should be checked separately. It is recommended to use a temporary workspace outside of the workspaces of other machinery to inspect the robot program.
2. We, as RealMan Intelligent Technology (Beijing) Co., Ltd., will not be responsible for the damage to the robot or personal injury caused by human reason.
3. Do not expose the robot to permanent magnetic fields. Strong magnetic fields can damage the robot.

1.4 Responsibility and Regulation

RM65 robots itself is not complete to accomplish certain tasks but can be combined with other peripheral equipment to achieve that. Therefore, the information contained in this manual does not indicate the design, installation, and operation of a complete robot, nor does it include all the possibilities that may affect the safety of the peripheral equipment of such a complete system. The safety of a complete robot installation depends on how the robot is ensembled. The integrator is required to conduct a risk assessment for the design and installation of the complete system in accordance with the laws, regulations and safety codes and standards of the host country or region. Risk assessment is one of the most important tasks that must be performed by an integrator. An integrator can perform the risk assessment process by referring to the following standards. Risk assessment is one of the most important tasks that must be performed by an integrator. An integrator can perform the risk assessment process by referring to the following standards.

- ISO 12100:2010 Machinery Safety-General Design Principles-Risk Assessment and Risk Reduction.
- ISO 10218-2:2011 Robots and Robotic Equipment-Safety Requirements-Part 2: Industrial Robot System and Integration.



- RIA TR R15.306-2014 Technical Report of Industrial Robots and Robotic Systems-Safety Requirements, Task-Based Risk Assessment Methods.
- ANSI B11.0-2010 Machinery Safety; General Requirements and Risk Assessment.

The integrator of the RM65 robot is required to perform but is not limited to the following responsibilities:

- A comprehensive risk assessment of a complete robotic system.
- To confirm the design and installation of the entire system is accurate.
- To provide training to users and staff.
- To create operation specification of a complete system, and clear description of use process.
- To establish appropriate safety measures.
- To use appropriate methods to eliminate hazards or minimize all hazards to acceptable levels at the time of final installation.

1.5 Hazard Identification

The risk assessment should take into account all potential contacts between the operator and the robot and foreseeable maloperations during normal use. The neck, face and head of the operator should not be exposed to avoid touching. The use of a robot without the use of peripheral safety guards requires first a risk assessment to determine whether the associated hazards pose an unacceptable risk, including but not limited to:

- The use of sharp actuator or tool connectors which may be dangerous.
- Handling toxic or other hazardous substances which may be dangerous.
- The operator's fingers being caught by the robot base or joint.
- The operator being hit by robots.
- The fastness of robot and tool connected to its end.
- Impact between the robot payload and the firm surface.

The integrator must measure such hazards and their associated risk levels through a



risk assessment and identify and perform appropriate measures to reduce the risk to an acceptable level. Be aware that there may be other significant hazards associated with certain robotic devices.

By combining the inherent safety design measures applied by the RM65 robot with the safety specifications or risk assessments implemented by the integrator and user, the risks associated with collaborative robot operation are minimized to a reasonable and feasible level. This document is used to communicate any residual risks of the robot prior to installation to the integrator and users. If the integrator's risk assessment indicates that there are risks in its application that may pose an unacceptable risk to users, the integrator must take appropriate risk mitigation measures to eliminate or minimize these risks until the risk is reduced to an acceptable level. It is not safe to use until appropriate risk mitigation measures, if needed, have been taken.

If the robot is installed uncooperatively (e.g., when using hazardous tools), the risk assessment may infer that the integrator needs to connect additional safety devices (e.g., safe start devices) to ensure the safety of personnel and equipment while it is programmed.

2. Handling and Precautions

When the robot is hoisted, proper measures and positioning should be taken for the moving parts, so as not to cause accidental movement and damage during hoisting and transportation. Before transportation, the packing shall be carried out in accordance with the packing standard, and the required marks shall be marked on the outside of the packing cases.

During transportation, the robot needs to be fastened and kept in a fixed position.

When unpackaging the to the installation position, hold the robot until all bolts on the base of the robot are fastened.



There is no brake installed inside the robot Joint4~6. Before power off, please keep the robot in the proper position to prevent the joint from rotating and colliding under the gravity. (When the robot is vertical, place the robot in the origin position before powering off.)

Keep the original packaging after transportation and store the packaging box in a dry place in case you need to repack and ferry the robot in the future.

3. Maintenance, Repair and Disposal

All safety instructions in this manual must be followed in maintenance.

After changing the control system and robot joint, it is necessary to re-calibrate the robot and tool end origin on site. You also need to check the hyperparameter settings. If there is a hyperparameter backup, you can import the backup hyperparameters, otherwise, you need to reset the hyperparameters.

Repairs must be conducted by the authorized integrators or us as RealMan Intelligent Technology (Beijing) Co., Ltd. The parts shall be returned to us, as RealMan Intelligent Technology (Beijing) Co., Ltd., in accordance with the regulations of the manual.

Assure the required safety level for maintenance and repair. Comply with national or regional safety regulations. Test whether all safety features can work properly.

The purpose of maintenance is to ensure the proper operation of the system or to help bring it back to a normal status in the event of a system failure.

Maintenance includes fault diagnosis and undergoing maintenance.



The following safety procedures and cautions must be followed when operating the robot arm or controller:

Safety procedures:

1. Move away the power source from the controller ports to ensure it is completely powered off. Necessary precautions should be taken to prevent others from accidentally powering on the system during maintenance. Double check the system to ensure the power is off.
2. When disassembling the robot or control box, comply with ESD (electrostatic discharge) regulations.
3. Avoid water or dust entering the robot arm or controller.

Cautions:

1. Replace the faulty part with a new part that has the same serial number or we, as RealMan Intelligent Technology (Beijing) Co., Ltd., replace the faulty part.
2. Reactivate all disabled safety features as soon as maintenance is accomplished.
3. Keep maintenance records in the technical documents related to the whole robot system.
4. The controller has no parts that users can repair by themselves. Please contact your supplier or us, as RealMan Intelligent Technology (Beijing) Co., Ltd., to maintain or repair the controller.

Disposal:

RM65 Robots must be disposed in accordance with applicable national laws, regulations and standards.

Maintenance:

The safety features of the robot must be tested at least once a year to ensure it constantly works properly.



4. Quality Assurance

4.1 Product Quality Assurance

RM65 robot includes a 12-month limited warranty.

If the new device and its components are found to be defective due to faulty manufacturing or material defects within 12 months (or no more than 15 months including transportation time) after commissioning, we, as RealMan Intelligent Technology (Beijing) Co., Ltd., shall provide necessary spare parts to replace or repair the relevant parts.

The ownership of the device or components replaced or returned to RealMan Intelligent Technology (Beijing) Co., Ltd. shall remain with us as RealMan Intelligent Technology (Beijing) Co., Ltd.

If the product is no longer under warranty, we, as RealMan Intelligent Technology (Beijing) Co., Ltd., reserves the right to charge the customer for the replacement or repair.

Out of the warranty period, we, as RealMan Intelligent Technology (Beijing) Co., Ltd., shall not be responsible for any damage or loss, such as loss of production or damage to other production equipment.

4.2 Disclaimer

If the defect is caused by improper operating or failure to follow the relevant instructions set out in the user's manual, the warranty of product quality is void.

Failure caused by the following conditions is not covered by this warranty:

1. Fail to install, wire and connect other control equipment according to the user manual.



2. The usage exceeds the specifications or standards specified in the user manual.
3. Use the product for purposes other than those specified.
4. The storage and workspace environment exceed the specified scope in the user manual (such as pollution, salt damage, condensation, etc.).
5. Product damage caused by improper transportation.
6. Damage caused by accident or collision.
7. Install non-authentic parts and accessories.
8. Damage caused by the modification, commissioning, or maintenance of the original parts by a third party other than RealMan Intelligent Technology (Beijing) Co., Ltd. or its designated integrator.
9. Natural disasters such as fires, earthquakes, tsunamis, lightning strikes, strong winds and floods.
10. The production date or warranty start date cannot be identified.
11. Changes to software or internal data.
12. Failure that cannot be reimplemented or failure that cannot be identified by us, as RealMan Intelligent Technology (Beijing) Co., Ltd.
13. Use the product in radioactive equipment, biological test equipment or in the use that we, as RealMan Intelligent Technology (Beijing) Co., Ltd., judge to be dangerous.
14. Failures other than the mentioned above is not caused by the duties of RealMan Intelligent Technology (Beijing) Co., Ltd.

Under the Product Quality Assurance Agreement, we, as RealMan Intelligent Technology (Beijing) Co., Ltd., are responsible for the defects of the products and parts sold only to the distributor. We, as RealMan Intelligent Technology (Beijing) Co., Ltd., are not responsible for any other express or implied warranty or liability, including but not limited to any implied warranty of merchantability or a particular purpose. In addition, we, as RealMan Intelligent Technology (Beijing) Co., Ltd., shall not be responsible for any indirect damages or consequences of the relevant products.



In the case of robot malfunction, it is necessary to contact RealMan Intelligent Technology (Beijing) Co., Ltd. at the first time to seek a solution, and the user shall not carry out robot disassembly and maintenance for any reason, otherwise the warranty service will be terminated.

5. Robot Hardware System

5.1.1 Robot System Overview

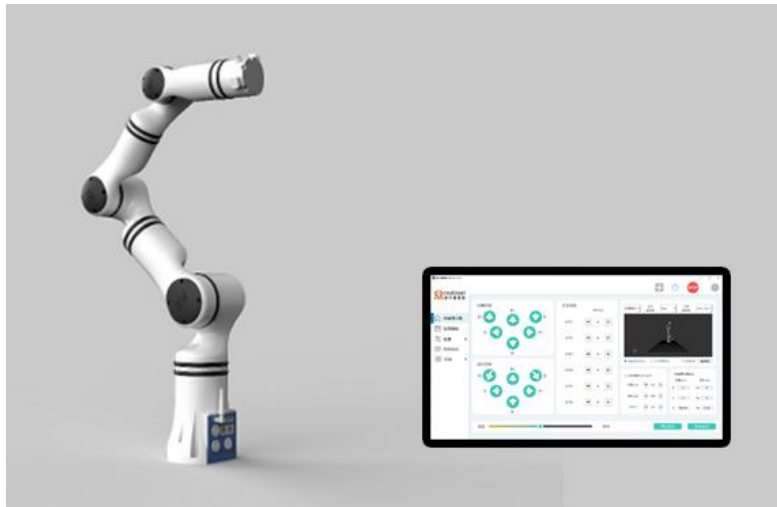


Fig. 5-1 The overview of the robot system.

As shown in Fig. 5-1, RM65 cooperative robot system is mainly composed of robot body or the robot arm, controller (integrated in the body base) and tablet/pad with teach pendant software (optional). The robot body mimics a human arm that has six rotating joints, each representing one degree of freedom (DoF). As shown in Figure 5-2, the robot joints include shoulder (joint 1), shoulder (joint 2), elbow (joint 3), wrist 1 (joint 4), wrist 2 (joint 5), and wrist 3 (joint 6). After the teach pendant software is connected to the controller, the user can control the rotation of each joint of the robot thus move the end tool to different positions and poses.

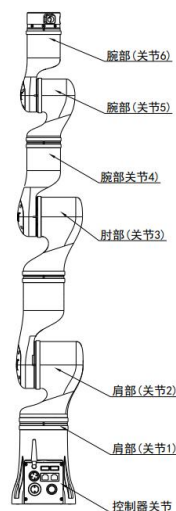


Fig. 5-2 The distribution map of robot joints.

5.1.2 Electrical Interface

A controller is integrated at the bottom part of the robot for controlling the robot and communicating. The robot arm is powered by DC 24 volts (when using a DC power supply, select a DC power supply with an output of not less than 20A), and the power supply interface is a 2-core aviation plug, located at the lower left corner of the controller panel. In the 2-core power cable, the brown core is the positive power supply, and the blue core is the negative power supply. The robot also integrates a variety of communication interfaces for data transmission with various devices as shown in Figure 5-3. The maximum energy consumption of the robot is less than 200W, and normally, the combined energy consumption is less than 100W.



The positive and negative power cables must not be reversed, otherwise the robot will be damaged! (The factory standard power cord, brown is positive, blue is negative) In addition, the power supply range of the robot is DC20V~DC27V, exceeding this range may also damage the robot.

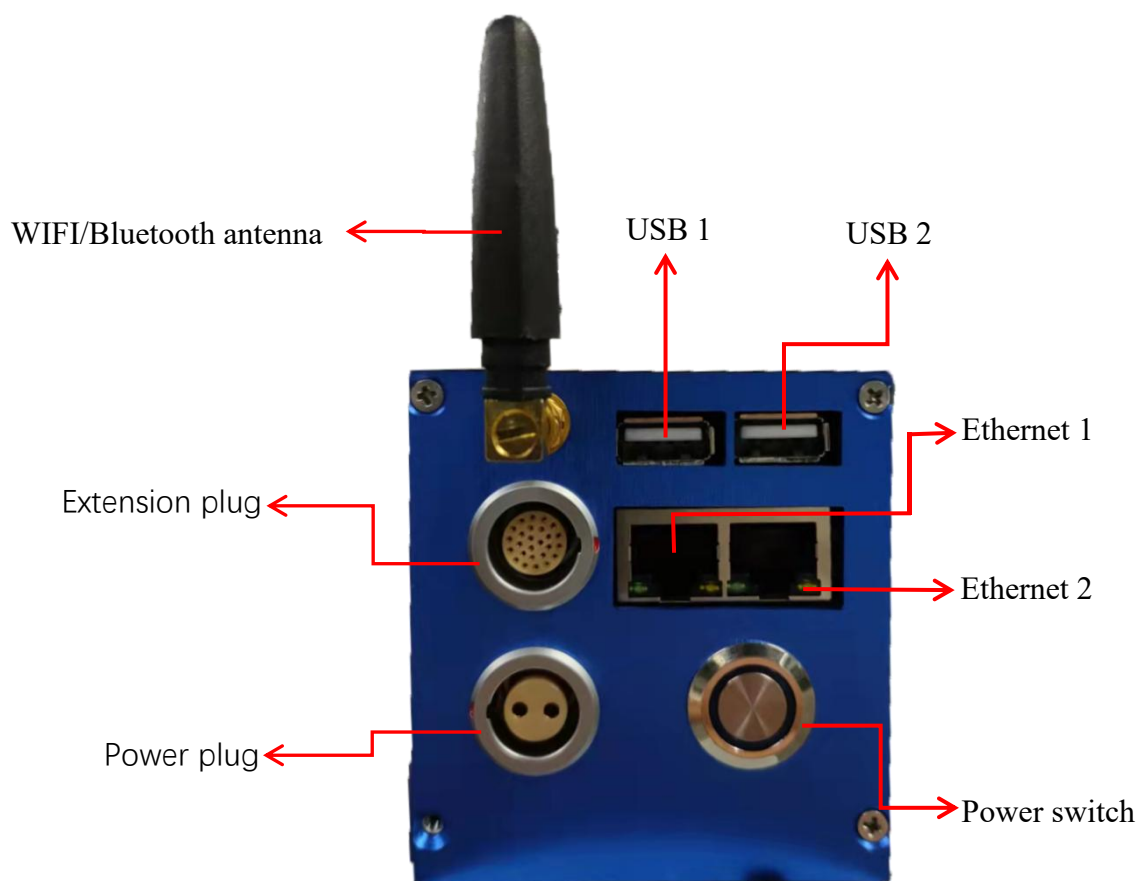


Fig. 5-3 Robot electrical interface.

Table 4 Robot electrical interface description.

#	Interface	Functionality
1	power switch	control the power supply of the robot the blue light on once powered on
2	power socket	plug in the power cable
3	extension plug	outlet the RS485、I/O etc. interface of the controller
4	WIFI/Bluetooth antenna	wireless communication
5	USB 1	update software, import and export files
6	USB 2	control the robot
7	Ethernet 1	connect to ethernet devices
8	Ethernet 2	connect to teaching devices and remote access

5.2 Controller I/O



There is a 26-pin connector on the robot controller panel. All I/Os of the robot are led out from this connector. Please refer to the figure below.

Note: When making wire connections, it is forbidden to plug and unplug the aviation plug with electricity.

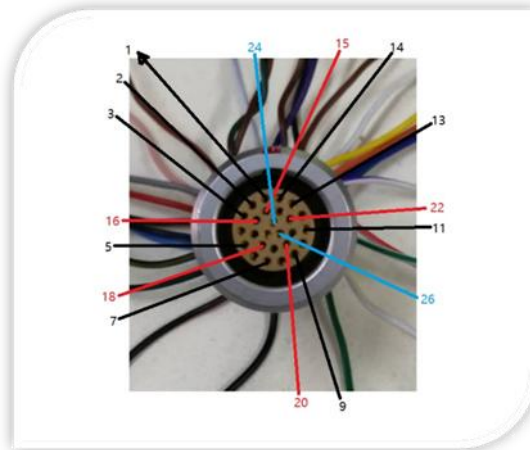


Fig. 5-4 The I/O interface.

Specifically, the cable definition of the I/O interface is shown in the table below.

#	Color	Symbol	Functionality	Other
1	blue striped brown, purple	5V+	5 volts output	
2	yellow brown, green brown	GND	Ground	
3	red brown	12V+	12 volts output	
4	purple brown	CAN_H	CAN bus	Optional
5	blue black	CAN_L	CAN bus	Optional
6	yellow black	485_L	485 bus	
7	green black	DOUT1	Digital output channels	0~12 volts
8	red black	DOUT2		
9	purple black	DOUT3		
10	yellow green	DOUT4		
11	yellow white	AOUT1	Analog input channels	0~10 volts
12	green white	AOUT2		



13	red white	AOUT3		
14	purple white	AOUT4		
15	yellow	AIN1	Analog output channel	0~10 volts
16	brown	AGND	Analog ground	
17	gray	DIN1	Digital output channel	0~12 volts
18	pink	485_H	485 bus	
19	light blue	DIN2	Digital input channel	0~12 volts
20	blue white	OUT_PWR_DIN+	External digital input power	0~12 volts
21	green	DIN3	Digital input channel	0~12 volts
22	blue	AIN2	Analog output channel	0~10 volts
23	orange	AIN3		
24	white	AIN4		
25	red	OUT_PWR_DOUT+	External digital output channel	0~12 volts
26	black	DGND	External digital ground	

Robot has I/O ports whose quantities and functionalities are shown below.

digital output: DO	4 ports; configurable from 0 to 24 volts.
digital input: DI	3 ports; configurable from 0 to 24 volts.
analog output: AO	4 ports; output voltage from 0 to 10 volts.
analog input: AI	4 ports; input voltage from 0 to 10 volts.

5.2.1 Digital Input

The controller interface has 3 ports of digital input. The user needs to connect the external input digital power channel (OUT_PWR_DIN+) and the external digital ground channel (DGND) to provide the power reference for the digital input.



Electrical characteristics are shown in the table below.

Digital input	Min	Typical	Max	Unit
input power V_{in}	0	5	12	Volt or V
input voltage	-0.5		12	Volt or V
logic low level			1	Volt or V
logic high level	$V_{in}-0.5$			Volt or V

5.2.2 Digital Output

The controller interface has 4 digital output ports. Users need to connect the external output digital power channel (OUT_PWR_DOUT+) and the external digital ground channel (DGND) to provide level reference for digital output. Electrical characteristics are shown in the table below.

Digital output	Min	Typical	Max	Unit
input power V_{in}	0	5	24	V

5.2.3 Analog Input

The controller has 4 analog input channels or ports. Its voltage range is 0~10V. Its electrical characteristics are shown in the table below.

Analog input	Min	Typical	Max	Unit
input voltage	-0.5	-	12.5	V
detection range	0		10	V
resolution	12			Bit

5.2.4 Analog Output

The controller has 4 analog output channels or ports. Its voltage range is 0~10V. Its electrical characteristics are shown in the table below.

Analog output	Min	Typical	Max	Unit
output voltage	0	-	10	V



port output current	0	1	mA
resolution	12		Bit

5.3 The Tool End Interface Board

To facilitate the users to add tools to the end of the robot, a 6-pin connector beside the tool flange at the tool end of the cooperative robot arm can provide power and control signals for the different grippers and sensors connected to the robot. Besides, there are two buttons on the flange shell to control the robot by drag teaching and trajectory reproduction, respectively.

Note: When plugging and unplugging the aviation plug cable of the end interface board, please ensure that the end output power is off, otherwise there is a risk of hardware damage.

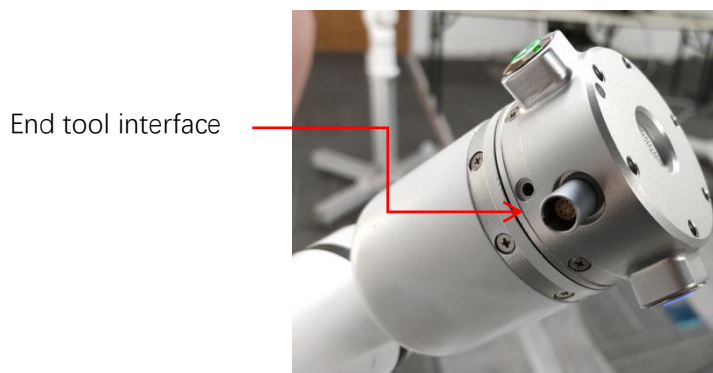


Fig. 5-5 The arm-end tool interface.

The description of the interface board is shown as follows.

#	Interface Type	Quantity	Functionality
1	power output	1	configurable from 5V/12V/24V; switch on and off is controllable
2	digital output	≤ 2	the reference level is consistent with the power output; support 12V/24V
3	digital input	≤ 2	the reference level is consistent with the power output; support 12V/24V
4	RS485	1	communicate with the peripherals via RS485
5	drag teaching button in	1	long-hold press, then the robot begins the



	green		drag teaching mode
6	trajectory repetition button in blue	1	short-term press, then the robot repeats the trajectory recorded by dragging

The tool end interface provides a 6-pin aviation plug to be connected. Its pins and functionalities are shown below.

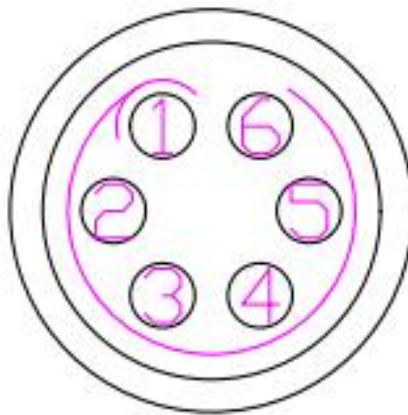


Fig. 5-6 Pin definition of aviation plug on tool end.

Pin #	Wire Color	Functionality
1	yellow	RS485_A
2	white	RS485_B
3	red	digital interface 1 (DI1/DO1)
4	black	digital interface 2 (DI2/DO2)
5	green	power GND
6	blue	power output: 0V/5V/12V/24V, which is programmable

Note that multiplexing function in the above table can be switched by programming. The factory default pin 3 and 4 are the digital input channel (DI1 and DI2), and the power output of the pin 6 is 0V, which is programmable.

5.3.1 Digital I/O Input

There are two digital input channels, and their electrical characteristics are shown in the table below.



Digital Input	Min	Typical	Max	Unit
input power V_{in}	0	—	24	V
input voltage	-0.5		24	V
logic low level			1	V
logic high level	$V_{in}-0.5$			V

5.3.2 Digital I/O Output

There are two digital output channels at the tool end, which can be configured directly through the controller by teach pendant software or JSON protocol. The electrical characteristics are shown in the table below.

Digital Output	Min	Typical	Max	Unit
input power V_{in}	0	—	24	V

5.3.3 Power Output

The tool end of the robot can output 5V or 12V or 24V power supply. When the output voltage is 24V, the actual output voltage is the same as the power supply voltage of the robot. If the power supply voltage is unstable, the output voltage will be affected. The power output type can be configured and switched on and off via the teach pendant software or JSON protocol. The electrical characteristics are shown in the table below.

Hyperparameter	Min	Typical	Max	Unit
power voltage	0	—	24	V
power current	—	1000	1500	mA

Note: When supplying power to the end tool through the end power supply, refer to the above table for current limits to prevent overload and burn out the end interface board.

5.3.4 Communication Interface

The robot has one RS485 communication port at each of the 26-core aviation plug of the controller, and the 6-core aviation plug of the end interface board (only for the



robot to control external devices, not to support external devices for robot motion control). These two RS485 ports can be configured to standard Modbus RTU mode through the JSON protocol. Then read and write to the peripherals connected to the ports via the JSON protocol (refer to section 4.15 Modbus RTU Configuration in the "Robot JSON Protocol Description" for detailed instructions).

6. Robot Installation

6.1 Introduction

The brief installation steps of RM65 robot are as follows:

- (1) Determine the robot workspace,
- (2) Install the robot body on the base,
- (3) Install the end tool.

6.2 Important Safety Instruction

Environmental requirements of installation include

- non-corrosive gases or liquids,
- no dust or metal powder,
- no radioactive material,
- no oily fume,
- no mechanical strike or vibration,
- low humidity,
- altitude below 1,000 meters,
- avoid direct sunlight (not used outdoors),
- no salty fog,
- no electromagnetic noise,
- and no flammable materials.

Required environmental temperature is 0°C ~ 45°C.

Required operating humidity is 25%~85% (no condensation).

Regarding floor load-carrying capacity, please mount the robot on a solid surface that is strong enough to withstand at least ten times the full torsional force of the base joint and at least five times the weight of the robot arm. Moreover, the surface must not



vibrate. Please refer to Section 11 (Technical Specifications) document for specific load-carrying capacity. A safety assessment must be carried out after each installation of the robot, and operation should strictly follow the instructions in Section 1 (Safety).

6.3 Robot Workspace

Fig. 6-1 shows the dimensions of RM65-B robot. The installation must consider the range of the robot movement, to avoid contact with the surrounding personnel and equipment.

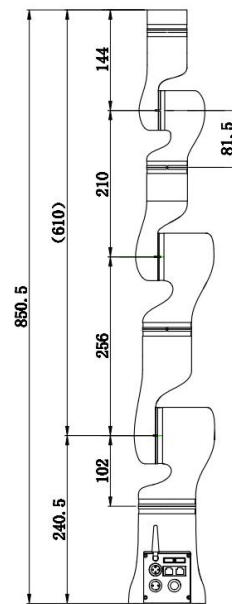


Fig. 6-1 The dimensions of robot joints.

Fig. 6-2 shows the movement range of RM65-B robot. Excluding the cylindrical space above and below the base, the movement range of the robot is a sphere with a radius of 610 mm. When selecting the robot installation location, be sure to consider the cylinder space above and below the robot and avoid moving the tools into the cylinder space as much as possible. Moreover, the rotational range of each joint in practical applications is listed as follows, i.e., rotation range of joint 1: $\pm 180^\circ$, rotation range of joint 2: $\pm 130^\circ$, rotation range of joint 3: $\pm 135^\circ$, rotation range of joint 4: $\pm 180^\circ$, rotation range of joint 5: $\pm 128^\circ$, and rotation range of joint 6: $\pm 360^\circ$.

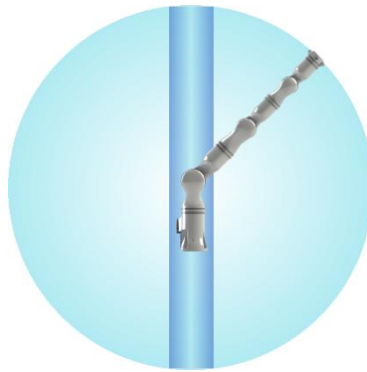


Fig. 6-2 The schematic of the robot's reachable space.

6.4 Robot Installation

When installing on the base, 4 M6 bolts are used to fix the robot body on the base.

The mechanical dimensions are shown in Fig. 6-3.

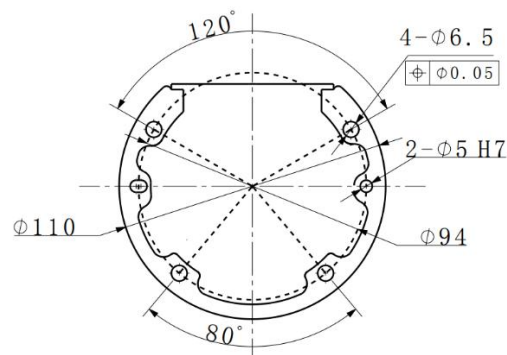


Fig. 6-3 The dimensions of robot base.

1. When mounted on the base, the robot shall be in close contact with the base surface, which shall be sufficient to withstand torsional forces of at least 3500Nm in the rotation direction of rotation of the base joint and a weight of at least 100kg. The base surface must not vibrate. If the robot is mounted on a moving platform, the acceleration of the moving platform should be very low.
2. It is recommended that the user use base surface with large heat dissipation, such as all-aluminum material. When the operating environment exceeds 35°C, it is strongly recommended that the user use material with large heat dissipation.

Ensure that the robot arm is properly and safely installed in place.



If the robot is submerged in water for a certain period of time, it may be damaged. Robots should not be installed in water or wet conditions unless they are declared to have IP67 protection rating.

Tipping hazard: if the robot is not securely positioned on a solid surface, the robot may tip over and cause damage.

6.5 The End Tool Installation

The dimensions of tool flanges are shown in Fig. 6-4.

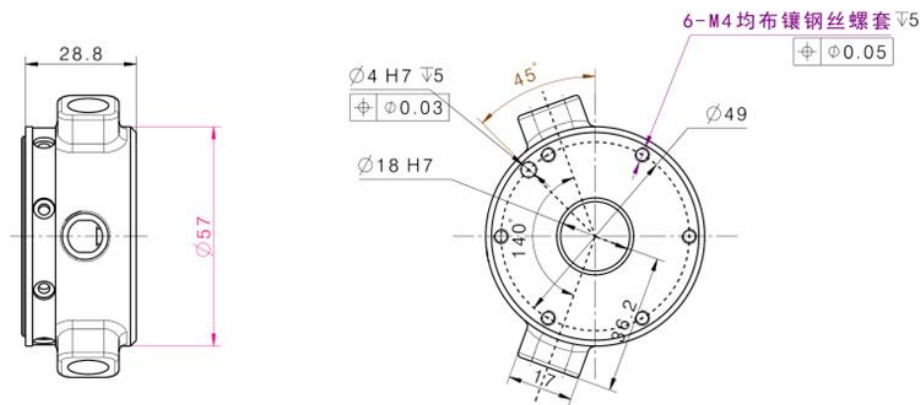


Fig. 6-4 The dimensions of the tool end.

1. Make sure tools are properly and securely installed in place.
2. Ensure the safety of the installed tool-end structure so that no parts will accidentally fall and cause damage.

7. Robot Power-On and Power-Off

7.1 Before Power On

Unpack and install the RM65 robot to the base. Please refer to Chapter 6 Robot Installation for the detailed installation instructions.

1. Ensure that the robot and cable do not contact the liquid.
2. The robot shall not be exposed to dust or humidity above IP54 rating. Pay close attention to the presence of conductive dust.
3. Connect the robot cable. If there is no external device, just connect the power cord (refer to Section 5.1.2 for specific interface description).

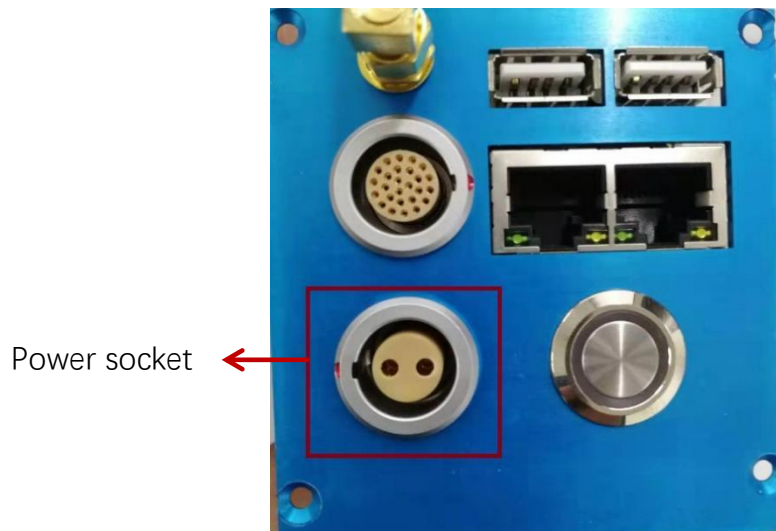


Fig. 7-1 Robot power socket.

7.2 Power On

- Connect the power cable to the power socket.
- Check that the controller power switch is in the closed status when it is not connected.
- Ensure that the robot does not bump into nearby people or equipment.
- Make sure the power cable is connected to a 24V DC power supply.
- Press the power button. After the power indicate light turns blue, and wait for about 25s. When the controller buzzer sound stops, the initialization of the controller system of the robot is completed.

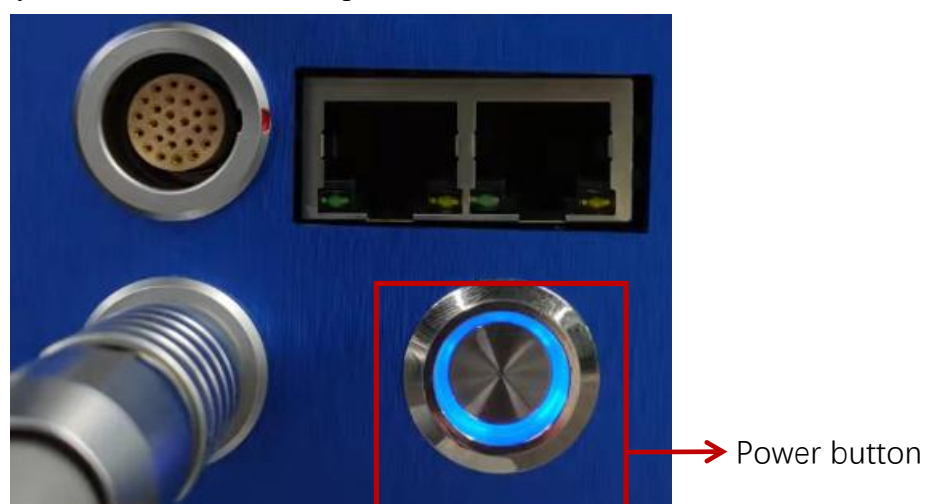


Fig. 7-2 Robot power button.

7.3 Power Off



1. Press the power button to make it in the pop-up off status.
2. Turn off DC 24V power supply for the robot.

8. Robot Online Programming

8.1 Introduction

The optional teach pendant contains the RM65 teach pendant software. Through this human-computer interaction interface, you can operate the robot body and controller, execute and create robot programs, and read robot information.



Fig. 8-1 The teach pendant shortcut.

If optional teach pendant is not included, users install the package to use the teach pendant software or teach pendant software on Windows. The installation of the software package is as follows.

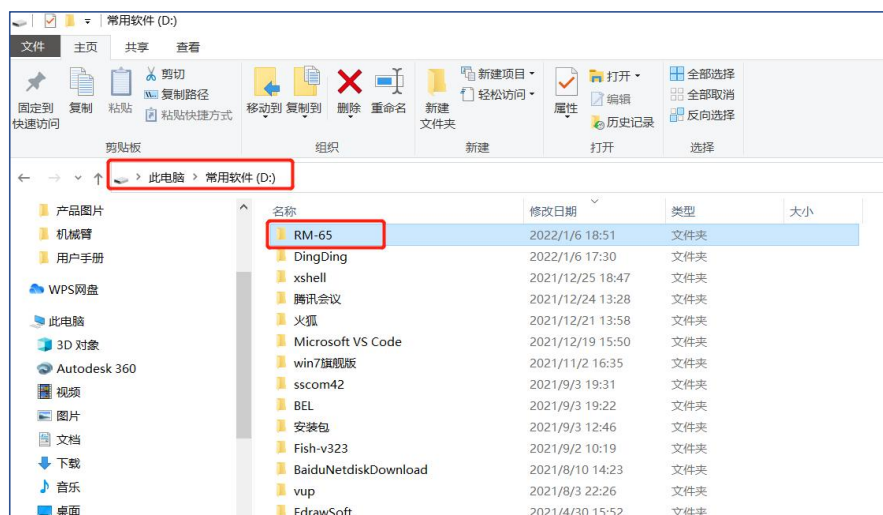


Fig. 8-2 Software installation package.

- (1) Copy the RM65 directory to any disk directory on your computer (the storage directory must contain English only).
- (2) Send the file “RM_ROBOT.exe” at the RM-65 folder to the desktop shortcut.

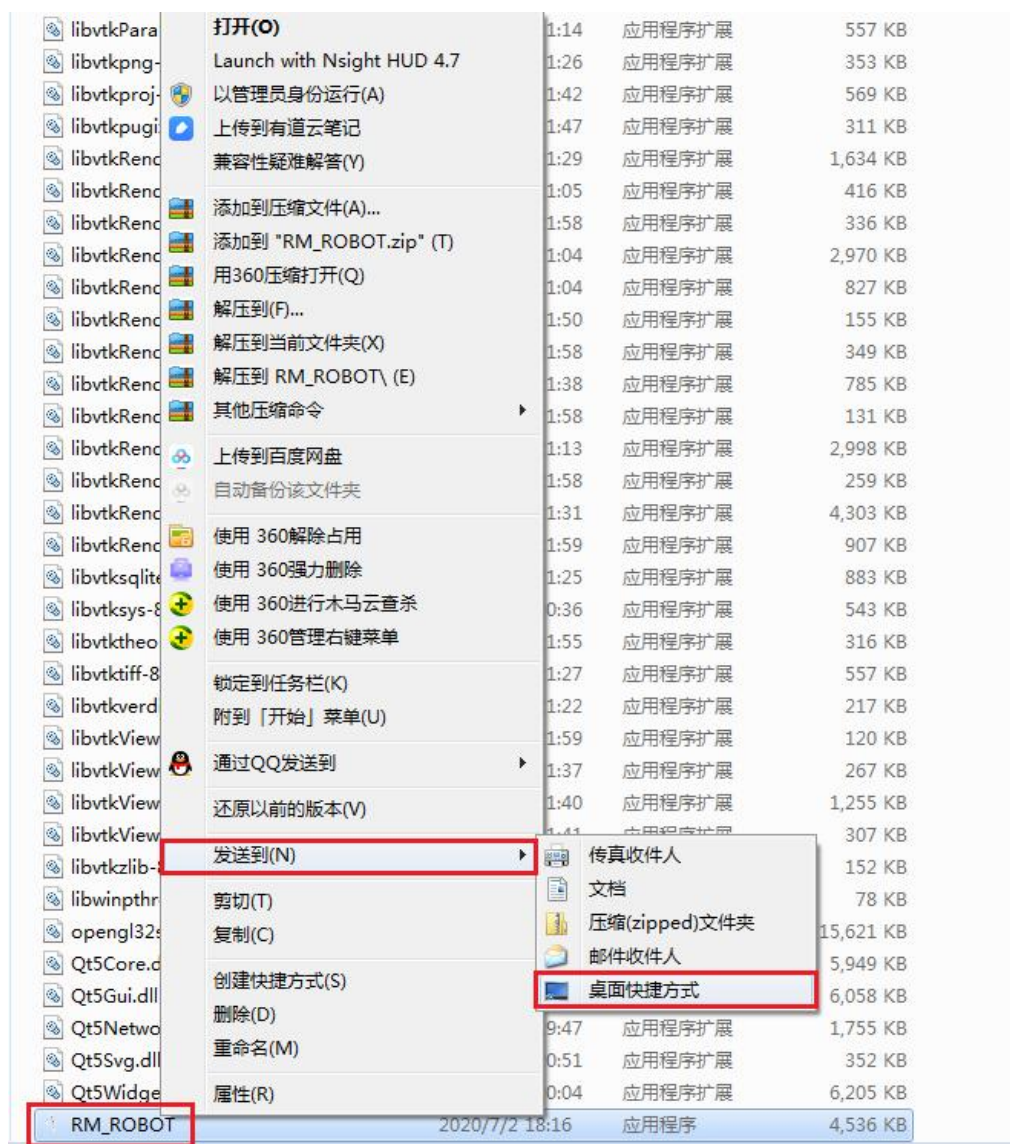


Fig. 8-3 Desktop shortcut creation.

(3) Double-click the shortcut generated on the desktop to run the teach pendant software interface. The teach pendant software shortcut is shown as follows.



Fig. 8-4 The shortcut of the teach pendant software.

8.2 Robot Teaching

The teaching panel is used for robot teaching operation. Users can move the robot joints by clicking on the icon on the panel. This panel also demonstrates the information of the robotic movement to the user.

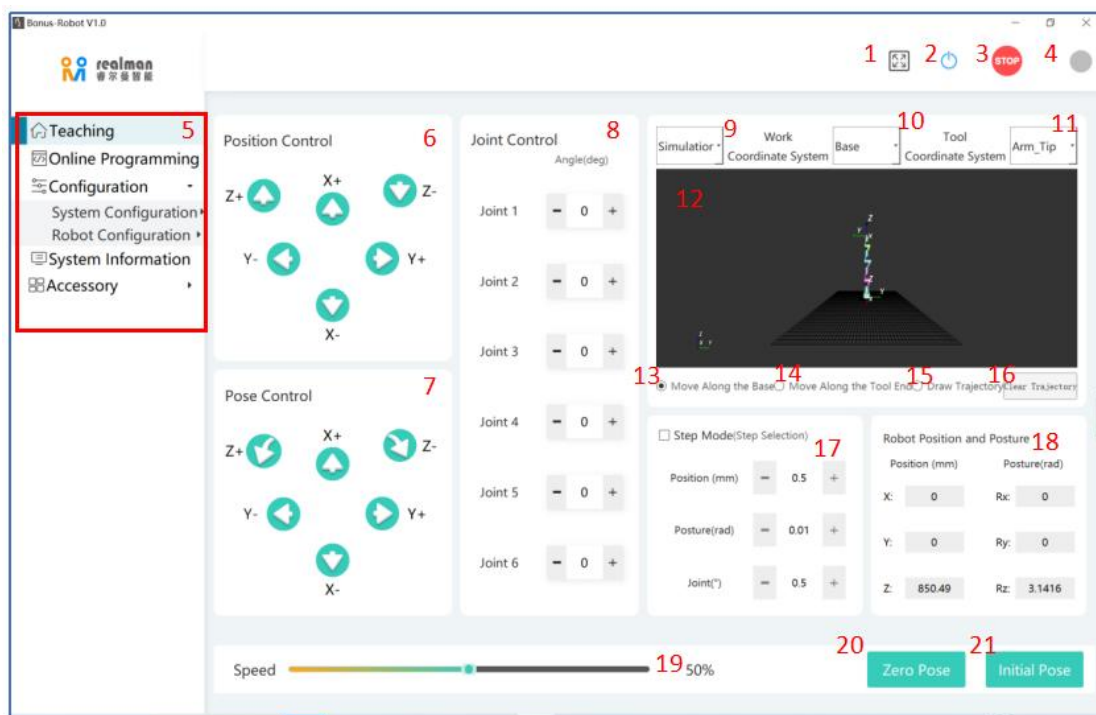


Fig. 8-5 The robot teach pendant.

Table 6 Name of each functional block in the robot teach pendant.

#	Name
1	full-screen button
2	robot power button
3	robot emergency stop button
4	communication status, gray-robot not connected, green-robot connected
5	menu bar
6	position control
7	pose control
8	joint control
9	operation mode selection
10	operation coordinate system selection
11	tool coordinate system selection
12	3D simulation model
13	move in base coordinate system

14	move in tool-end coordinate system
15	draw trajectory
16	clear trajectory
17	step mode setting
18	robot position and posture display
19	move speed percentage display
20	origin pose button
21	initial pose button

The blocks/keys are described as follows in the order of Table 5.

8.2.1 Full-screen Button

This button is used to control the teach pendant software into and out of full screen.



Fig. 8-6 The full-screen button.

8.2.2 Power Button

The button is used to control the robot power. Blue represents that the power supply of the robot is on, and gray represents that the power supply of the robot is in the off status.



Fig. 8-7 The robot power button.

8.2.3 Robot Emergency Stop Button

When this button is pressed, the robot stops immediately and the trajectory is unrecoverable.



Fig. 8-8 The robot emergency stop button.



8.2.4 Communication Status Display

When communication is established with the robot, it turns green. When communication is disconnected, it turns gray.

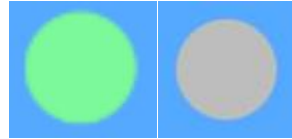


Fig. 8-9 The communication status display icons.

8.2.5 Menu Bar

Click the button in the menu bar to switch to the corresponding name panel, which is convenient for users to operate. The selected panel has an light blue background.

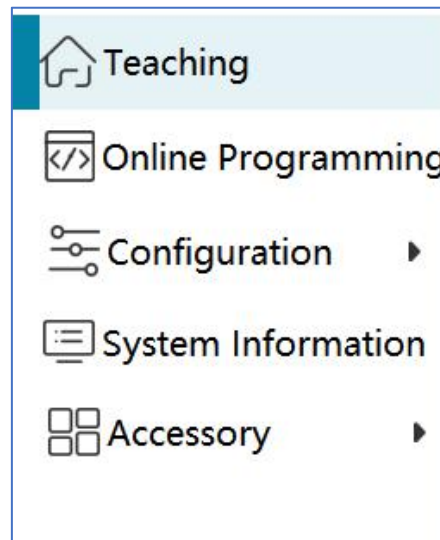


Fig. 8-10 The menu bar.

8.2.6 Position Control

The position of the robot end can be controlled based on the base coordinate system (Base), the tool coordinate system (Arm_Tip) and the customized coordinate system.

The user can teach the robot end in different coordinate systems.  x^- denotes moving to negative x-axis direction,  x^+ denotes moving to positive x-axis direction. Long hold the button, the robot moves, after releasing it, the robot stops moving. Likewise, same thing with the rest of the buttons.

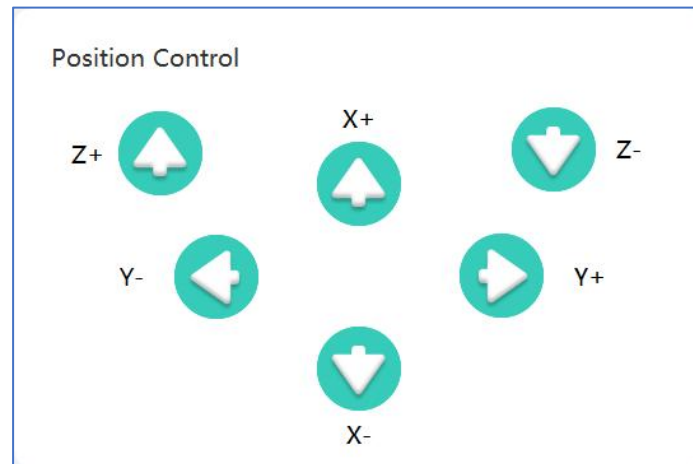


Fig. 8-11 The position control panel.

8.2.7 Pose Control

The pose of the robot end can be controlled based on the base coordinate system (Base), the tool coordinate system (Arm_Tip) and the customized coordinate system. The user can teach the robot end in different coordinate systems. When teaching pose, the position of the robot arm end remains unchanged while the pose changes around

the specified coordinate axis.  denotes rotating to negative x-axis direction,  denotes rotating to positive x-axis direction.

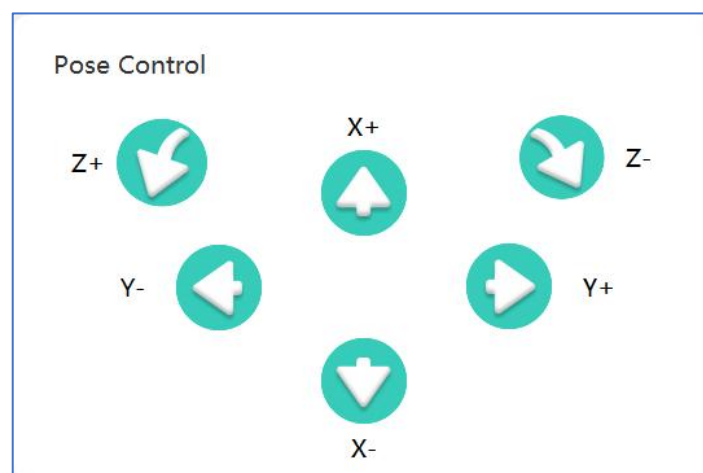


Fig. 8-12 The pose control panel.

8.2.8 Joint Control

The robot has 6 DoF. Each joint from bottom to top is named as joint 1 to joint 6, which corresponds to the six joints of the robot. Users only need to use the joint



control buttons on the teach pendant panel to control the rotation of each robot joint.

 denotes increasing the angle of the joint,  denotes decreasing the angle of the joint. Unit: degree.

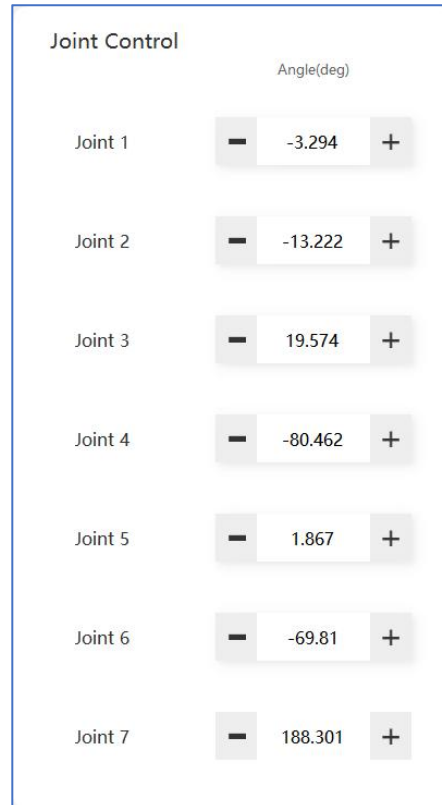


Fig. 8-13 The joint control panel.

8.2.9 Operation Mode Selection

When the actual robot arm is selected, the program runs on the actual robot. The robot will move according to programs. Its parameters and the move status simulation of the robot arm will be displayed on the interface.

When the simulation mode is selected, the robot does not move but its 3D simulation. To finalize a robot program, the simulation mode can be selected first, and then the program can be run simulatively to verify whether the program is feasible, improve the safety of the robot application and determine whether the planning trajectory is reachable.



Fig. 8-14 An operation mode selection demo.

8.2.10 Operation Coordinate System Selection

The user can select the operation coordinate system to control robot movement. Select the Base coordinate system (Base) on the panel of the teach pendant software to control the robot, and the robot will take the coordinate system as shown in Fig. 8-15 as the Base coordinate system. Users can also create their own operation coordinate system as the reference direction of the robot movement to meet actual project requirements. Assuming that work1 is the operation coordinate system set by the user (see Section 8.4.2.3 for the method of setting robot operation coordinate system). After the setting is completed, the operation coordinate system can be switched, as shown in Figure 8-16.

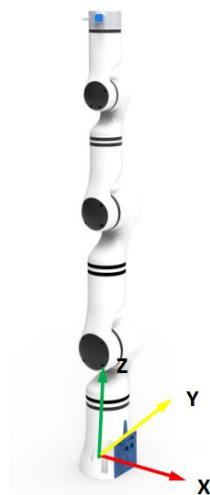


Fig. 8-15 The Base coordinate system of the robot.

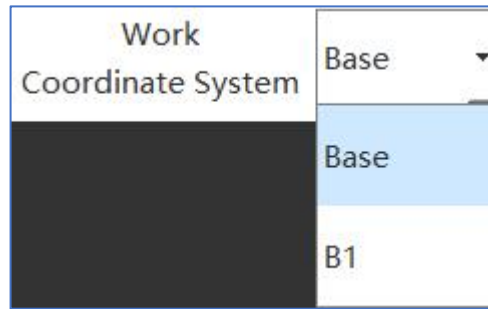


Fig. 8-16 Operation coordinate system selection demo.

8.2.11 Tool Coordinate System Selection

The tool end or tool coordinate system can be selected through the drop-down menu and select the coordinate system of the flange center by default (see Fig. 8-17). Users can also set customized tool coordinate systems. Assuming that tool1 is the tool coordinate system set by the user (see Section 8.4.2.2 for the method of setting the robot tool coordinate system), the tool coordinate system can be switched after the setting is completed, as shown in Fig. 8-18.

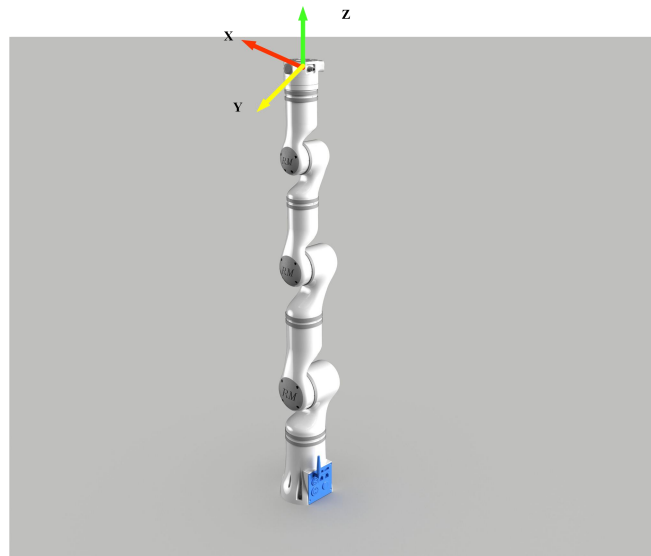


Fig. 8-17 The coordinate system of the flange center at the robot end.

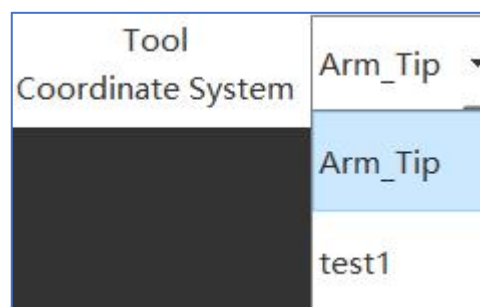


Fig. 8-18 A tool coordinate system selection demo.



8.2.12 3D Simulation Model

The purpose of the robot simulation interface is to verify the program by the user without the actual robot. Users can check whether the control program of the robot is reasonable and correct by simulation. In the simulation model, users can change the dimension and direction by dragging the mouse (or touching the tablet interface) according to the needs.

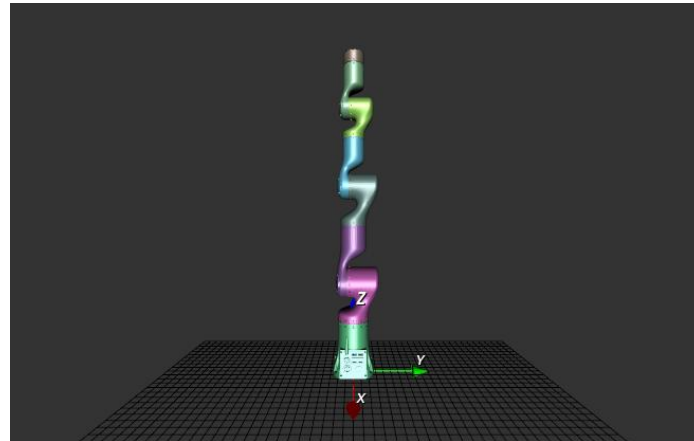


Fig. 8-19 The 3D simulation model.

8.2.13 Move in Base Coordinate System

Select “Move in Base Coordinate System”, the robot will move in base coordinate system.

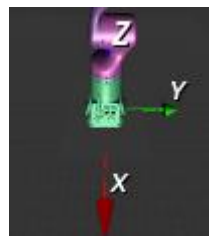


Fig. 8-20 Move in base coordinate system.

8.2.14 Move in Tool End Coordinate System

Select “Move in Tool End Coordinate System”, the robot will move in tool end coordinate system.

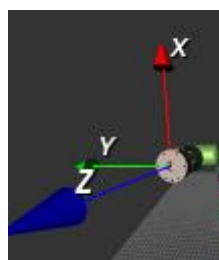


Fig. 8-21 Move in tool end coordinate system.



8.2.15 Draw Trajectory

Select “Draw Trajectory”, the real-time movement of the robot will be displayed in the model simulation section.

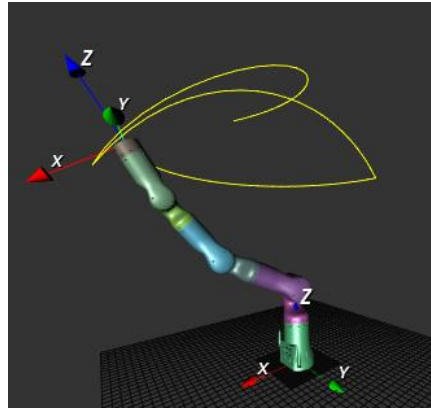


Fig. 8-22 Draw trajectory demo.

8.2.16 Clear Trajectory

Select “Clear Trajectory”, the robot movement trajectory will be cleared in the model simulation section.

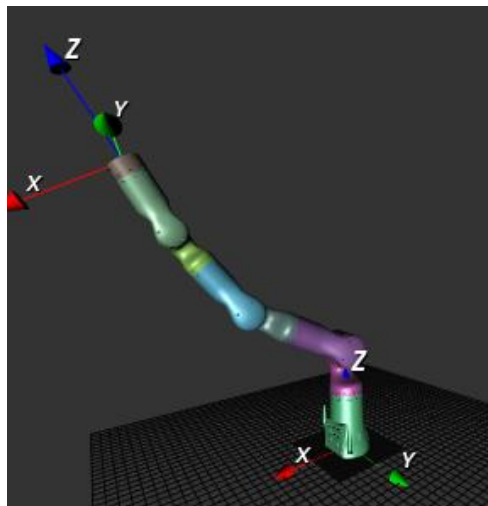


Fig. 8-23 Clear trajectory demo.

8.2.17 Step Mode Setting

To increase the teaching accuracy, step control model is used, which can make the controlled variable change accurately in the way of step.

- First select the "Step Mode" box to activate the step mode.
- The user can directly input the desired step size in the input box or adjust the



step size of the robot by clicking the buttons on the left and right sides of the input box.

- “Position”: Indicates the step size, in millimeters, that controls the movement of the end position at the position control panel. Do not release the button during the movement, it will stop once released.
- “Posture”: Represents the step size to control the motion angle of the end, in radians, at the pose control panel.
- “Joint”: Indicates the step to control the motion angle of each joint, in degrees, at the joint control panel.
- Step control is only effective for robot end and joint control.

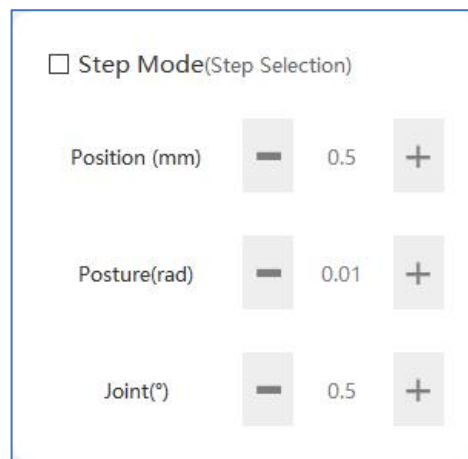


Fig. 8-24 Step mode demo.

8.2.18 Robot Position and Posture Information Display

The position (X, Y, Z) denotes the center of tool flange (the selected tool coordinate system) in the selected coordinate system (from one of Base coordinate system, end coordinate system, and customized coordinate system). The pose (RX, RY, RZ) expresses the rotation arc relative to the selected coordinate system, resulted from rotating along the selected coordinate system in a certain order.

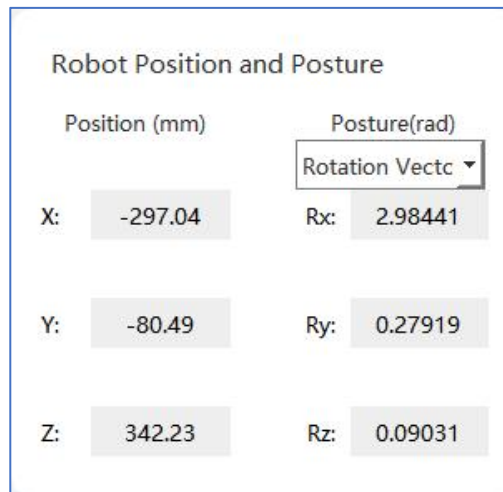


Fig. 8-25 A robot end position and posture display demo.

8.2.19 Speed Display

Drag the slider to set the percentage of the robot speed with respect to the designed maximum speed.



Fig. 8-26 The speed setting slider.

8.2.20 Origin Pose Button

Origin pose: Long-hold  can reset the robot to the origin. Release the button to stop the movement.

8.2.21 Initial Pose Button

Initial pose: Long-hold  can reset the robot to its initial. Users can also freely set the initial position and pose of the robot according to the descriptions in the section of the initial pose calibration (Section 8.4.2.4) through the teach pendant software. Release the button to stop the movement.

8.3 Online Programming

Users can program the RM65 robot via the “online programming” interface to implement the complex robot movement.



Fig. 8-27 The online programming panel.

Table 7 Online programming panel

#	Name
1	create new project button
2	select project button
3	save project button
4	project content display
5	add trajectory point
6	basic commands
7	advance commands
8	edit
9	start button
10	pause button
11	stop button
12	single step
13	joints move there
14	move straight there
15	model simulation

The blocks/keys are described as follows in the order of Table 7.



8.3.1 New Project Button

Note: Opening Online Programming has created a blank project file by default, where users can add commands directly.

After clicking  button, an empty project file is created, and by default an <empty> command line is added, where the user can add commands.



Fig. 8-28 Create a new project.

If there is a project that is being edited and is not saved, the "save the current project?" prompt box will pop up, click "Yes" to save, or click "No" to not save.

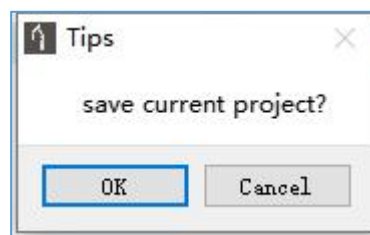


Fig. 8-29 Prompt box to save or not save the project.

8.3.2 Select Project Button

For the created project, click the  button, then select the project path and click "Open", and the file will be displayed in the text box on the right side. The project file suffix is .txt. For example, select a file named "test.txt" in this demo.

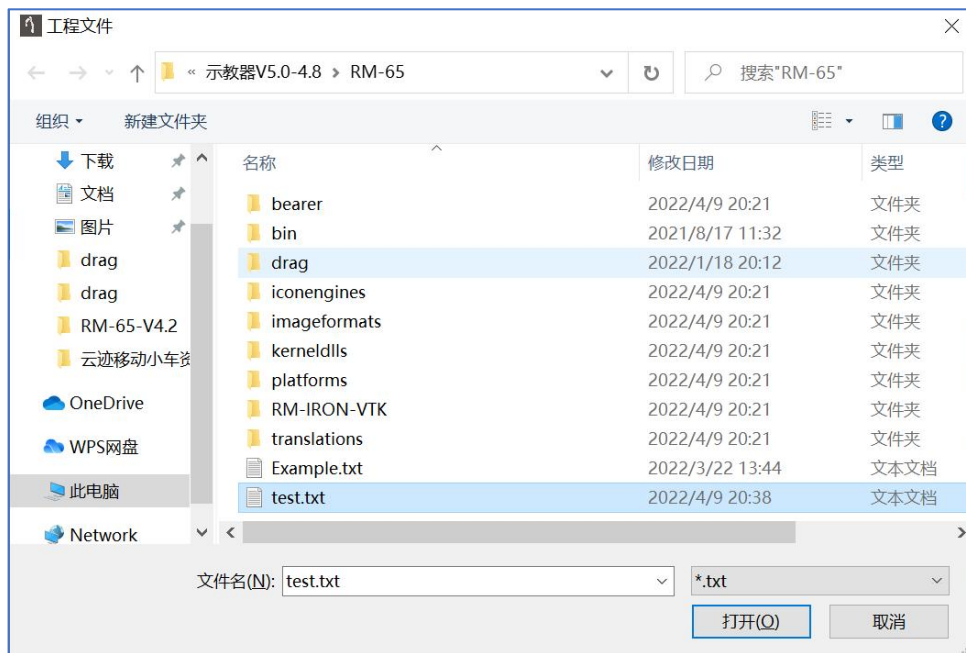


Fig. 8-30 A project selection demo.

8.3.3 Save Project

When the  button is clicked, the "select save path" dialog box will pop up. After the project name is entered, click the "save" button to complete the save. The data in the project content display area will be automatically saved to the document specified by the user with suffix as .txt.

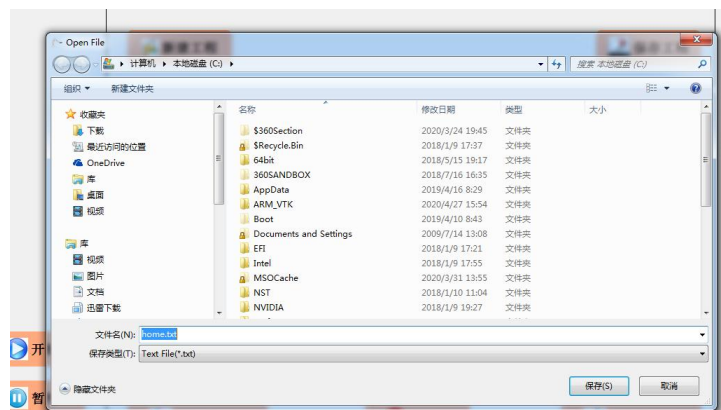


Fig. 8-31 A project save demo.

8.3.4 Project Content Display

This area displays the edited program and the recorded motion points in the form of a tree map. When the program runs, it will be executed from the first line.

Click the  button before a command to show or hide the commands under the node.



Commands that have been edited are displayed with a green ✓ icon, and commands that have not been edited are displayed with an orange ⚠ icon. The right side of the program tree displays the specific number of lines in the project where the command is located.

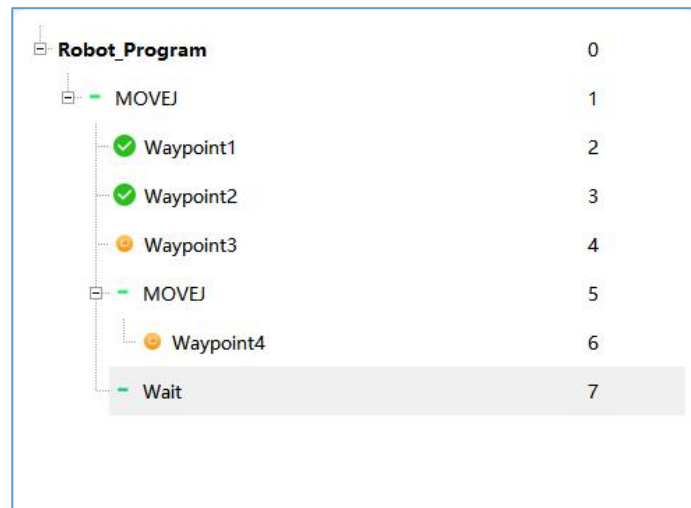


Fig. 8-32 Program tree map.

8.3.5 Add Trajectory Point

A trajectory point can be added after or before by selecting "Add After" or "Add Before".

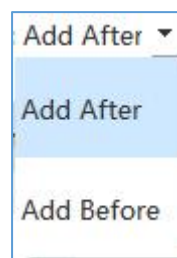


Fig. 8-33 Position options for adding a trajectory point.

These options indicate that the next command will be added to the previous or next line of the cursor position in the program. The reference command position is displayed with a blue cursor.

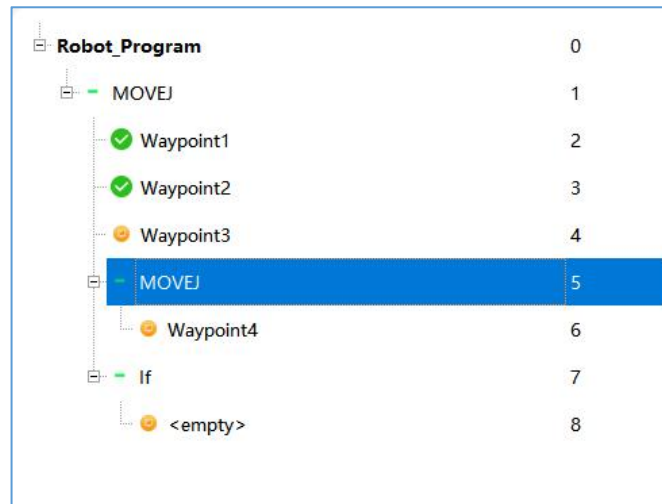


Fig. 8-34 Cursor position example.

8.3.6 Basic Commands

The basic commands include "Move", "Waypoint", "Wait", "Set", "If", "Loop", Pop-up, "Halt", and "File".

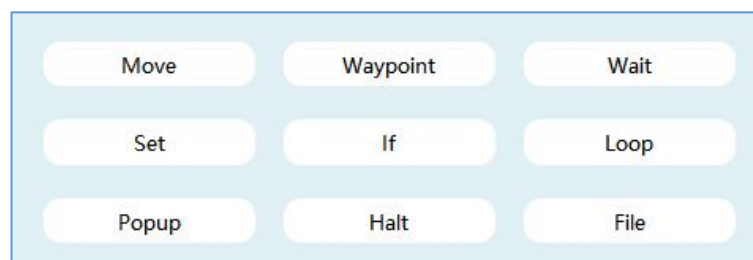


Fig. 8-35 Basic commands.

<Move>

The move command includes four types of movements: "MOVEJ", "MOVEJ_P", and "MOVEC".

MOVEJ and MOVEJ_P: This only guarantees to reach the final position, but no intermediate trajectory is constrained.

MOVEJ: While ensuring reaching the final position, the trajectory between the two points is linear.

MOVEC: Used to execute an arc or circular trajectory, only two waypoints (intermediate point and end point) can be added.

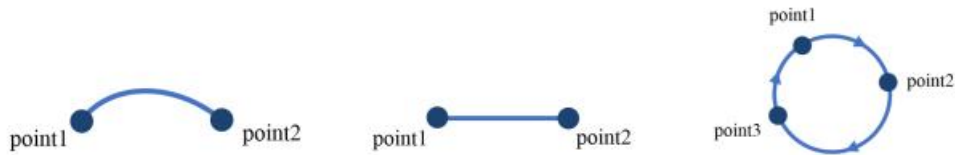
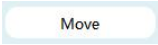


Fig. 8-36 MOVEJ, MOVEJ_P (left), MOVEL (middle) and MOVEC (right) command.

Select one command and click  button. It adds "MOVEJ" command by default and adds one waypoint automatically.

Robot Program	0
MOVEJ	1
Waypoint1	2

Fig. 8-37 Add move command.

Double-click the command line, you can edit the parameters of the command. In "Move" commands, you can set the movement type, speed, operation coordinate system, tool coordinate system. After the setting is completed, click the "OK" button to save.

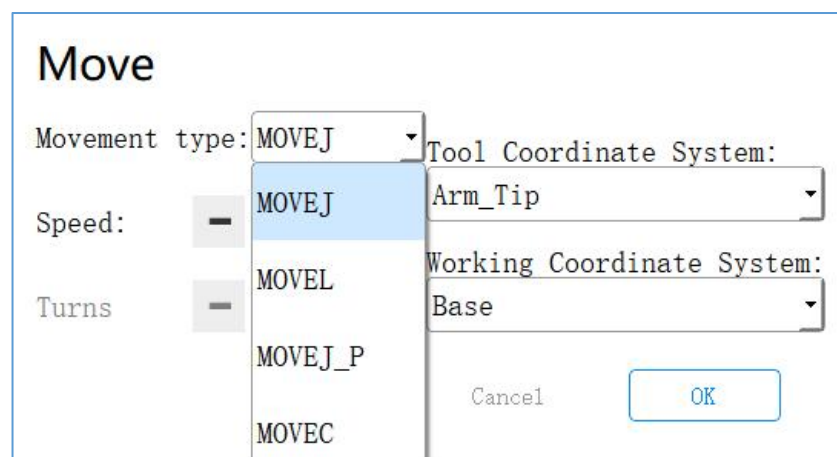


Fig. 8-38 Configuration of Move command.

- **Movement type:** including "MOVEJ", "MOVEL", "MOVEJ_P" and "MOVEC", representing joint motion, linear motion, and circular/arc motion (when the number of execution laps is "0", the arc trajectory is executed; when the number of execution laps is greater than or equal to 1, the circular trajectory is executed), respectively. "MOVEJ", and "MOVEJ_P" are both joint motion but have different waypoint parameters. The parameters of "MOVEJ" are the joints' angles while the parameters of "MOVEJ_P" are the tool-end position and posture.



- **Move speed:** the robot arm move speed.
- **Working/Operation coordinate system:** The coordinate system set by the actual working. It can be customized.
- **Tool coordinate system:** The coordinate system set as the center of the tool end. It can be customized.

Demo 1: Add a MOVEJ trajectory in the program, where the motion between Waypoint1 and Waypoint3 is MOVEJ, as shown in the following figure.

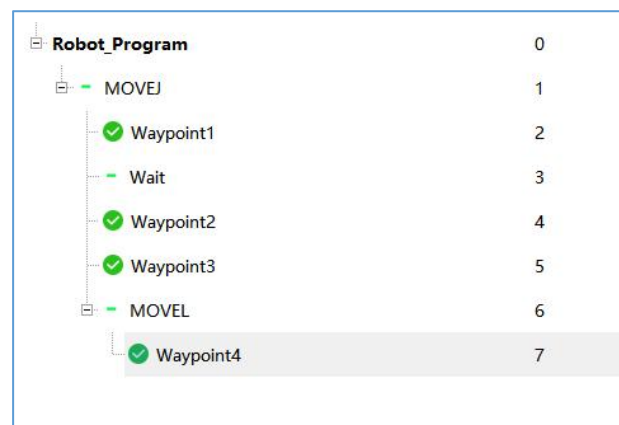


Fig. 8-39 MOVEJ command demo.

Demo 2: Add a MOVEJ trajectory in the program, where the motion of Waypoint4 and Waypoint5 is MOVEJ, as shown in the following figure.

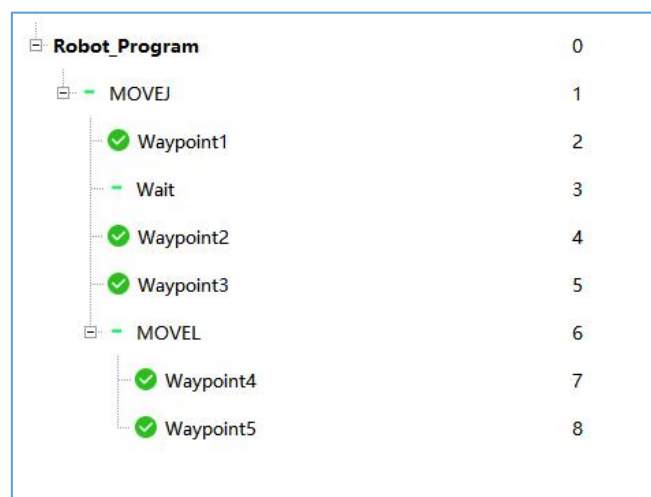


Fig. 8-40 MOVEJ command demo.

Demo 3: Add a MOVEC trajectory in the program, where the motion of Waypoint7 and Waypoint8 is MOVEC, as shown in the following figure.

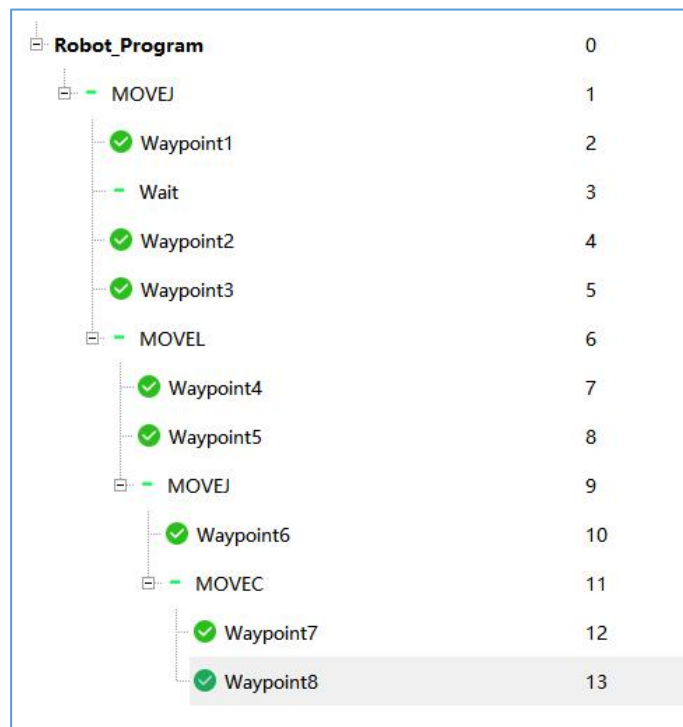


Fig. 8-41 MOVEC command demo.

<Waypoint>

The "Waypoint" command must be added under the "Move" command as the robot motion point. Double-click to edit the command, including point name, speed, blend radius, point setting, and point editing.

The dialog box is titled 'Waypoint'. It contains the following fields and controls:

- 'Waypoint name:' followed by a text input field containing 'Waypoint9'.
- 'Speed:' followed by a slider control with a minus button, the value '100', and a plus button.
- 'Blend Radius:' followed by a slider control with a minus button, the value '0', a plus button, and the unit 'mm'.
- At the bottom, there are four buttons: 'Set Point', 'Edit Point', 'cancel', and 'OK'.

Fig. 8-42 Waypoint hyperparameters.

- **Waypoint name:** The user can set the waypoint name, the default name is composed of the Waypoint number, e.g., Waypoint1.
- **Speed:** The waypoint speed is customizable. The actual operation speed is the product of the speed slider and the speed of the waypoint.



- **Blend radius:** The trajectory planning smooth transition distances. When the blend radius is 0, the robot accurately moves to this point, slowing down and stopping.
- **Point setting:** This sets the motion position of the waypoint. Positional parameters can be taught or manually modified (acting on real robotic arms).
- **Point editing:** This sets the motion position of the waypoint. Positional parameters can be taught or manually modified (acting on simulated robotic arms).

Demo: Add a waypoint in the MOVEJ command in the program, and set the waypoint to Waypoint3 under Waypoint2 as shown in the following figure.

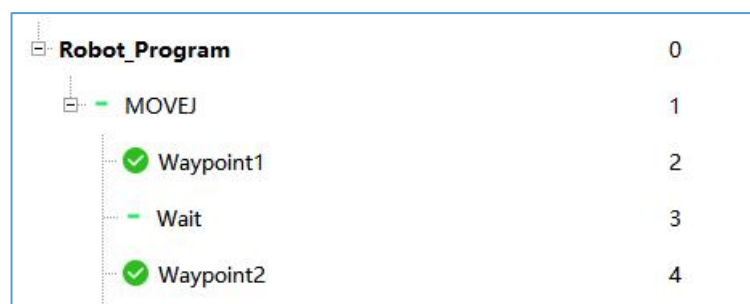


Fig. 8-43 Waypoint demo.

Click the waypoint to set the point shown in the following figure:

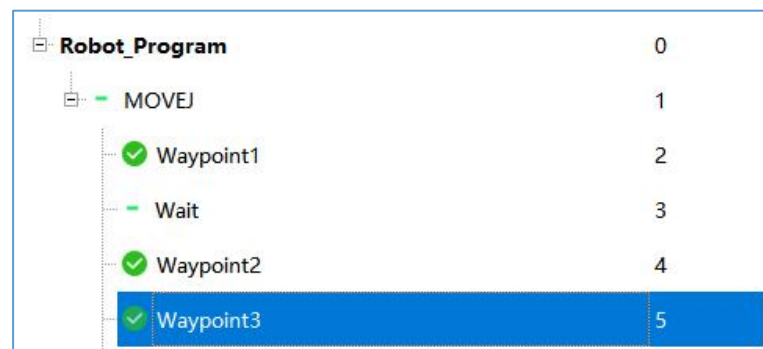


Fig. 8-44 Waypoint demo.

<Wait>

The Wait command is used to wait for time or signal input. The options for Wait command include no waiting, waiting time, waiting for digital input, and waiting for analog input.



Fig. 8-45 Wait command hyperparameters.

- **No waiting:** no waiting time.
- **Waiting time:** The waiting time in seconds is customizable.
- **Waiting for digital input:** Wait for the digital signal input to meet the predefined conditions. Digital inputs include controller-end digital input interfaces DIN1, DIN2, DIN3 and tool-end digital input interfaces T_DIN1, T_DIN2. The digital inputs are divided into high and low potentials.
- **Waiting for analog input:** Wait for the analog signal input to meet the predefined conditions. Analog inputs include controller-end analog input interfaces AIN1, AIN2, AIN3, AIN4 and tool-end analog input interfaces T_AIN1. The analog input reference can be 0~10V.

Demo: Add Wait command between Waypoint1 and Waypoint2, shown as follows.

Robot_Program	0
MOVEJ	1
Waypoint1	2
Wait	3
Waypoint2	4
Waypoint3	5

Fig. 8-46 Wait command demo.

The figure below shows that the waiting time is set as 2s.

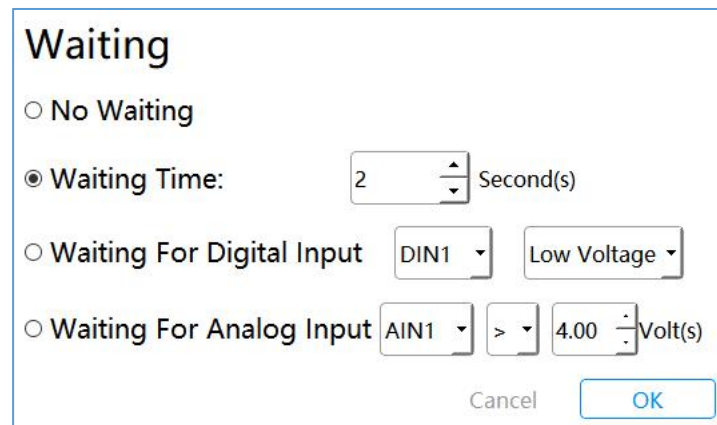


Fig. 8-47 Wait command demo.

<Set>

The Set command is used to set the digital and analog output interface status. Options are no action, set the digital output, and set the analog output.

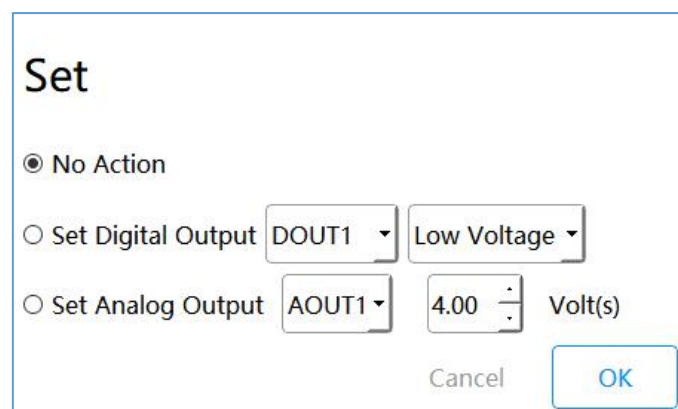


Fig. 8-48 Set command demo.

- **No action:** To keep the output interface status the same.
- **Set the digital output:** Set the digital signal output interface to the specified status. Digital output interface includes controller-end digital output interfaces DON1, DON2, DON3, DON4 and tool-end digital input interfaces T_ DON1, T_ DON2. The digital output interface is divided into high and low potentials.
- **Set the analog output:** Set the analog signal output interface to a specified voltage. Analog output interface includes controller-end analog input interfaces AON1, AON2, AON3, AON4 and tool-end analog input interfaces T_AON1. The analog output interface can be 0~10V.

Demo: Add a Set command between Waypoint2 and Waypoint3, shown as follows.

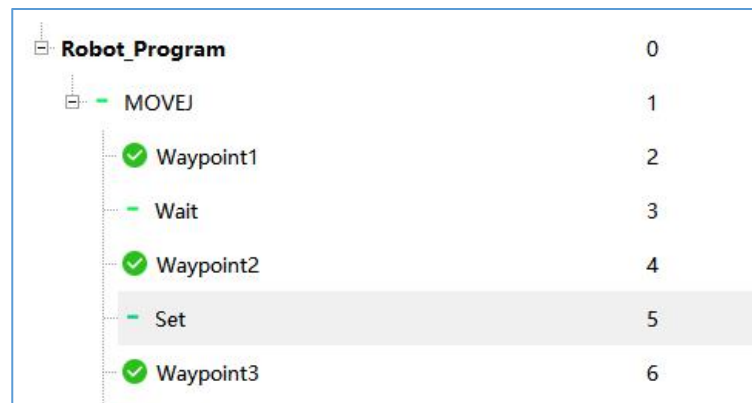


Fig. 8-49 Set command demo.

At the line 5 is Set command, and the digital output can be set to low or high as shown in the figure below.

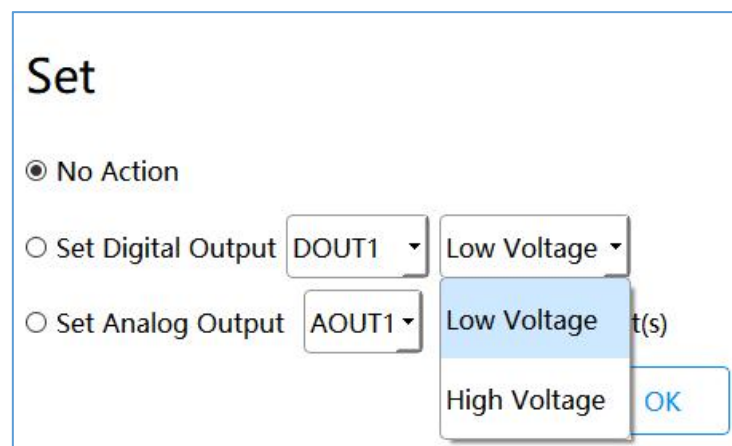


Fig. 8-50 Set command demo.

<IF>

The IF command is used to determine whether to execute a branch program. The branch program is executed when the predefined conditions are met, and the branch program is skipped when it is not met.

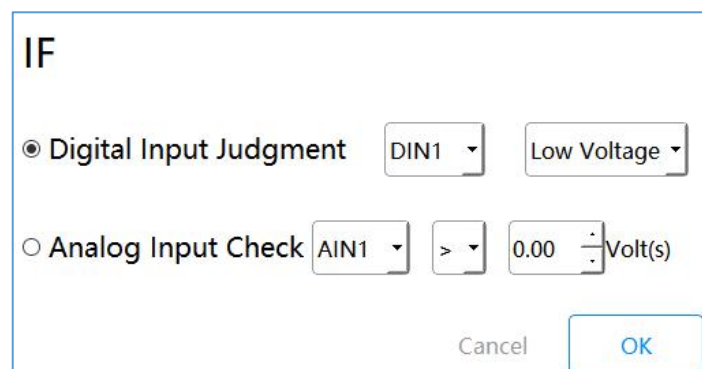


Fig. 8-51 IF command settings.

- **Digital input judgment:** Check if the digital input meets the predefined



conditions. Digital inputs include controller-end digital input interfaces DIN1, DIN2, DIN3 and tool-end digital input interfaces T_DIN1, T_DIN2. The digital inputs are divided into high and low potentials.

- **Analog input check:** Check if the analog signal input meets the predefined conditions. Analog inputs include controller-end analog input interfaces AIN1, AIN2, AIN3, AIN4 and tool-end analog input interfaces T_AIN1. The analog input reference can be 0~10V.

Demo: Add an IF command between Waypoint4 and Waypoint5 as shown below.

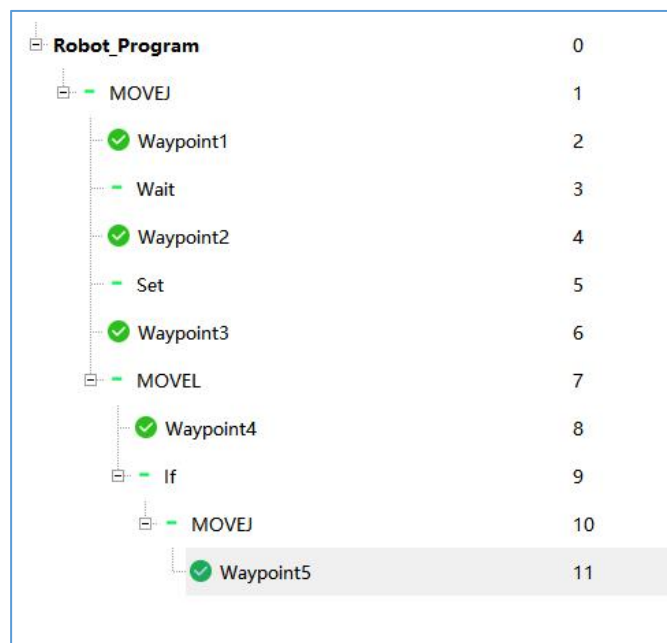


Fig. 8-52 IF command demo.

The line 8 is the IF command to check if the digital input is low voltage or high voltage.

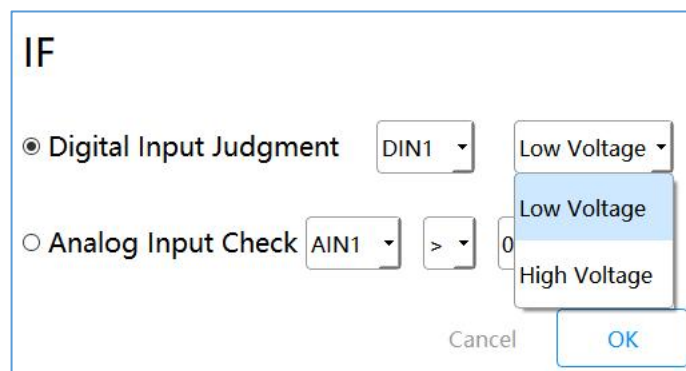


Fig. 8-53 IF command demo.

<Loop>



The Loop command means a repeat execution of a program. It can be set to no loop, loop a specified number of times, and loop infinitely.

Loop

☒ No Loop

☐ Run Loop 2 Times

☐ Infinite Loop

Cancel OK

Fig. 8-54 Loop command hyperparameters.

- **No loop:** Run the program once.
- **Loop a specified number of times:** repeat the program for a specified number of times.
- **Infinite loop:** Repeat the program infinitely.

Demo: Add a Loop command between Waypoint6 and Waypoint7 as the figure shows below.

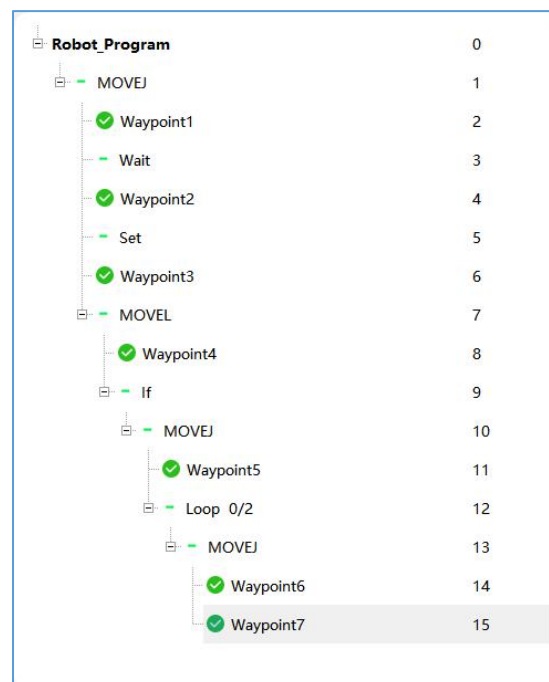


Fig. 8-55 Loop command demo.

The line 12 is the Loop command that runs the program two times.

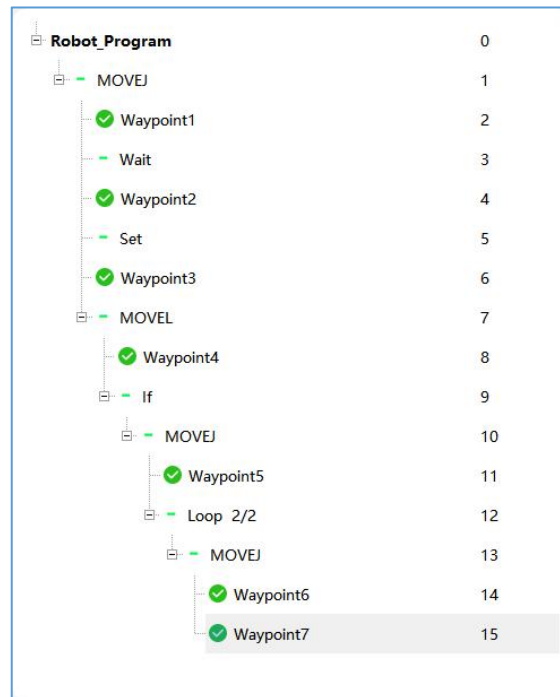


Fig. 8-56 Loop command completion demo.

<Popup Prompt>

The Popup Prompt command is used to indicate information to the user, and the pop-up content must be English.



Fig. 8-57 Popup prompt command setting.

Demo: Add a Popup Prompt command after Waypoint7 shown below.

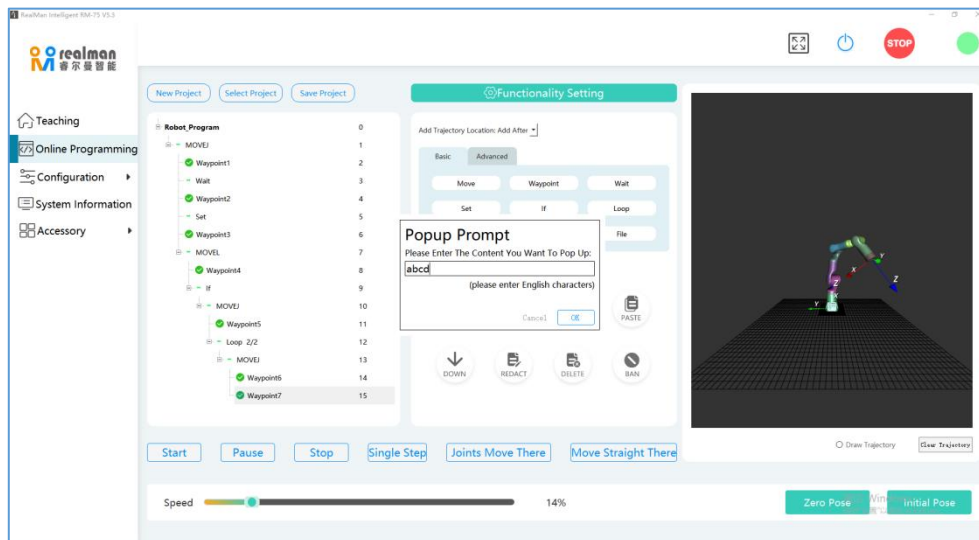


Fig. 8-58 Popup prompt command demo.

It shows in the figure below the completion of the popup prompt command setting.

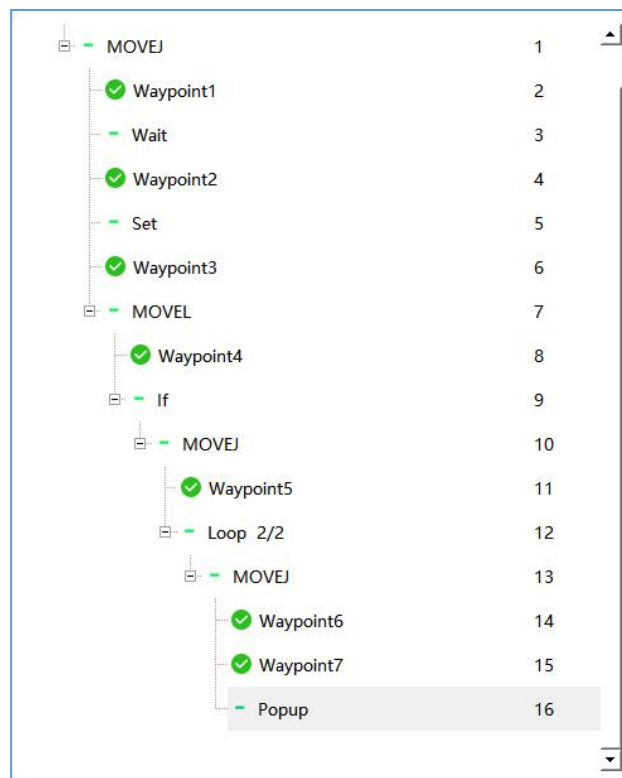


Fig. 8-59 Popup prompt command demo.

The line 16 is a popup prompt command that when the trajectory moves to this point it will popup prompt window.

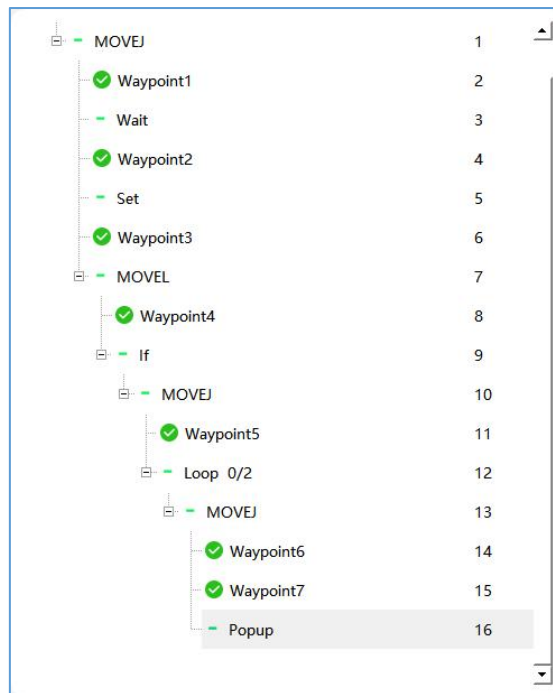


Fig. 8-60 Popup prompt command demo.

After the popup prompt is confirmed, the program continues. The following figure shows after the project is completed.

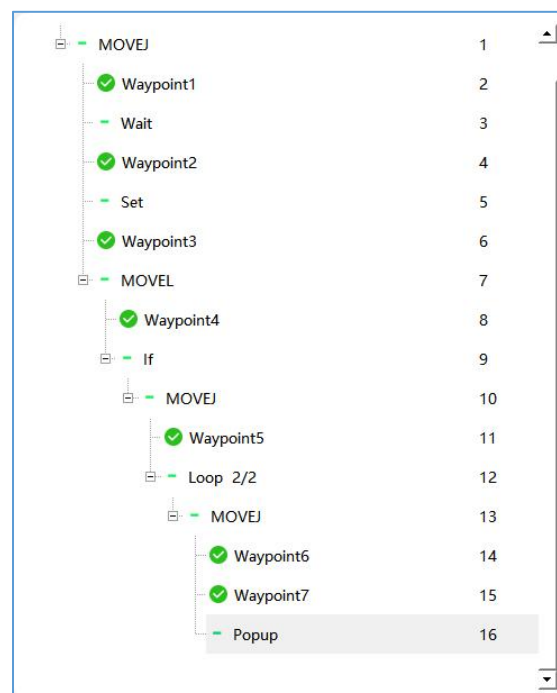


Fig. 8-61 Popup prompt command demo.

<Halt>

The Halt command is used to stop a running program.

Demo: Add a Halt command between Waypoint6 and Waypoint7 as shown below.

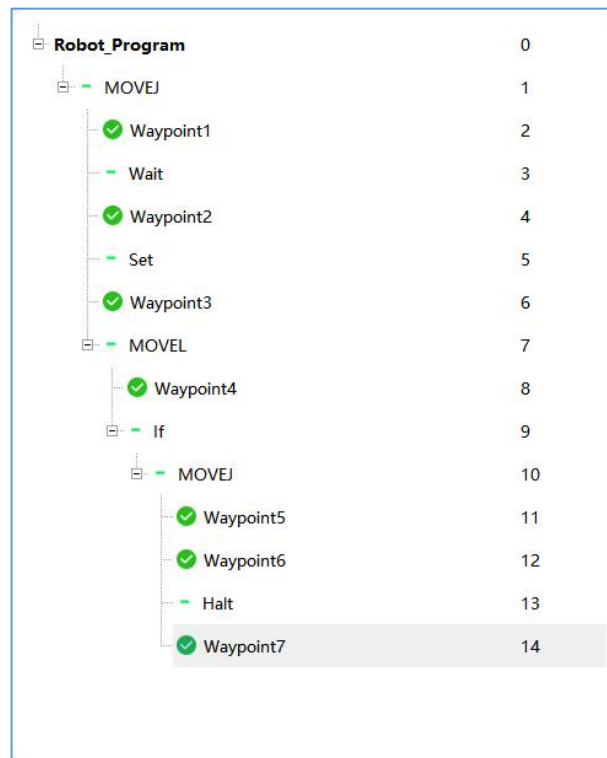


Fig. 8-62 Halt command demo.

The line 13 is the halt command that the program will exit after Waypoint6 is completed and Waypoint7 will not be executed.

<File>

The File command is used to import a saved program file, including a project file and a trajectory-by-dragging file.

Import a project file: Double-click the "File" command, it will pop up the project file selection dialog box, then select the project file, and click the "Open" button to import the project file.

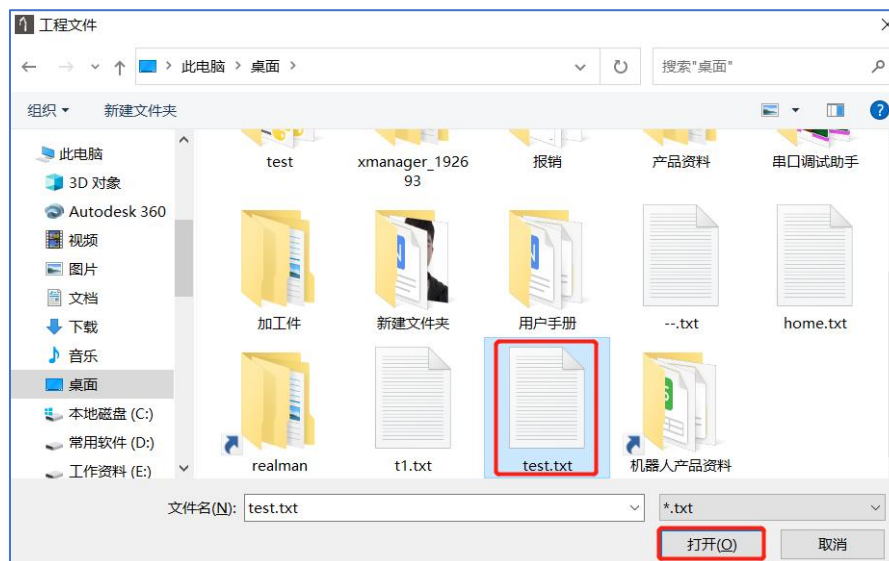


Fig. 8-63 File command demo.

Import a trajectory file: When the trajectory file is imported, you need to store the file in the specified directory, otherwise the "trajectory file open failed" prompt will appear.

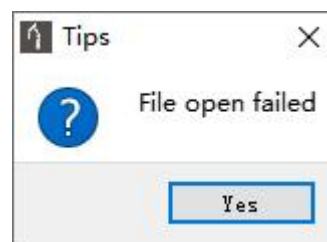


Fig. 8-64 Trajectory file import error.

Double-click the "File" command, it pops up the default file path (the *drag* folder under the root directory of the teach pendant software, that is, the directory where the trajectory file needs to be put). Then select the project file, click the "Open" button to import the trajectory file into the project.

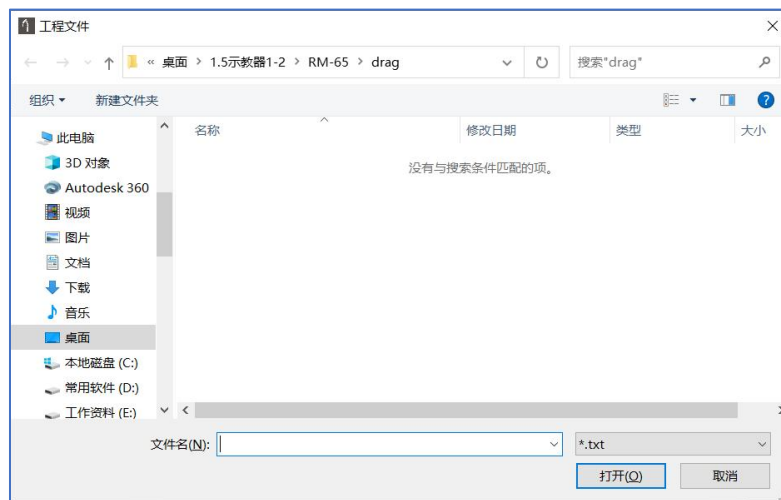


Fig. 8-65 Trajectory file storage path.

Demo: Add a File command between Waypoint4 and Waypoint5 as shown below.

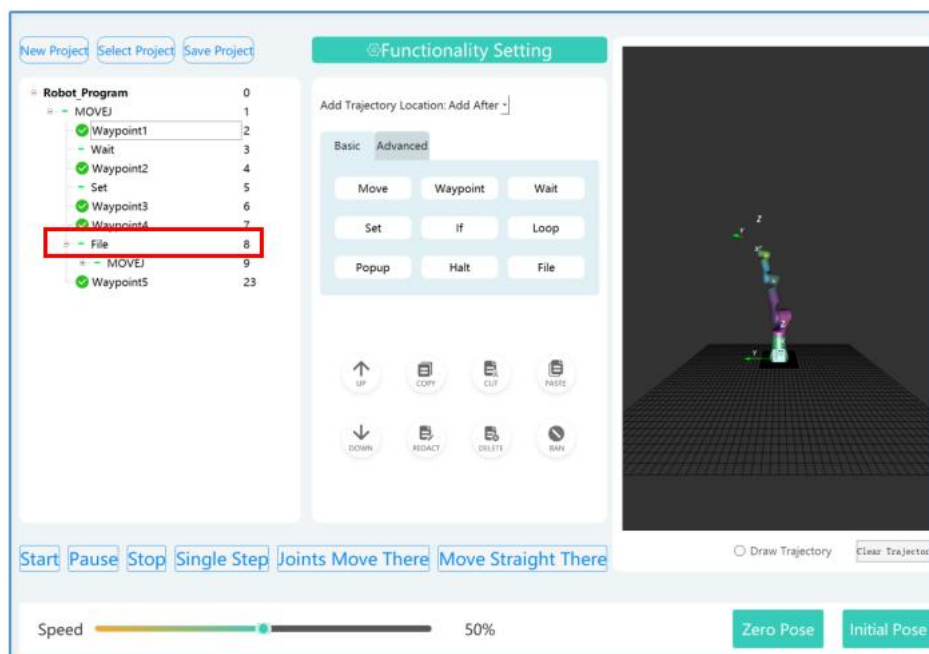


Fig. 8-66 File command demo.

The line 8 is the File command that it will execute the trajectory file. The following figure shows after the project is completed.

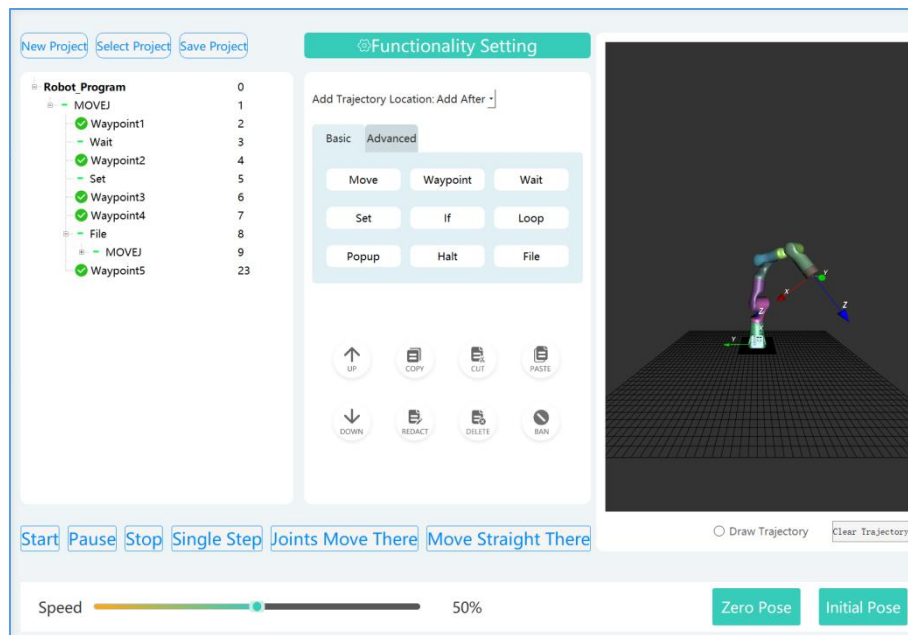


Fig. 8-67 File command demo.

8.3.7 Advanced Commands

The Advanced commands include "Force", "Comment", "Gripper", "Hand" and "Lift".



Fig. 8-68 Advanced commands.

<Force>

The Force Control or Force command is only for robots that have a torque sensor at the end of the robot, i.e., RM65-ZF/RM65-6F/RM75-ZF/RM75-6F. The hyperparameters include sensor options, coordinate system options, hybrid force-position control direction, force values, and hybrid force-position control mode on and off.

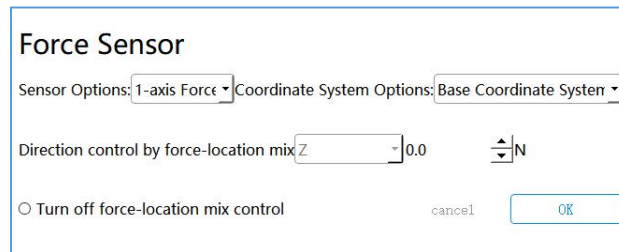


Fig. 8-69 Force control command.

- **Sensor option:** Sensors include 1-axis force sensor and 6-axis force sensor.
- **Coordinate system option:** To choose the force control reference coordinate system.
- **Hybrid force-position control or force-location mix control:** The direction and force of the hybrid force-position control can be set. The direction of the one-axis force sensor is the Z direction, and the six-axis force sensor can choose one of the directions in X\Y\Z\Rx\Ry\Rz.
- **Turn off hybrid force-position control or force-location mix control:** After checking the hybrid force-position control, the subsequent movement command in the program will no longer use the hybrid force-position control mode.

Note: 1. Waypoint controlled by hybrid force-position must record its parameters through the Cartesian coordinate system. That is, it must not contain MOVEJ command.

2. RM65-B robot does not support force control command, if you add force control command, there will show a data error prompt at the corresponding line.

3. The previous waypoint of the force control should be consistent with the first waypoint of the force control, and wait for at least 1s before opening the force control (refer to the program example).

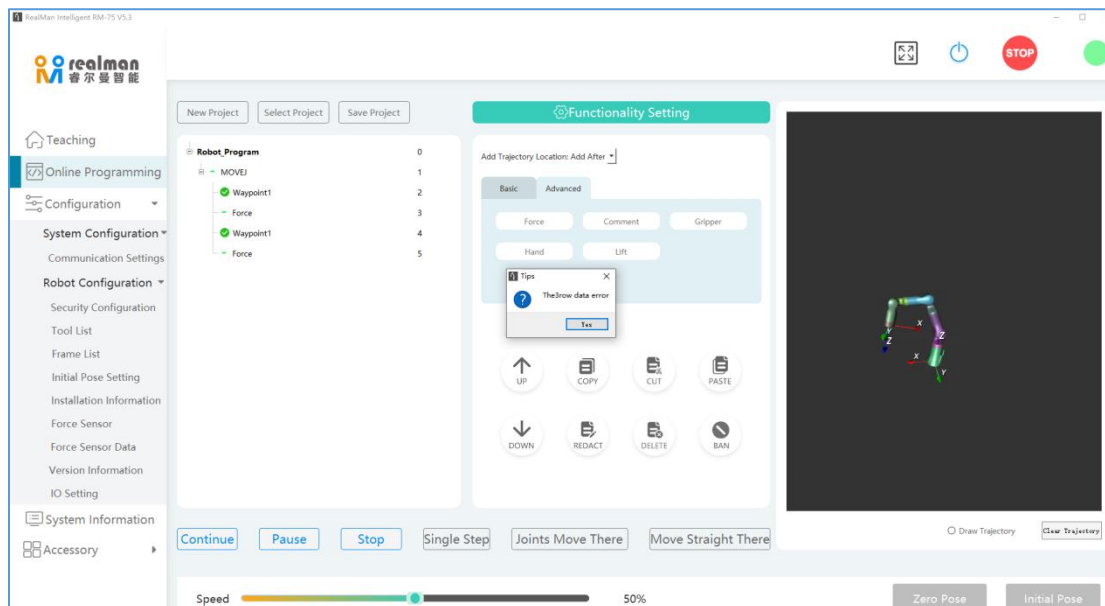


Fig. 8-70 RM65-B robot error prompt.

Demo: Add a force control trajectory, e.g., the linear movement between Waypoint4 and Waypoint5 as shown below.

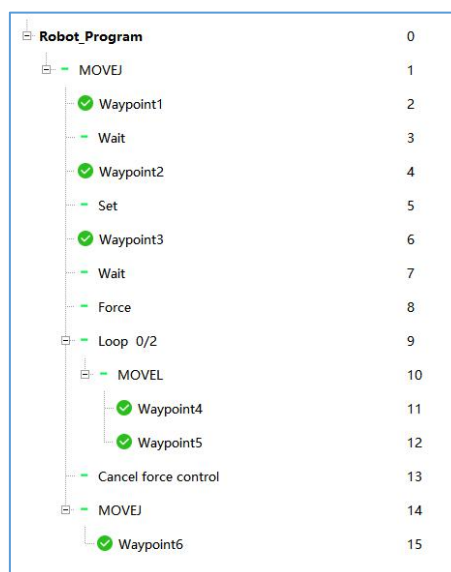


Fig. 8-71 Force control demo.

The line 8 is to start the force control mode with its settings as below.

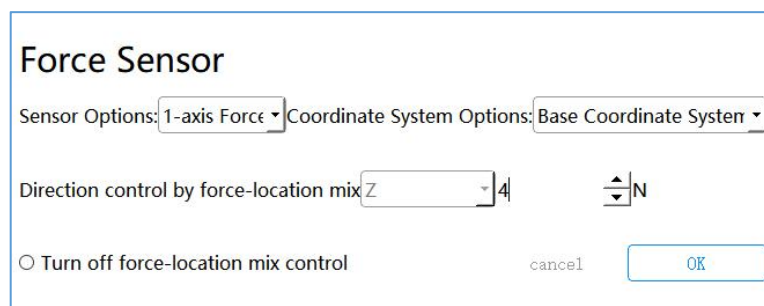




Fig. 8-72 Hybrid force-position control setting.

In the demo, the trajectory runs twice between Waypoint4 and Waypoint5 in force control mode before turning the mode off. The force control mode setting is shown as follows.

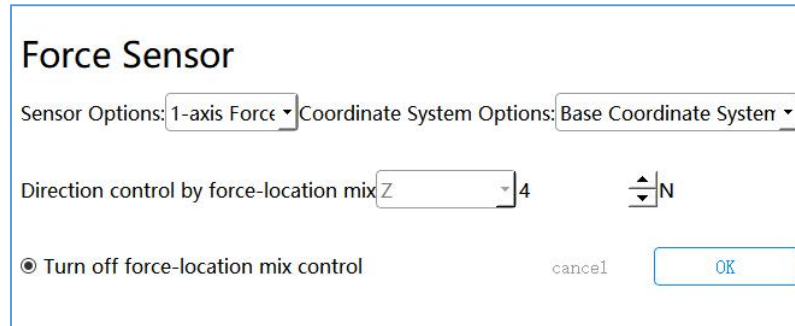


Fig. 8-73 Turn off the force control.

<Comment>

The Comment command is used to explain the functionality of a program. Comment content must be English.

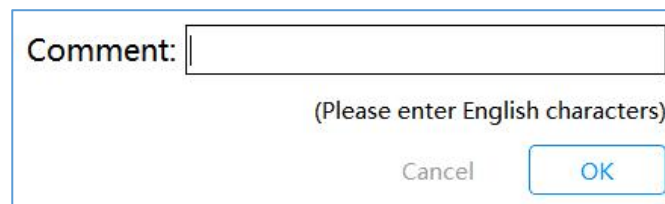


Fig. 8-74 Comment command example.

Demo: Add a Comment command between Waypoint5 and Waypoint6, shown as follows.

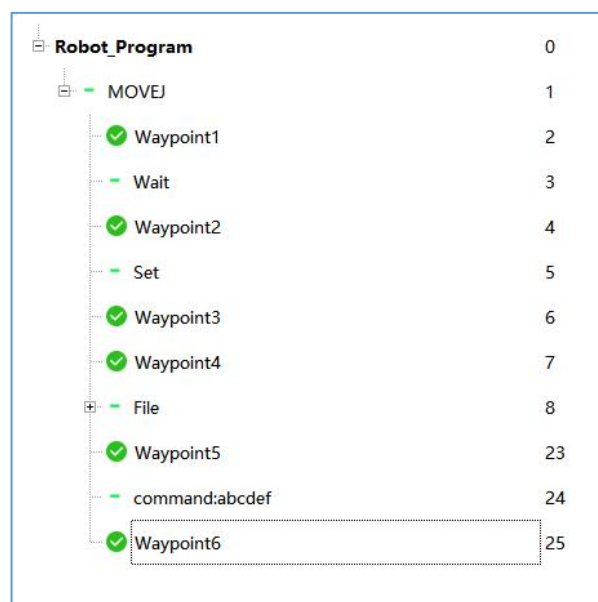




Fig. 8-75 Comment command demo.

<Gripper>

The Gripper command is used to control the two-finger gripper action, including speed, force, block mode, and gripping action.

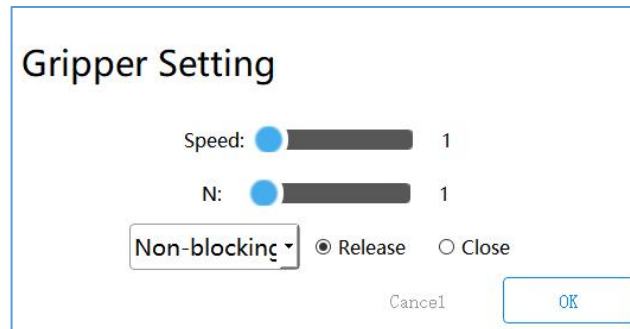


Fig. 8-75 Gripper command example.

- **Speed:** To set the gripper speed. The speed parameter can be set to 0-1000 with the maximum speed of 70mm/s.
- **Gripping force:** To set the gripper force. The force parameter can be set to 0-1000 with the maximum force of 20N.
- **Block mode:** It has blocking and non-blocking modes. In blocking mode, after the gripper movement is completed, the robot executes the subsequent instructions; in the non-blocking mode, the robot synchronously executes the subsequent program during the gripper movement.
- **Gripping action:** It supports release and close.

Demo: Add a Gripper command after Waypoint6 shown as follows.

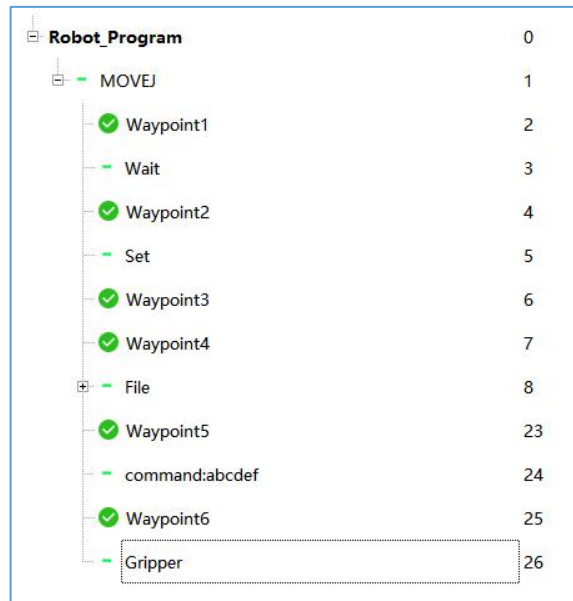


Fig. 8-77 Gripper command demo.

The line 26 is the Gripper command where its speed and force are set as 200 and 420, respectively.

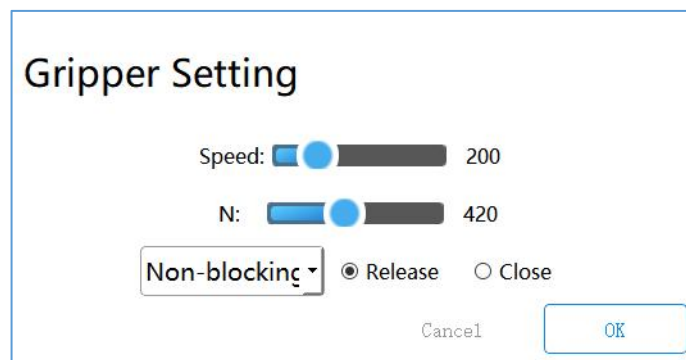


Fig. 8-78 Gripper release example.

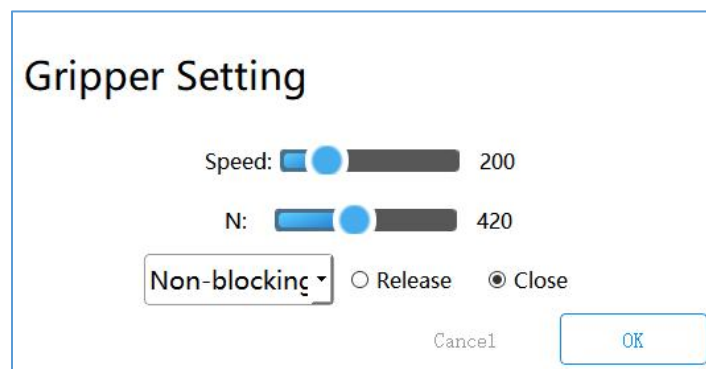


Fig. 8-79 Gripper close example.

< Hand >

The Dexterous Hand or Hand command is used to control the five-fingered dexterous hand movement. It supports blocking mode setting, gesture setting, and action



sequence number setting.

Hand Settings

☒ Gesture Settings ☐ Action Sequence Setting

Non-blocking

14 1

Cancel OK

Fig. 8-80 (Dexterous) Hand command setting.

- **Blocking mode setting:** It has blocking and non-blocking modes. In blocking mode, after the dexterous hand movement is completed, the robot executes the subsequent instructions; in the non-blocking mode, the robot synchronously executes the subsequent program during the dexterous hand movement.
- **Gesture setting:** The predefined gesture, e.g., 14 by default.
- **Action sequence number setting:** The predefined gesture sequence number of the dexterous hand that can be set to 1-40, and each sequence number represents 1 gesture action.

Demo: Add a Hand command after Waypoint7 shown as follows.

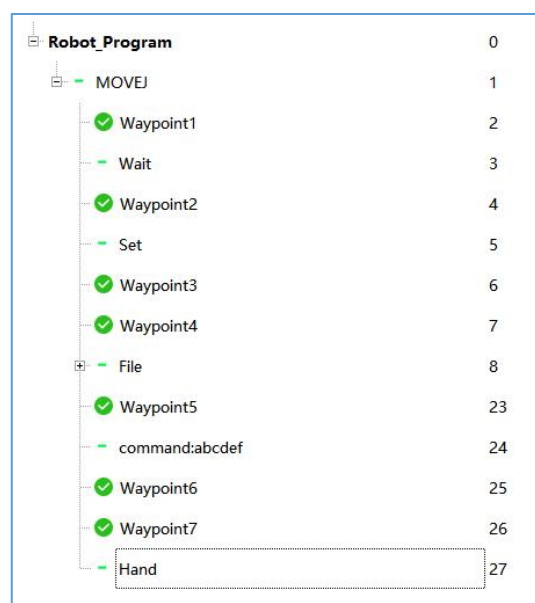


Fig. 8-81 Hand command demo.



The line 27 is the Hand command with 14th gesture and action sequence number of 6, shown below.

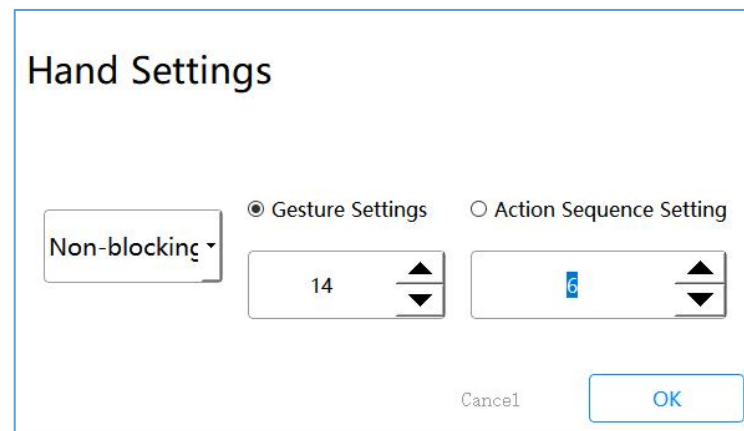


Fig. 8-82 Hand command setting example.

<Lift>

The Lift command is used to control the movement of a robot's extended joint lift or slide. It can set target height, blocking mode, and speed.

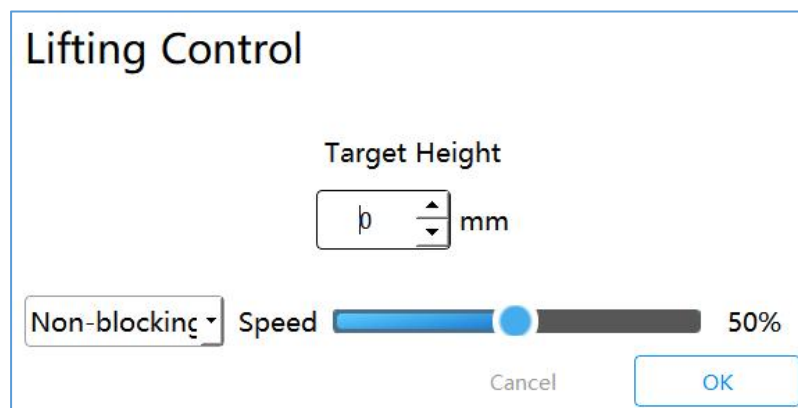


Fig. 8-83 Lift command example.

- **Target height:** This controls the position of the lift. The position can be set according to the actual working position of the robot but within the actual itinerary of the lift.
- **Blocking mode (setting):** It has blocking and non-blocking modes. In blocking mode, after the lift movement is completed, the robot executes the subsequent instructions; in the non-blocking mode, the robot synchronously executes the subsequent program during the lift movement.
- **Speed:** To set the speed of the lift in 0-100.

Demo : Add a Lift command between Waypoint7 and Waypoint8 shown as follows.

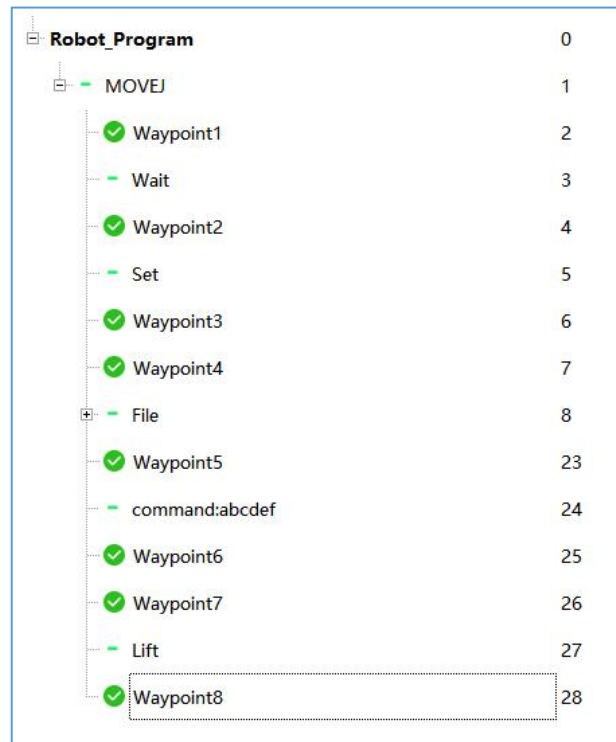


Fig. 8-84 Lift command demo.

The line 28 is the Lift command with the target height of 40mm and speed of 50%.

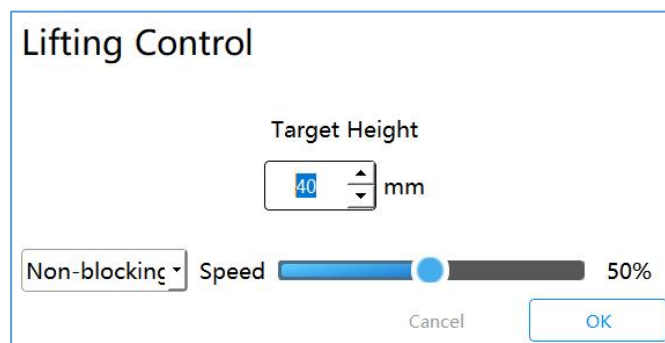


Fig. 8-85 Lift command example.

8.3.8 Edit

8.3.8.1 Up



Click  button, you can move the selected line up one position in the program. The move should happen between the same level commands in the program tree map.

8.3.8.2 Copy



Click  button, you can copy the command and location information for the



selected line.

8.3.8.3 Cut



Click  button, you can cut the command(s) of the selected line(s) and re-add it with the Paste button.

8.3.8.4 Paste



Click  button, and you can paste the copied information into the line before the selected line.

8.3.8.5 Down



Click  button, you can move the selected line down one position in the program. The move should happen between the same level commands in the program tree map.

8.3.8.6 Edit



Click  button and you can edit the selected command(s).

8.3.8.7 Delete



Click  button and it will delete the selected command line(s).

8.3.8.8 Ban



Click  button and it will disable the selected command line, and the disabled command line(s) will no longer run. The banned commands can be enabled

by clicking  button.

8.3.9 Start Button

When the online program project is completed, click the trajectory start point in the left display bar. Note that the middle point of MOVEC cannot be used as the start point. The background color of the selected point will change to blue, and then click

the **Start** button on the lower left side of the page (the button becomes a **Continue** button after being clicked). During the trajectory being running, the background color of the current movement command line changes to yellow.

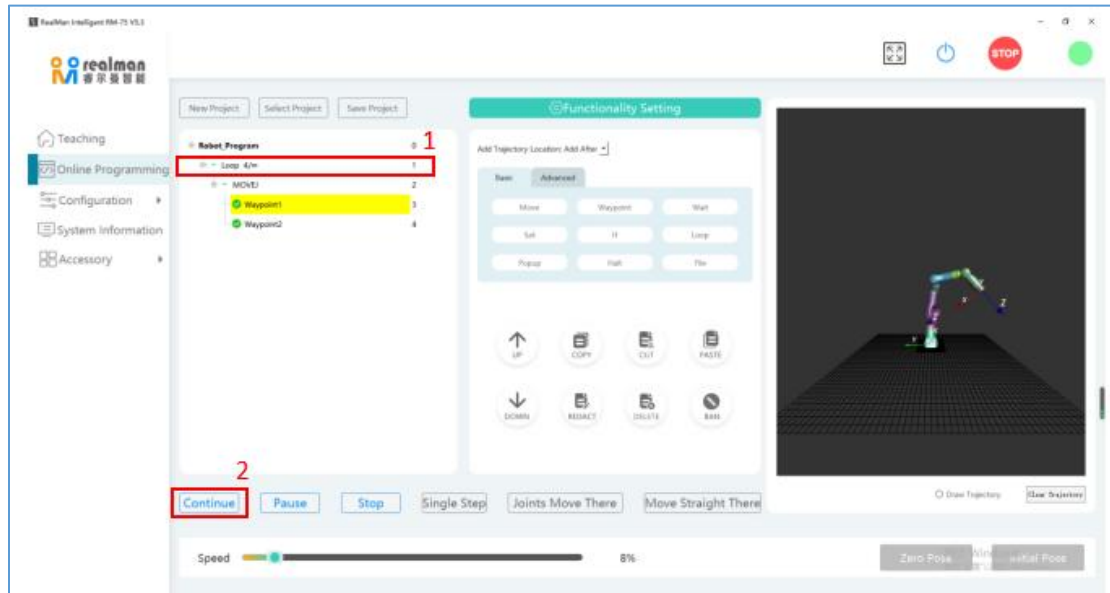


Fig. 8-86 Start running the online program.

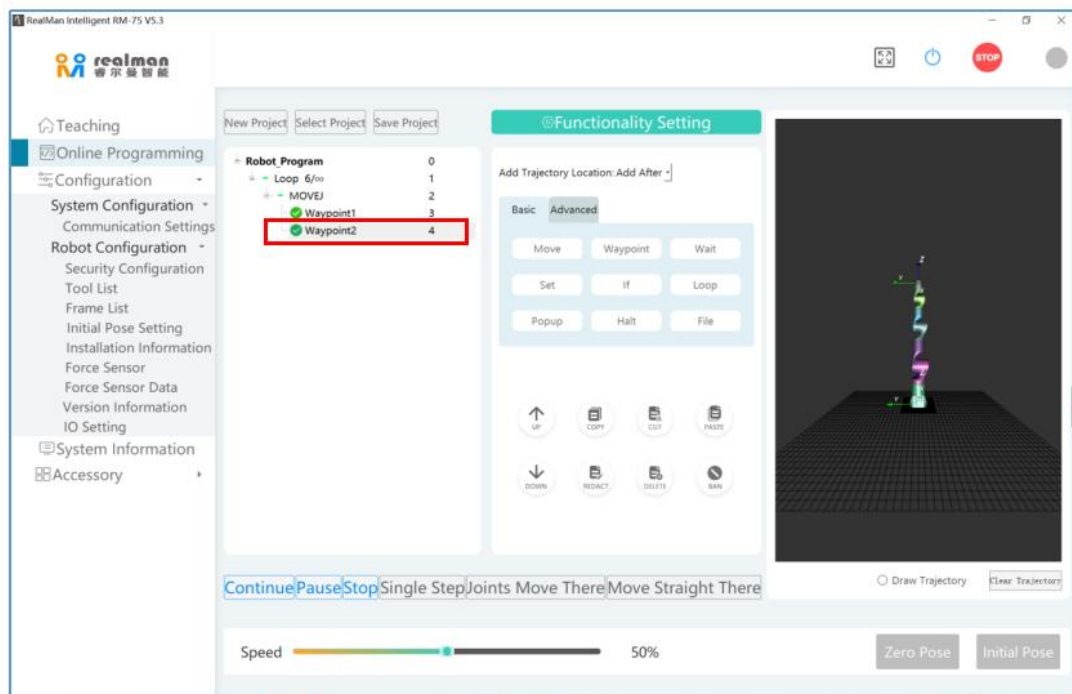


Fig. 8-87 Running the program.

8.3.10 Pause Button

Click the **Pause** button during the robot's movement, the robot movement will



immediately stop, and when clicked **Continue**, the robot will resume to move.

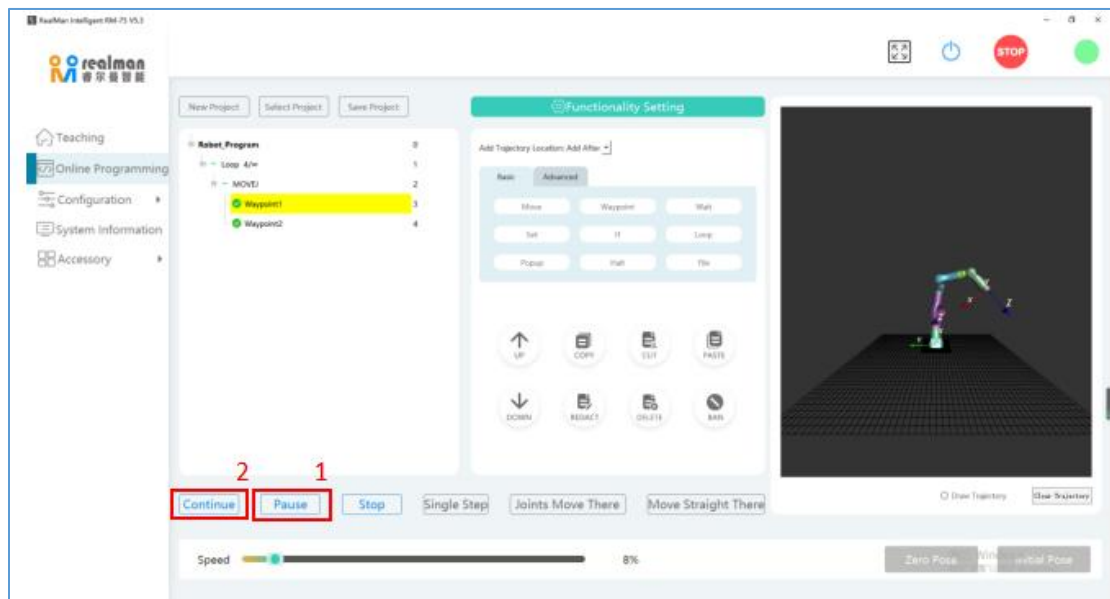


Fig. 8-88 Online program pause and continue demo.

8.3.11 Stop Button

When the **Stop** button is clicked to end the project, the button content reverts to **Start**. If a trajectory planning error occurs during the running, planning stops and cannot continue. Click the **Stop** button and the trajectory will also stop and cannot continue.

Note: During the operation of the program, in order to avoid accidents caused by misoperation, the function buttons of the interface are locked. After pressing **Stop**, buttons can be used normally.

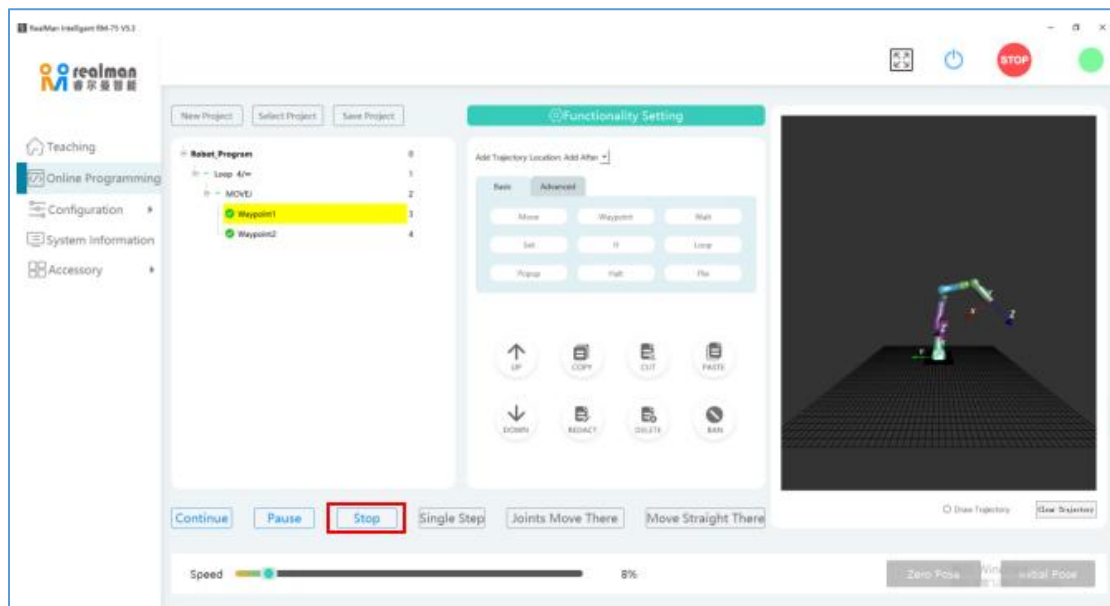


Fig. 8-89 Program stop demo.

8.3.12 Single Step Button

Online programming can be run in a single step fashion. The user selects the trajectory start point in the left bar, then the background color changes to blue. Click the **Single Step** button, and the **Start** button becomes a **Continue** button (with the pause function to complete the trajectory reproduction). In the single step mode, the program is executed one by one. Only after a single command is completed, click the **Single Step** button again to execute the next trajectory command.

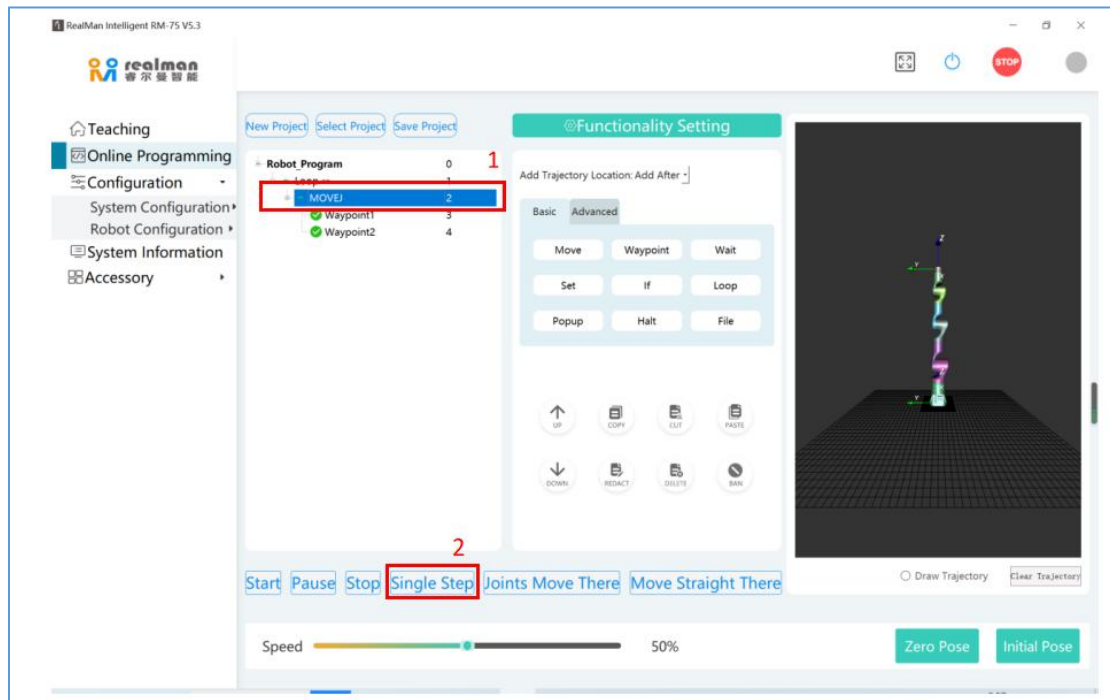


Fig. 8-90 Single step running.

8.3.13 Joints Move There

This button only acts on the Waypoint command and is used to control the robot's movement from its current position to the target waypoint in the form of MOVEJ. First, click on the target waypoint in the left display bar (the target point background color will turn blue). Then, press and hold the **Joints Move There** button, the robot will move to the target waypoint through joint space planning, and release the button to stop the movement.

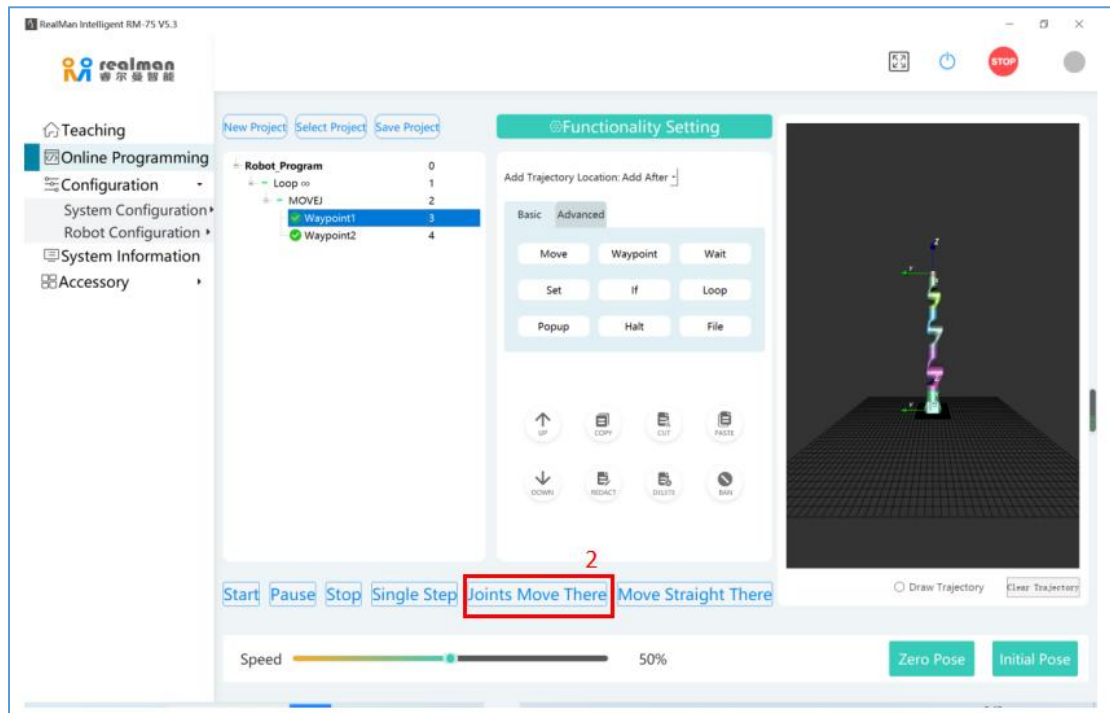


Fig. 8-91 Joints move there demo.

8.3.14 Move Straight There

The button only acts on the Waypoint command and is used to control the robot's movement from its current position to the target waypoint in the form of MOVE.

After selecting the target waypoint, press and hold **Move Straight There** button, then the robot end will move along a straight line toward the target waypoint. The movement will stop when releasing the button or the planning is wrong.

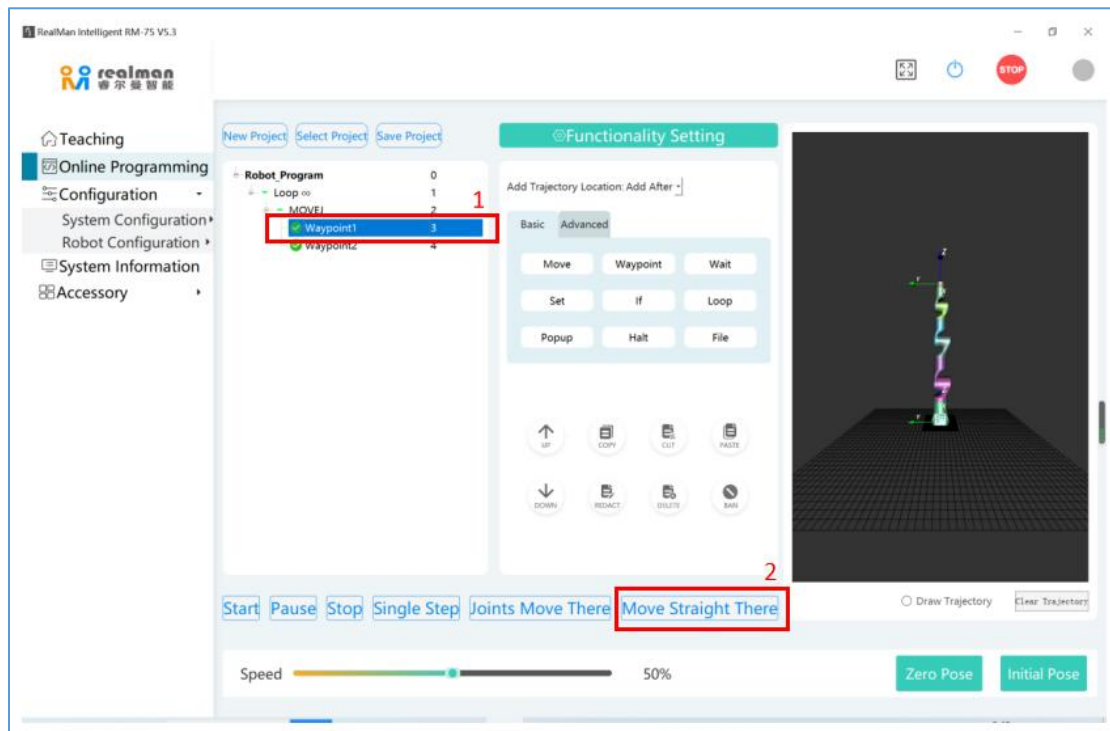


Fig. 8-92 Move straight there demo.

8.3.15 Robot Simulation Preview

The robot preview area can run the program in simulation mode which can preview the trajectory of the program and can run synchronously with the real robot in real-robot mode.

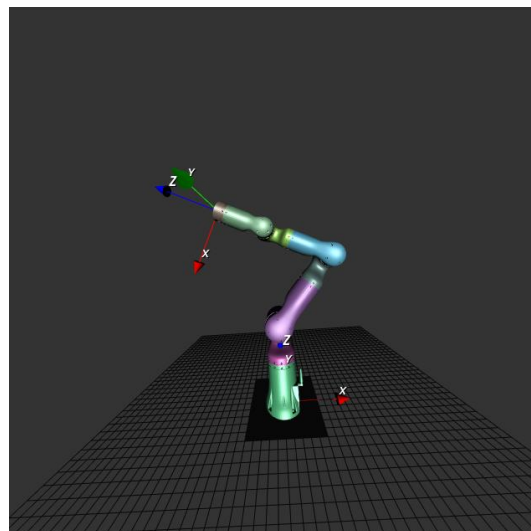


Fig. 8-93 Simulated robot preview.

8.3.15.1 Draw Trajectory

Turn on the "Draw Trajectory" function, and the robot trajectory will be displayed in real time in the robot simulation preview area.

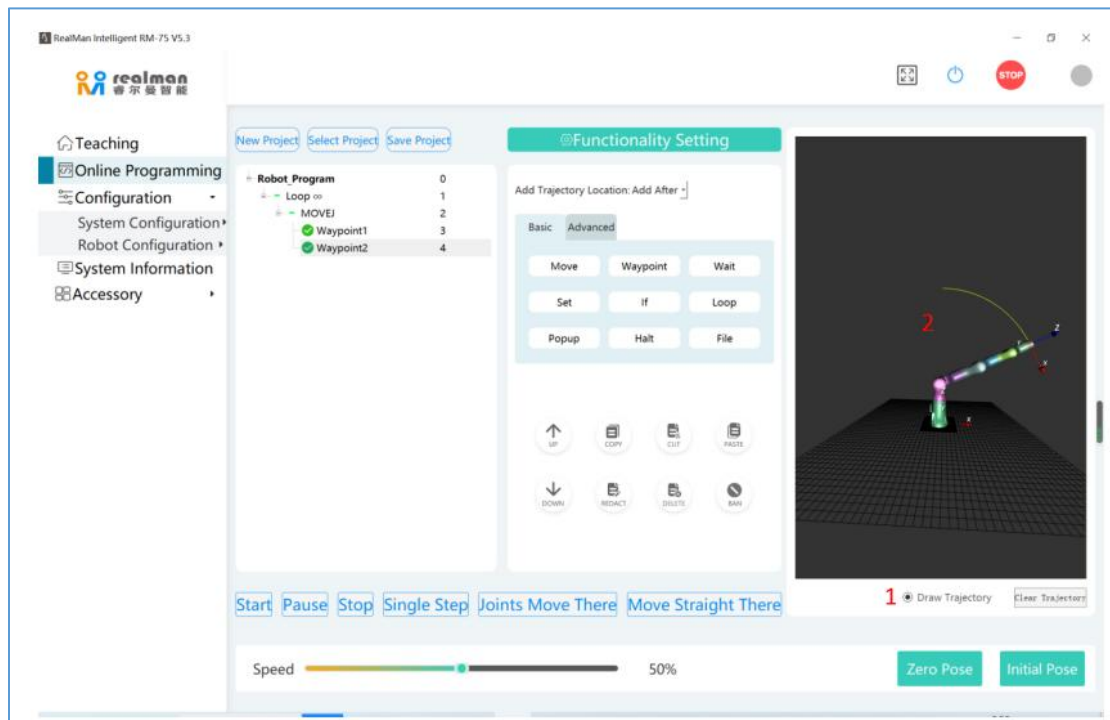


Fig. 8-94 Draw trajectory demo.

8.3.15.2 Clear trajectory

Click the Clear Trajectory button, the simulated robot preview area trajectory is cleared and the Draw Trajectory feature is automatically disabled.

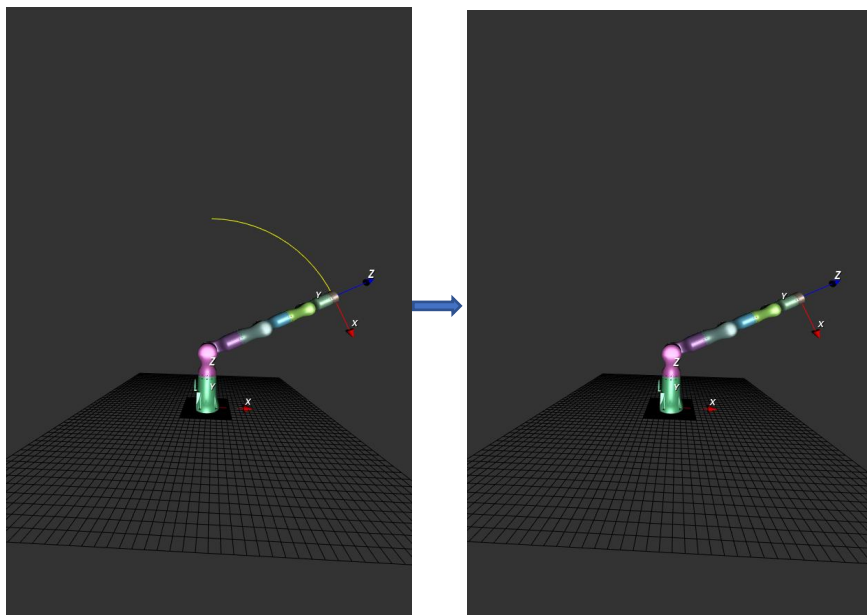


Fig. 8-95 Clear trajectory demo.

8.4 Configuration

8.4.1 System Configuration



The system configuration interface mainly configures the communication of the robot controller.

The screenshot displays a web-based configuration interface for a robot controller. It is divided into four numbered sections:

- 1. WIFI AP Mode Setting:** Includes input fields for 'Network Name' and 'Network Password', and buttons for 'Reset' and 'OK'.
- 2. WIFI STA Mode Setting:** Includes input fields for 'Network Name' and 'Network Password', and buttons for 'Reset' and 'OK'.
- 3. Local Network Configuration:** Includes input fields for 'Target IP' and 'Port Number', and buttons for 'Reset' and 'OK'.
- 4. Connecting Robot:** A blue button labeled 'Connecting Robot'.

Fig. 8-96 The system configuration interface.

Table 8 The system configuration content.

#	Name
1	WIFI AP mode configuration
2	WIFI STA mode configuration
3	Local network configuration
4	Establish a connection to robot

8.4.1.1 WIFI AP Configuration

The controller can switch to WIFI AP mode for external communication. The network name is the WIFI name of the controller, and the network password is the password of the controller's WIFI. After clicking the "Set" button, the controller will conduct network configuration according to the content, and communicate with the controller in WIFI AP mode immediately after the configuration. In this mode, the IP of the controller is 192.168.1.18, the communication port number is 8080, and the communication is in Server mode.



A configuration window for WIFI AP mode. It contains two input fields: 'Network Name' with the value 'RM75-019' and 'Network Password' with the value '12345678'. Below these fields are two buttons: 'Reset' (with a circular arrow icon) and 'OK' (with a checkmark icon).

Fig. 8-97 WIFI AP mode

WIFI AP模式连接机器人时，电脑连接好机器人WIFI（示例WIFI名称为RM75-019），设置电脑WLAN本地IP与机器人IP在同一网段。

The network name and password contain English characters and numbers only, and the network password is set to 8-10 digit password. Click the  button, if the robot controller emits a "DiDi" sound, then the mode switching is complete.

When to connect the robot in WIFI AP mode, the computer connects to the robot WIFI (in the demo, WIFI name is RM75-019), and sets the computer WLAN local IP and the robot IP in the same network segment.

A screenshot of the 'Internet Protocol Version 4 (TCP/IPv4) Properties' window in Windows. The 'General' tab is selected. The 'Use the following IP address' radio button is selected (labeled with a red '1'). The IP address is set to 192.168.1.100 (labeled with a red '2'), the subnet mask is 255.255.255.0, and the default gateway is 192.168.1.1. The 'Use the following DNS server addresses' radio button is also selected (labeled with a red '3'). The 'Preferred DNS server' and 'Alternate DNS server' fields are empty. The 'Advanced' button is visible at the bottom right. The 'OK' button is highlighted with a red box and labeled with a red '4'.

Fig. 8-98 PC local IP setting.

Open the teach pendant software, click  button to connect the robot.

8.4.1.2 WIFI STA Configuration

The controller can switch to WIFI STA mode to connect to the router specified by the



user. The network name is the router name to be connected to by the specified controller, and the network password is the specified router password. After the completion of configuration, the controller communicates with the outside in WIFI STA mode immediately. In this mode, the IP of the controller is automatically assigned to the router, the communication port number is 8080, and the communication mode is server.

Fig. 8-99 WIFI STA mode setting.

Click  button, if the robot controller emits a "DiDi" sound, then the mode switching is complete. The PC should connect to the same router as the robot.



Fig. 8-100 PC connecting to the same router.

Log in to the router management interface, check the IP address of the robot assigned by the router, and set the local network configuration on the teach pendant as the IP assigned by the router with a port number of 8080.



Network Name: CMCC-Z6en

Network Password: 12345678

Reset OK

Target IP: 192.168.1.142

Port Number: 8080

Reset OK

Fig. 8-101 Local network configuration. For example, the IP address of the robot assigned by the router is 192.168.1.142.

Click  button, then click  button to connect the robot.

8.4.1.3 Ethernet Mode

When the teach pendant software and the controller are connected through the Ethernet, the controller will communicate through the Ethernet port 2. Port number: 8080, and communication mode: server. The following figure shows the position of Ethernet port 2, and the communication rate is 100M.

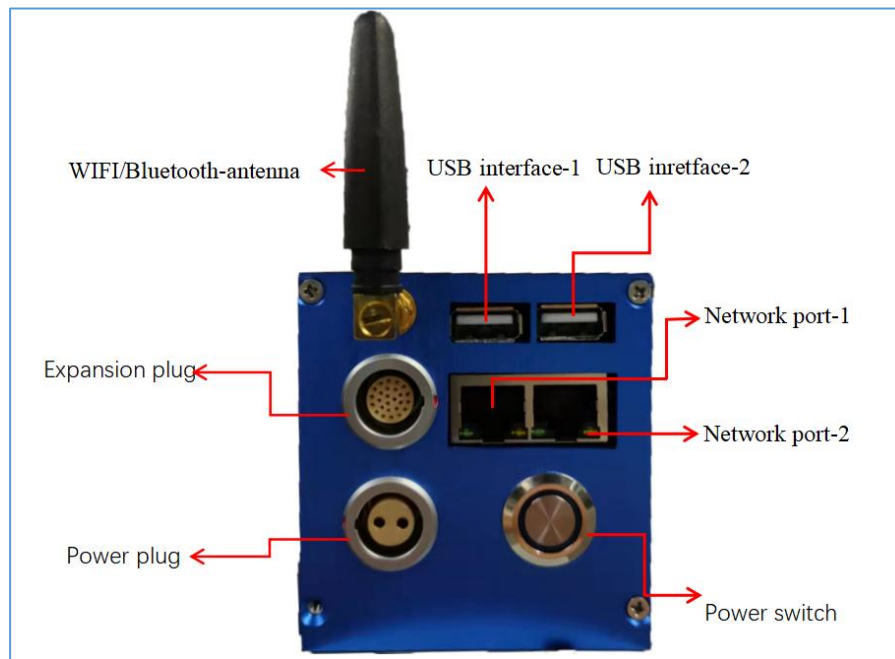


Fig. 8-102 The controller panel.

Local network configuration: The default IP address of the controller is 192.168.1.18 and port number is 8080 when the teach pendant software starts. If the robot IP has been reset, you need to set the actual connected robot IP in  本地网络配置.

The network IP address of the robot controller is 192.168.1.18. In order to establish network connection between the computer and the controller, the local network IP needs to be configured in the same network segment. The configuration is shown below.

(1) Open “Open Network and Sharing Center” at the lower right of the computer.



Fig. 8-103 Open network and sharing center in Windows.

(2) If the robot is connected by an Ethernet cable, click “Local Connection”.



Fig. 8-104 Local connection.

(3) Click the “Properties” button in the dialog box that pops up.



Fig. 8-105 The Property button of local connection.

(4) In the pop-up dialog box, select “Internet Protocol Version 4” first and then click the “Properties” button.

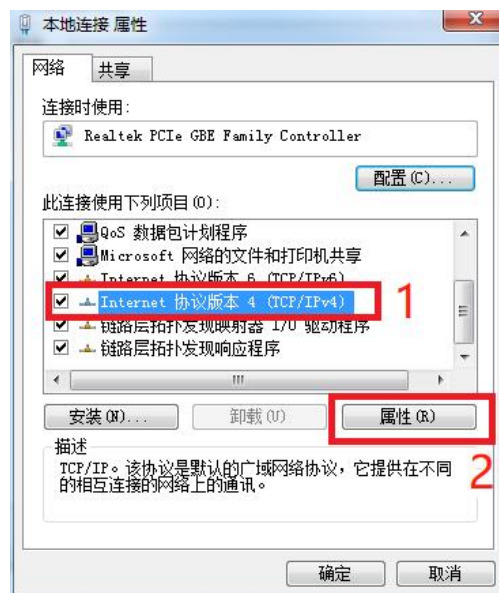


Fig. 8-106 Select the Internet protocol version.

(5) Configure the network IP address according to the following figure. Click “OK” button to complete the local network setting after the configuration.

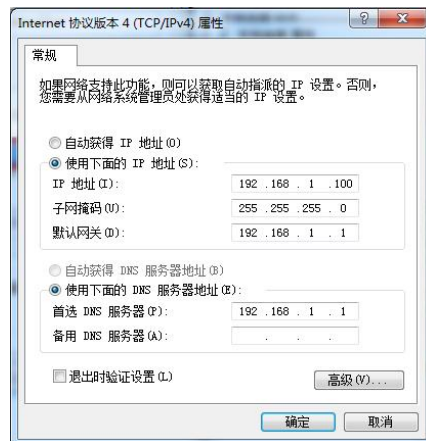


Fig. 8-107 The Internet IP address.

(6) Click the “Configuration -> Communication Configuration -> Connect Robot” button in the teach pendant software, and the network connection between the teach pendant software and the robot controller is established.

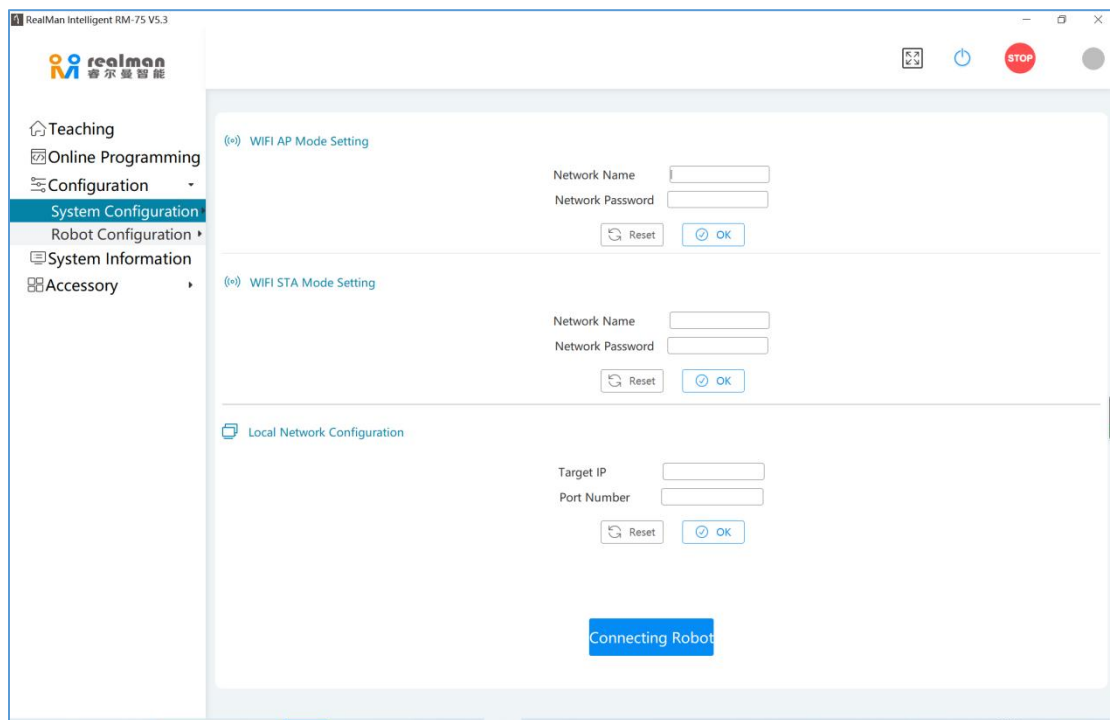


Fig. 8-108 Connect to the robot.

8.4.2 Robot Configuration

The robot configuration interface includes safety configuration, tool calibration, working/operation coordinate system calibration, initial pose setting, installation information, force sensor configuration, force sensor data map, version information, and IO setting.

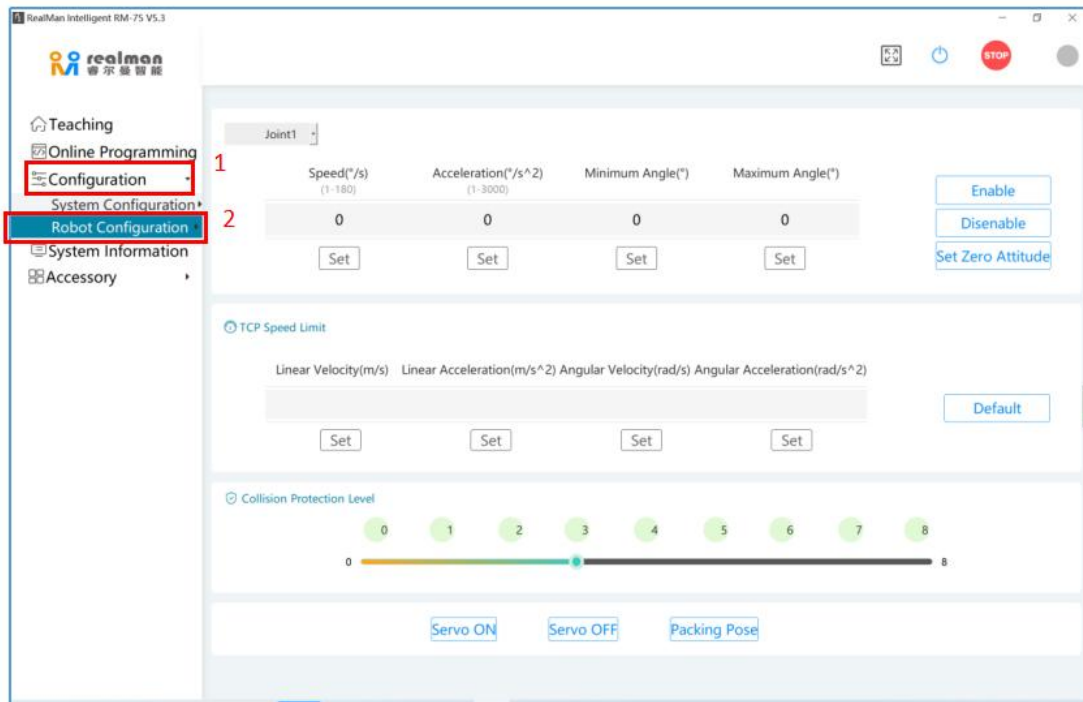


Fig. 8-109 Robot configuration.

8.4.2.1 Safety Configuration

The safety configuration interface mainly configures the joints of the robot, TCP parameters of the robot end and collision prevention, as shown in the figure below.

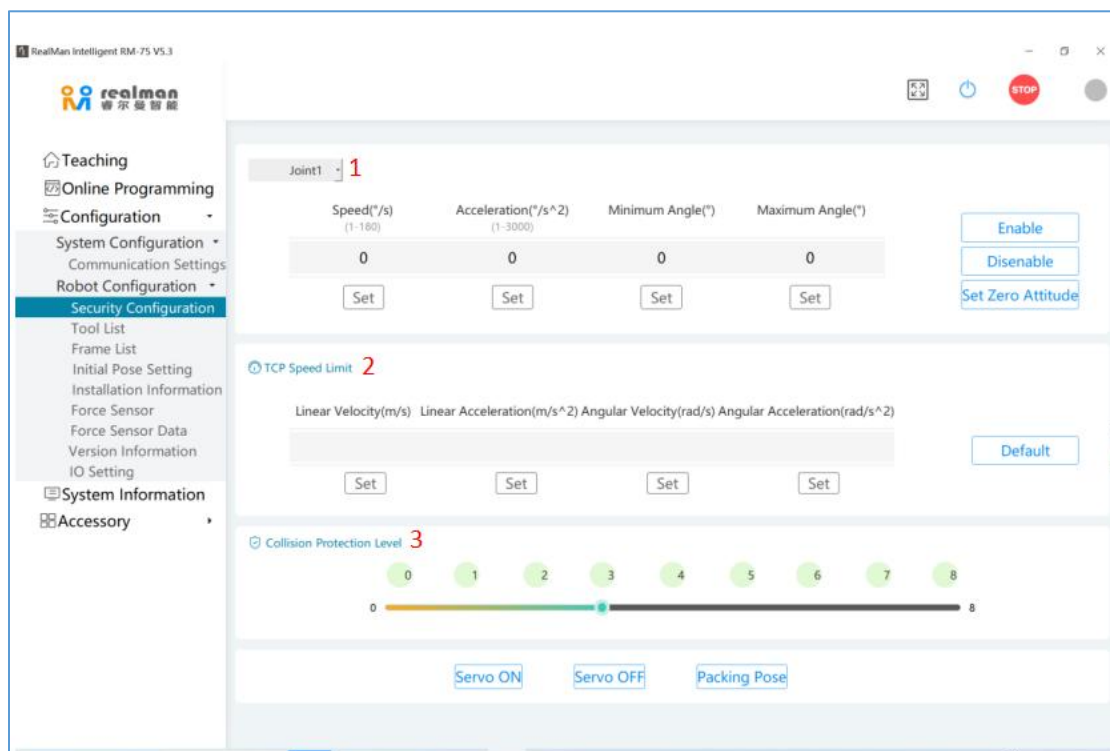


Fig. 8-110 The safety configuration.



1. Joint Configuration

Select joints 1-6 in the left drop down box, corresponding to the six joints from bottom to top of the robot. After the teach pendant software is connected to the robot, the maximum speed, acceleration, minimum and maximum angles of the joints will be displayed in the corresponding position in the software automatically.

Note: All parameters of the RM robot arm have been configured to the best state before leaving the factory, and it is not recommended that the user modify the underlying parameters of the joint. If the user really needs to modify, first of all, the robot arm should be in a disabled state, and then send a modified parameter instruction, after the parameter setting is successful, send the joint recovery enable instruction. It should be noted that when the joint is restored, the user needs to ensure that the joint is in a static state to avoid positioning errors in the joint during the activation process. After the joint is enable, the user can control the joint movement.

Joint1	Speed(°/s) (1-180)	Acceleration(°/s^2) (1-3000)	Minimum Angle(°)	Maximum Angle(°)
Joint1	0	0	0	0
Joint2				
Joint3				
Joint4				
Joint5				
Joint6				
	Set	Set	Set	Set

Fig. 8-111 The joint configuration.

Speed: Maximum speed of the joint in RPM, with a maximum of 30RPM.

Acceleration: Maximum acceleration of the joint in RPM/s, with a maximum of 300RPM/s.

Minimum angle: The minimum angle of a joint, in degrees.

Maximum angle: The maximum angle of a joint, in degrees.

Enable: the “Enable” button and the “Disenable” button send the enable and disenable commands to the specified joint, respectively.

Example: Enable joint 1 (Likewise, other joints can be enabled.)

1. Select joint 1 from the leftmost option.
2. Click the “Enable” button on the right.



Fig. 8-112 Enable a joint.

Set the origin: when the joint is in the disabled status, click the  button and set the current position of the specified joint as to be the origin. After setting, the joint is still in the disabled status. Please click  button to re-enable the joint before use.

Each joint of the robot has a mechanical origin position (as shown in the figure below). The origin position refers to the position and pose of all joints at the origin position of the robot. If the robot is in the origin position and the mark of the mechanical origin position is not aligned, then the robot needs to be set back to the mechanical origin position manually. In the origin position, the status of the robot is shown in the figure below.



Fig. 8-113 The origin pose of the robot.

When the robot joint is replaced, the origin position of the corresponding joint must be reset.

Example of setting origin:

Note that not all versions of RM robotics support this functionality. Please confirm

with RealMan Intelligent Technology Co., Ltd., before proceeding.

Set the origin of joint 1 (and the origins of other joints can be set likewise).

1. Select joint 1 from the leftmost option.
2. Click the “Disenable” button on the right (if the joint is in the upper enabled status) to disenable the joint first.



Fig. 8-114 Set the origin of a joint.

3. Rotate joint 1 to the mechanical origin position (i.e., the mechanical origin position after the grooves on both sides of the joint gap match exactly).



Fig. 8-115 Align the mark of joints.

4. Click the “Set Origin Pose” or “Set Zero Attitude” button on the upper right to complete the origin setting of joint 1.
5. Click the “Enable” button.

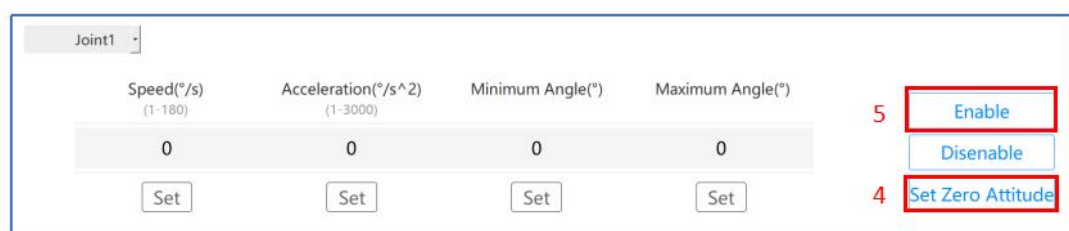


Fig. 8-116 Setting the origin position of a joint.



A demo of packing pose:

When the robot is completed and needs to be packed. Inside the controller has been saved robot packing pose. Long press **Packing Pose** button, the robot automatically moves to the packing pose. When the robot stops moving, the packing pose is completed.

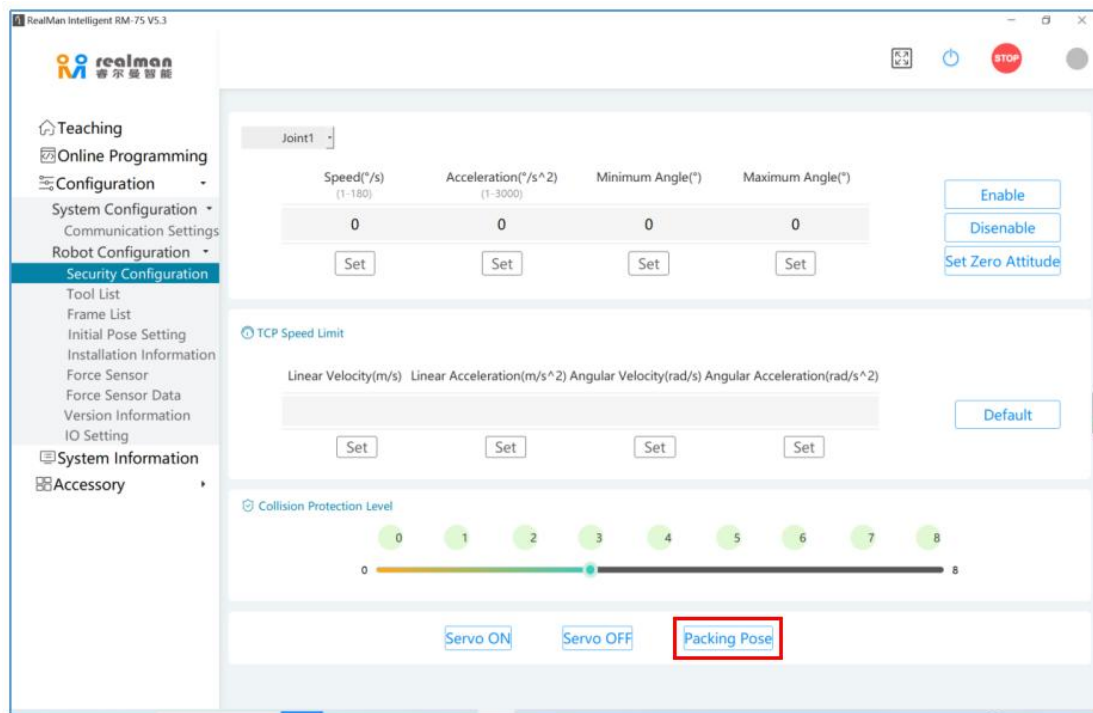


Fig. 8-117 Joint origin pose setting demo.

2. TCP Speed Limit

This feature includes the linear velocity, linear acceleration, angular velocity and angular acceleration of the robot end. After the network connection between the teach pendant software and the robot controller is established, this feature will automatically update the TCP parameters, and the user can manually modify the parameters and send them as well.

Click the default value button, and the robot TCP parameter will be set to the default value. End linear velocity: 0.1m/s, end acceleration: 0.5m/ s², end angular velocity: 0.2rad/s, end angular acceleration: 1rad/ s².

3. Collision Protection Rating



This part introduces the robot collision level setting. The level is 0-8, which represents the level of the robot's collision sensitivity. The higher the level, the more sensitive it is to the collision. The default collision level on the mechanical arm is 0, that is, there is no collision detection.

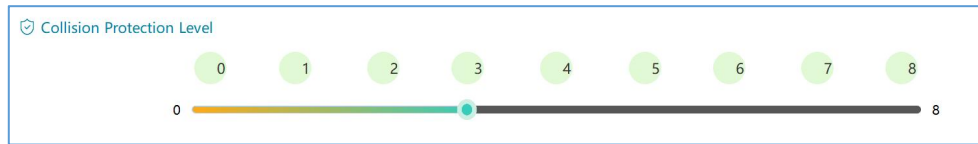


Fig. 8-118 Collision protection rating/level setting.

Note: The user should make reasonable choice when setting the collision protection level. The higher the level is, the higher the probability of the robot detecting a false collision will be. If the robot end changes the tool and payload, the mass and centroid parameters of the tool need to be set at "tool calibration" (refer to section 8.4.2.2 for the tool calibration process).

Fig. 8-119 End payload parameter setting.

8.4.2.2 Calibration of the Tool-End Coordinate System

Tool-end or tool coordinate system calibration is shown in the figure below. Region 1 displays all current tool coordinate system and tool pose information. Region 2 automatically calibrates the current tool coordinate system. Region 3 manually sets the tool coordinate system information.

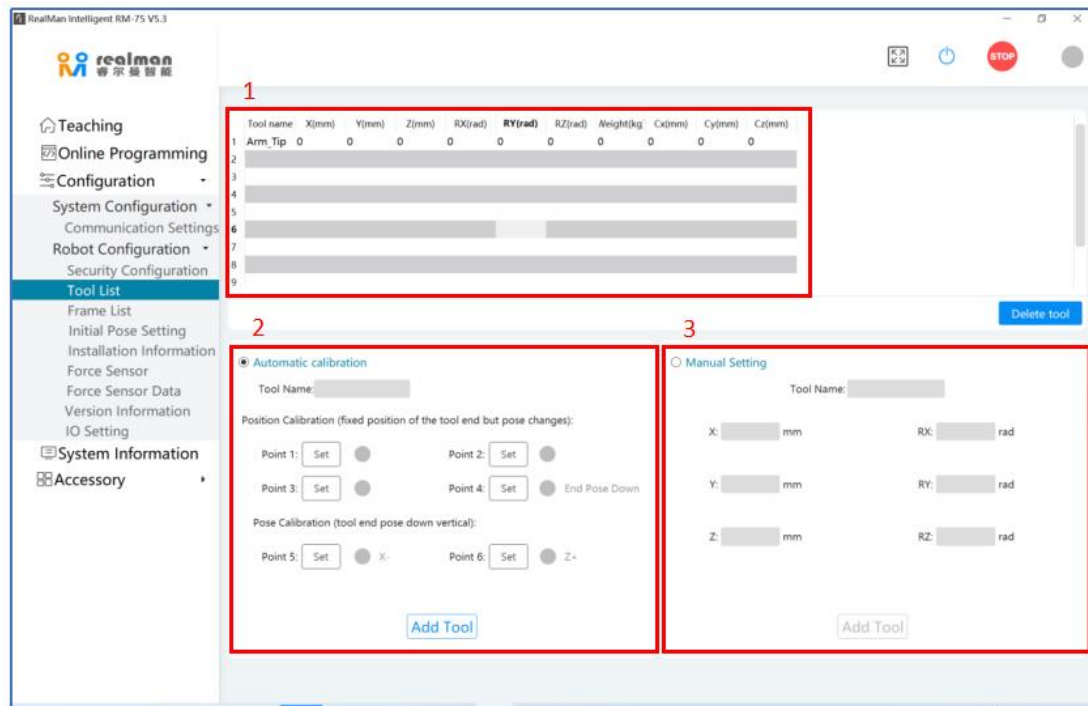


Fig. 8-120 Calibration of the tool coordinate system.

1. Tool Display

The table shows the names and pose parameters of all tool coordinate systems established by the current robot. To delete a tool, select it in the table and click the “Delete Tool” button. After the deletion is completed, the robot operates in end flange coordinate system. In addition, the Arm_Tip (robot tool end coordinate system) cannot be deleted.

2. Automatic Calibration

After selecting this feature, the current tool coordinate system can be calibrated by the six-point method. First, fill in the name of the tool (English characters, no more than 10 characters), and then contact the tool reference point with the robot tools in six pose respectively (this reference requires that the end is sharp and placed vertically within the robot reachable range).

After the 6 points have been calibrated, click “Add Tool” to automatically calculate the current tool information according to the 6 points. After the calculation is completed, it will be sent back to the teach pendant software and displayed in the tool list. In addition, due to the memory limitation of the robot controller, only 10 tool coordinates can be saved, so please make sure that the limit will not be exceeded



before calibration. After the calibration is successful, the robot enters the tool coordinate system whose center is the center of the flange.

The calibration rules of six-point method are shown below.

Table 9 The content of the six-point calibration method.

#	Name
1	Any pose, tool end in contact with reference end.
2	Any pose, tool end in contact with reference end.
3	Any pose, tool end in contact with reference end.
4	Tool end in vertical pose, and in contact with reference end.
5	Keeping the pose of #4 and moving from #4 to some position along the negative x-axis of the Base coordinate system.
6	Keeping the pose of #4 and moving from #4 to some position along the positive z-axis of the Base coordinate system.

3. Manual Setting of the Tool End Coordinate System

When the user knows the accurate relative pose of the tool with respect to the center of the flange at robot end, the tool coordinate system can be set directly by manually entering the information. After selecting this feature, enter the name and pose of the new tool, and click the “Add Tool” button to send the new tool information to the robot controller and display it in the tool table. After the calibration is successful, the robot operates in the tool coordinate system of the center of the end flange.

4. Payload at the End

After the tool calibration, we need to enter the weight and center of gravity position of the end tool to make the tool parameters at the end of the robot more durable.

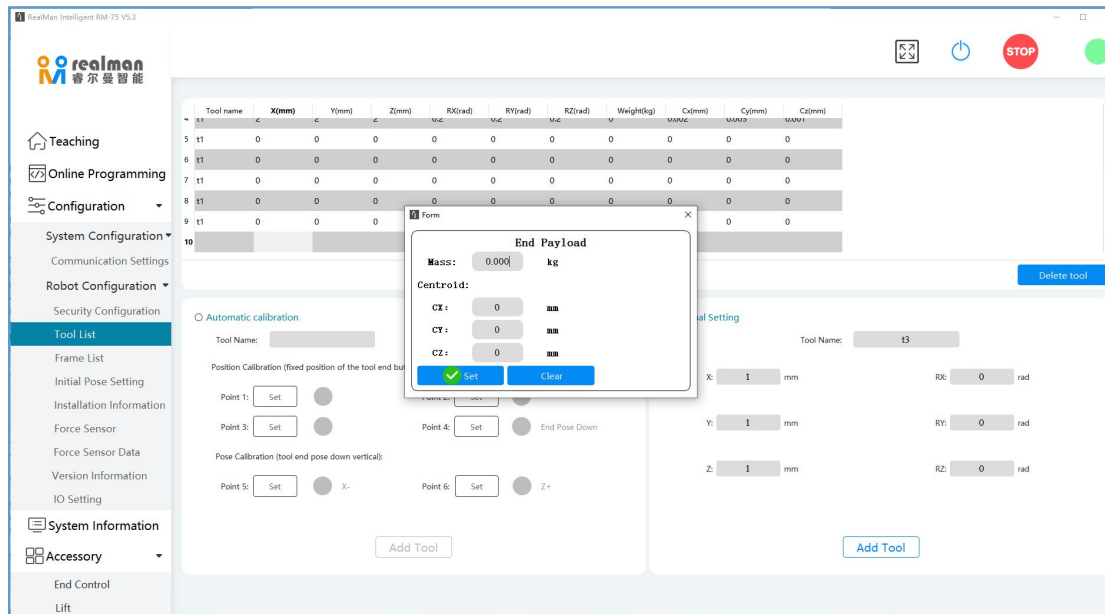


Fig. 8-121 End payload setting.

8.4.2.3 Calibration of the Operation Coordinate System

The calibration of the operation coordinate system is shown in the figure below. Region 1 displays the names of all the current operation coordinate system and its positions and poses relative to the Base coordinate system. Region 2 automatically calibrates the current operation coordinate system. Region 3 manually sets the information of the operation coordinate system.

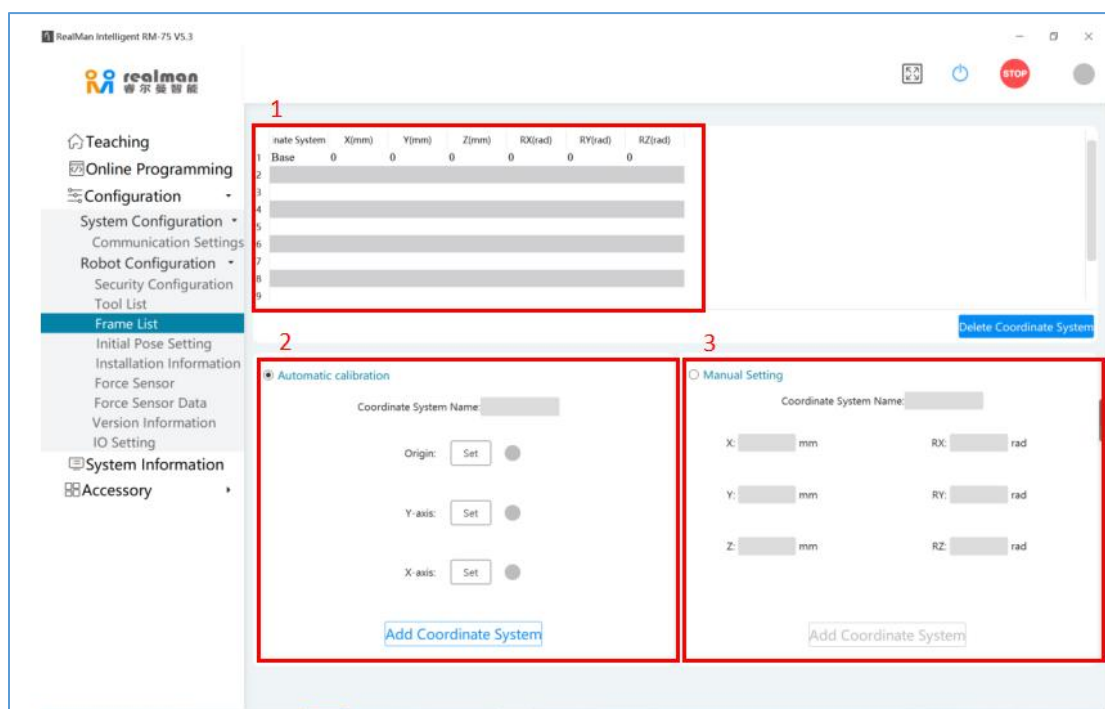


Fig. 8-122 Tool end coordinate system calibration demo.



1. Operation Coordinate System Display

The names and pose parameters of all the operation coordinate systems established by the current robot are shown in the table. If you want to delete a coordinate system, select it in the table and click the “Delete Coordinate System” button. After the deletion, the robot works in the Base coordinate system. Note that the Base coordinate system cannot be deleted.

2. Automatic Calibration

After selecting this feature, the current operation coordinate system can be calibrated by the three-point method. First, fill in the name of the coordinate system (English characters, no more than 10 characters). The tool end with a fixed pose is to contact the origin of the operation coordinate system, any point at the positive direction of x axis (better if the distance from the origin is greater than 10cm) and any point at the positive direction of y axis (better if the distance from the origin is greater than 10cm), respectively. After the calibration of these three points is completed, click the “Add Coordinate System” button. The system automatically calculates the current coordinate system information according to these three reference points. After the calculation is completed, the information is transmitted back to the teach pendant software and displayed in the coordinate system table. In addition, due to the memory limitation of the robot controller, only 10 operation coordinate systems can be saved. So please make sure that the number will not exceed the limit before calibration. After the calibration, the robot works in the Base coordinate system by default.

3. Manual Setting

When the user knows the accurate relative pose of the coordinate system relative to the Base coordinate system, the operation coordinate system can be set manually. After selecting this feature, enter the name and pose of the newly created coordinate system, and click the “Add Coordinate System” button to send the information of the newly created coordinate system to the robot controller and display it in the coordinate system table.

8.4.2.4 Setting Initial Pose

The initial pose of the robot can be set to facilitate the user to control the robot to



reach the position and pose quickly. As shown in the figure below, region 1 shows joint angles of the initial pose established by the current robot. Region 2 is manually input by the user. After setting the angles of the six joints, click the “Set” button to send the set joint angles to the robot for saving. After successful setting, the joint angles will be displayed in region 1. Region 3 is automatically set to set the current angles of the six joints of the robot as the joint angles of the initial pose. After successful setting, it will be shown in region 1.

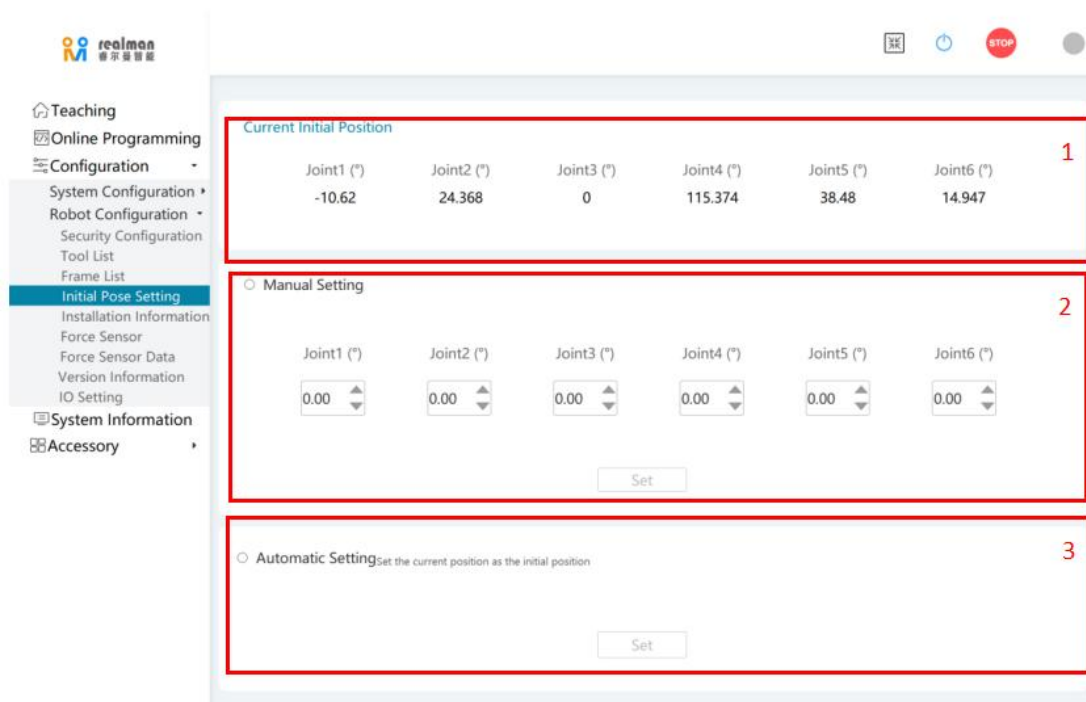


Fig. 8-123 Setting robot initial pose.

8.4.2.5 Installation Information

Robot installation information includes device model selection and installation angle setting. The interface contains a model window to see in real time whether the installation angle is consistent with the demand angle. Device model options include RM75-B, RM75-ZF, and RM75-6F. The installation orientation can be set by adjusting the X and Y axis angles. When the settings are complete, click the "OK" button to save.

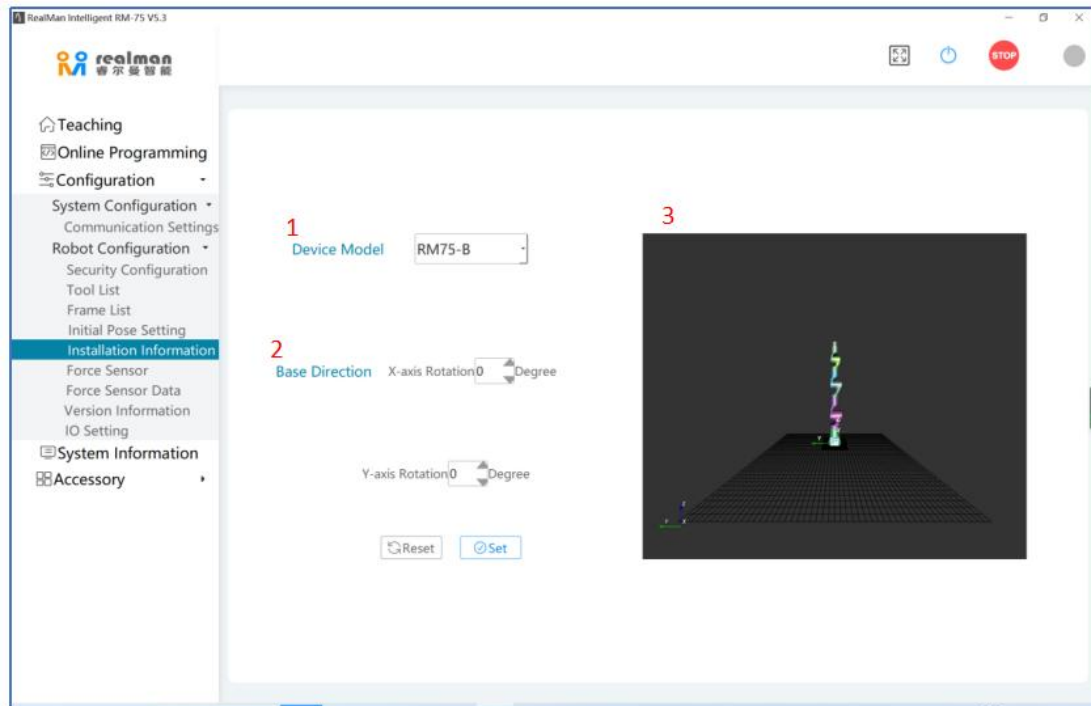


Fig. 8-124 Setting the installation information.

8.4.2.6 Force Sensor Configuration

Force sensors includes one-axis force sensor and six-axis force sensor. The parameters are described in the following table.

One-axis force sensor			
Load rating	Z axis: 200N		
Ultimate load (static load)	X: 400N	Y: 400N	Z:400N
	MX: 5Nm	MY: 5Nm	MZ:50Nm
Six-axis force sensor			
Load rating	X: 200N	Y: 200N	Z:200N
	MX: 7Nm	MY: 7Nm	MZ:7Nm

Note that during operation, the robot should avoid a hard collision between the sensor and external equipment which may cause damage.

The force sensor configuration interface includes six-axis force center of gravity calculation and one- axis force center of gravity calculation sensor calibration.

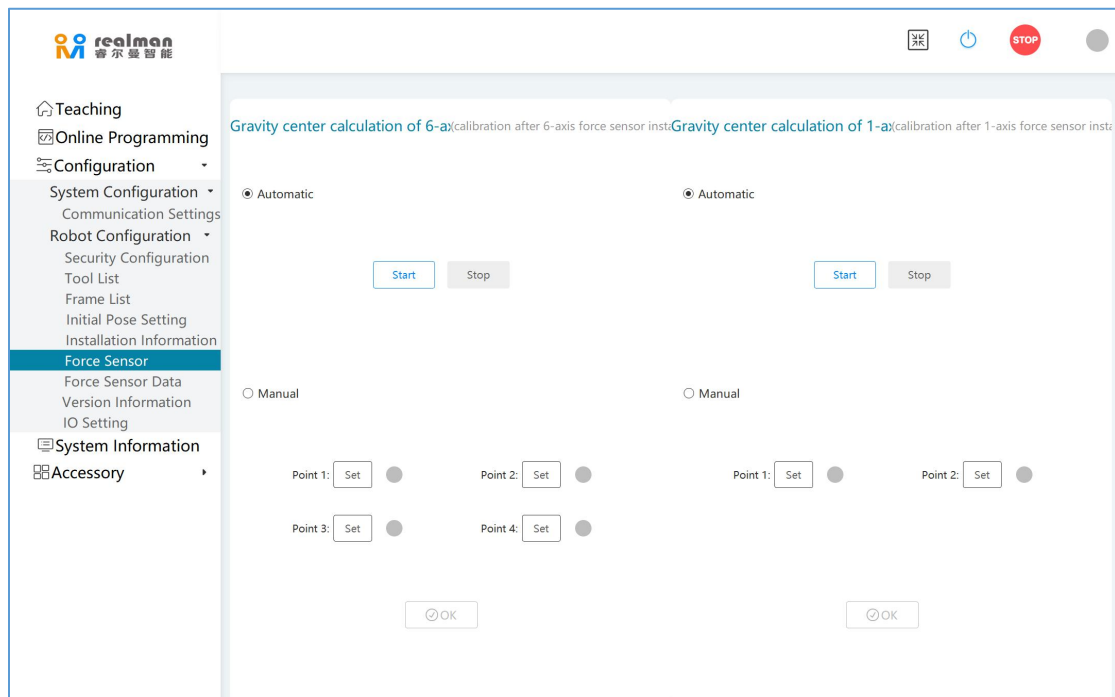


Fig. 8-125 Force sensor configuration.

1. Calibration of Force Sensor

① Six-axis force sensor calibration

The six-axis force calibration requires a re-calculation of the center of gravity of the six-axis force only after the end tool has been replaced. The calibration process can be automatically calibrated by the controller's pre-stored trajectory path. In order to avoid interference with external equipment during operation, the user can also manually calibrate according to the actual scene.

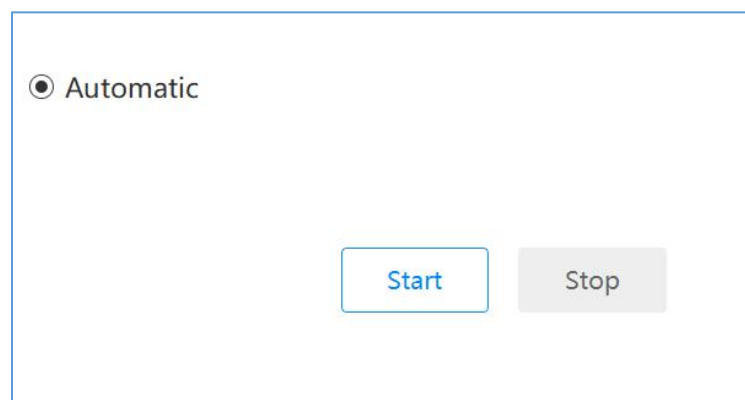


Fig. 8-126 Six-axis force sensor automatic calibration.

Click  button during automatic calibration, the calibration status confirmation prompt will pop up, as shown in the following figure.

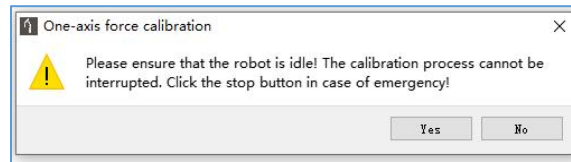


Fig. 8-127 Status confirmation prompt.

Click the "Yes" button and the robot will automatically run the 4 set of predefined poses to calculate the center of gravity. If there is a risk of robot collision during the

movement, you need to click the  button to terminate the operation.

After the calibration of the gravity of the six-axis force is successful, the "center of gravity of the sensor is calibrated successfully" prompt will pop up, and the calibration is completed.

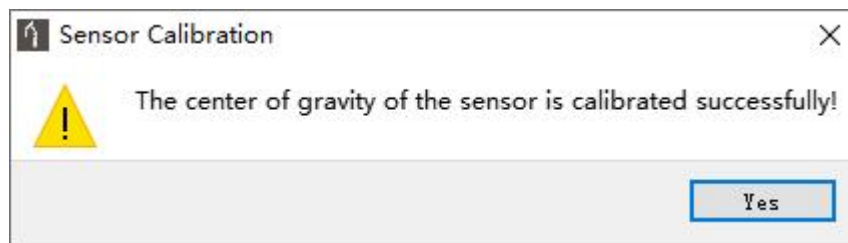


Fig. 8-128 Completion of the six-axis force sensor calibration.

In the manual calibration, check the **manual setting** marquee, set 4 points through the robot teach pendant software interface, and after the 4 points are recorded (as shown

in the figure below), click the  button.

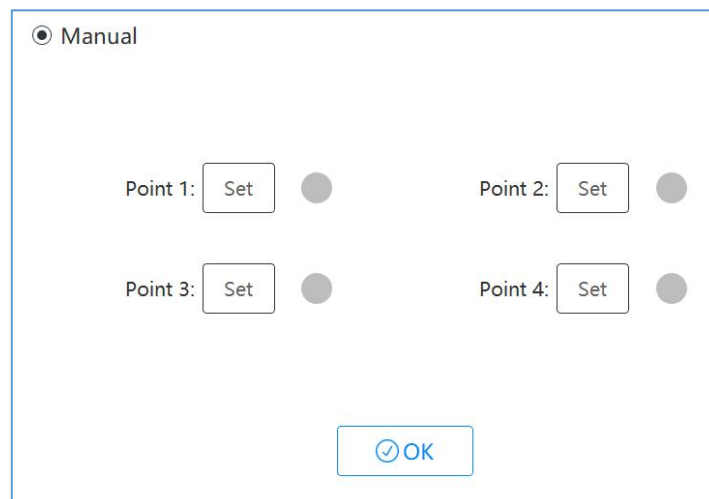


Fig. 8-129 Manual calibration of the six-axis force sensor.

The robot automatically calculates the center of gravity of the six-axis force. After the calibration of the gravity of the six-axis force is successful, the "center of gravity of



the sensor is calibrated successfully" prompt will pop up, and the calibration is completed.

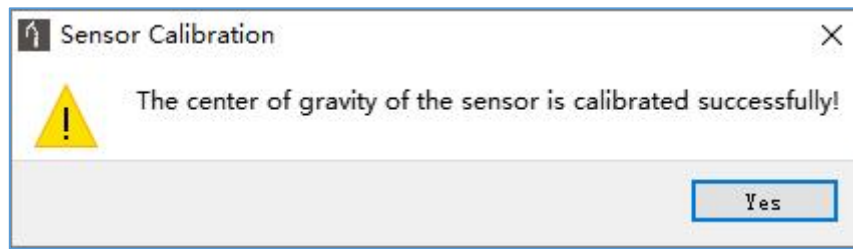


Fig. 8-130 Completion of the six-axis force sensor calibration.

②One-axis force sensor calibration

The calibration method of one-axis force transducer is similar to that of six- axis force sensor, and has also two methods, i.e., automatic calibration and manual calibration.

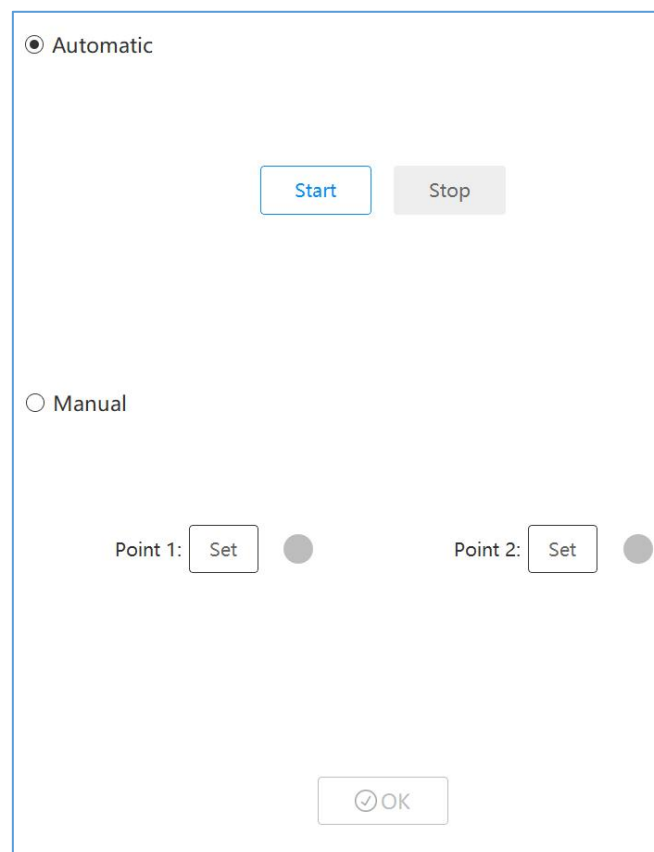


Fig. 8-131 Automatic calibration of one-axis force sensor.

Click  button during automatic calibration, the calibration status confirmation prompt will pop up, as shown in the following figure.

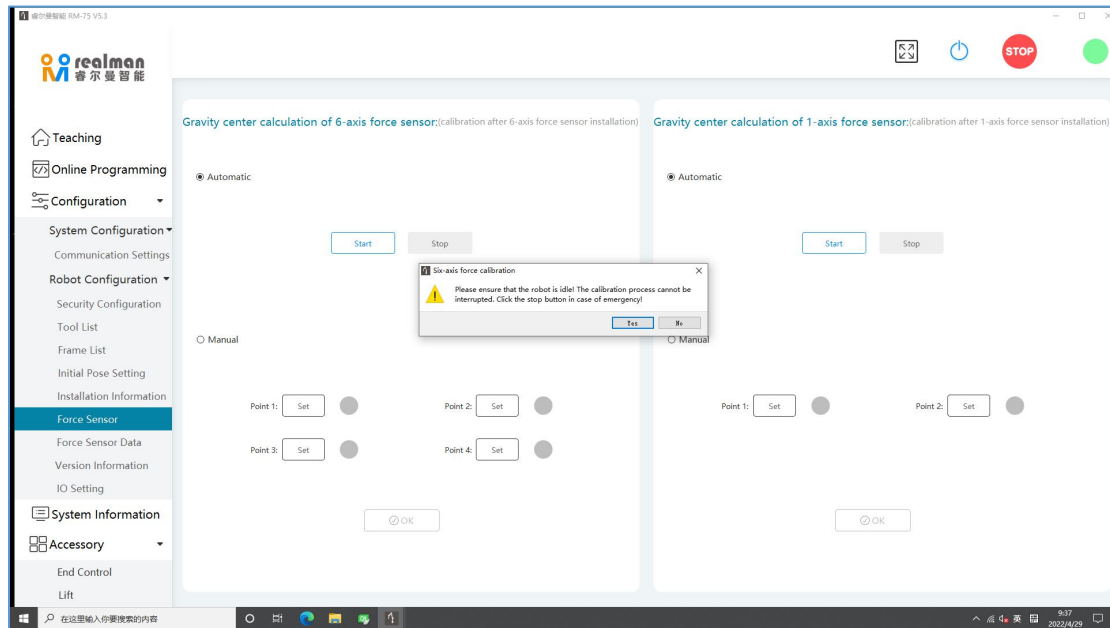


Fig. 8-132 Status confirmation prompt.

Click the "Yes" button and the robot will automatically run the 2 set of predefined poses to calculate the center of gravity. If there is a risk of robot collision during the movement, you need to click the  button to terminate the operation. After the calibration of the gravity of the one-axis force is successful, the "center of gravity of the sensor is calibrated successfully" prompt will pop up, and the calibration is completed.

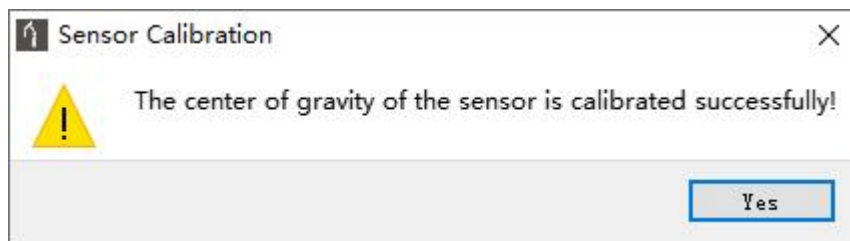


Fig. 8-133 Completion of the one-axis force sensor calibration.

In the manual calibration, check the **manual setting** marquee, set 2 points through the robot teach pendant software interface, and after the 2 points are recorded (as shown in the figure below), click the  button.

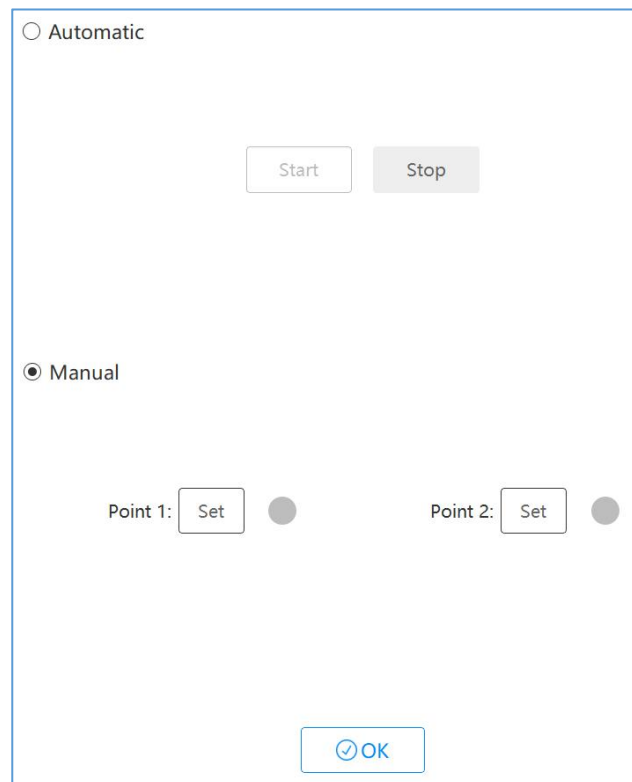


Fig. 8-134 Manual calibration of the one-axis force sensor.

The robot automatically calculates the center of gravity of the one-axis force. After the calibration of the gravity of the one-axis force is successful, the "center of gravity of the sensor is calibrated successfully" prompt will pop up, and the calibration is completed.

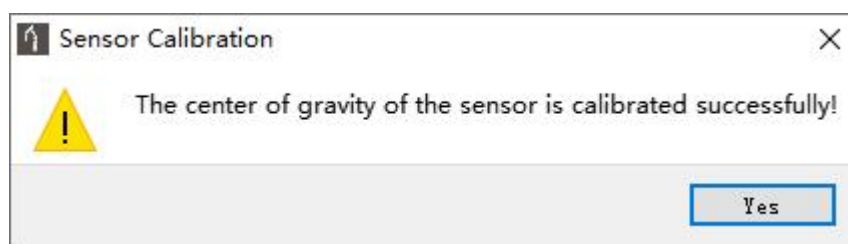


Fig. 8-135 Completion of the one-axis force sensor calibration.

Note that when calibrating the force sensor, there needs to be sufficient movement space around the robot to avoid collisions between the robot and external objects. Secondly, in the entire calibration process, the external force must not be added to the robot and the sensor, so as to avoid data errors.

8.4.2.7 Data Map of the Force Sensor

Robot with force sensor can record the one-axis force data or six-axis force data in real time as shown in the following figure which is six-axis force data.



Fig. 8-136 Force sensor data.

8.4.2.8 Version Information

After connecting the robot, the version information interface lists the controller software version number, joint software version number, terminal interface board version number, and Chinese-English switch.

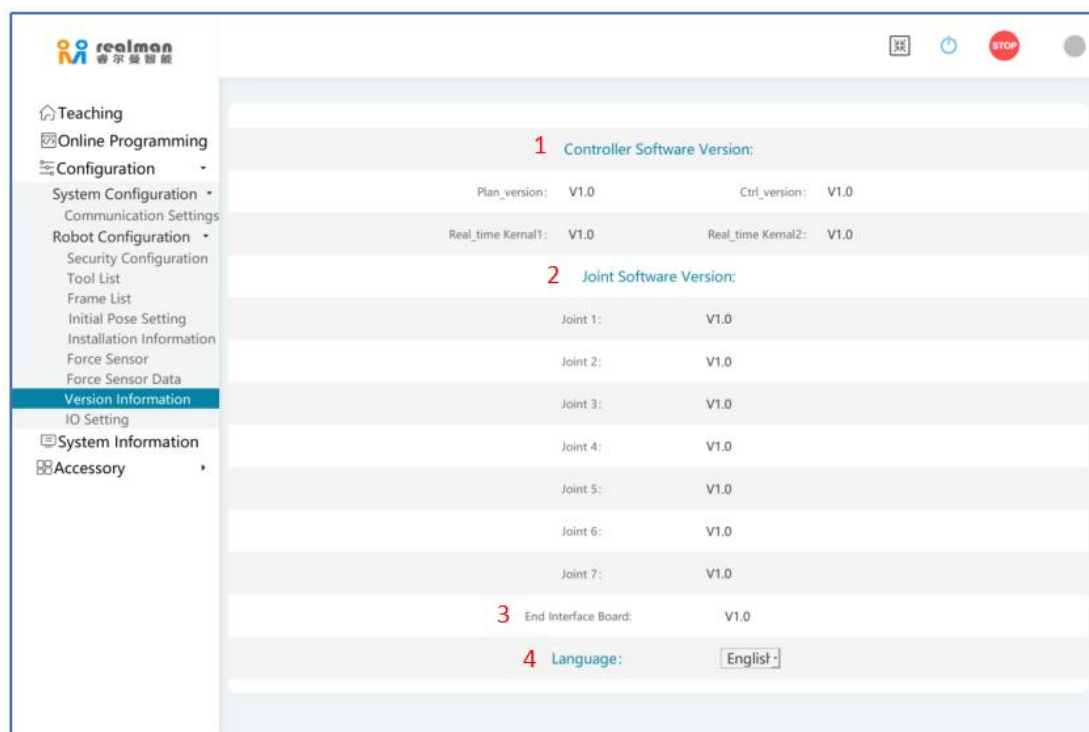


Fig. 8-137 Version information example.

8.4.2.9 I/O Setting

The I/O setting can set the controller I/O and tool I/O, as shown in the following



figure.

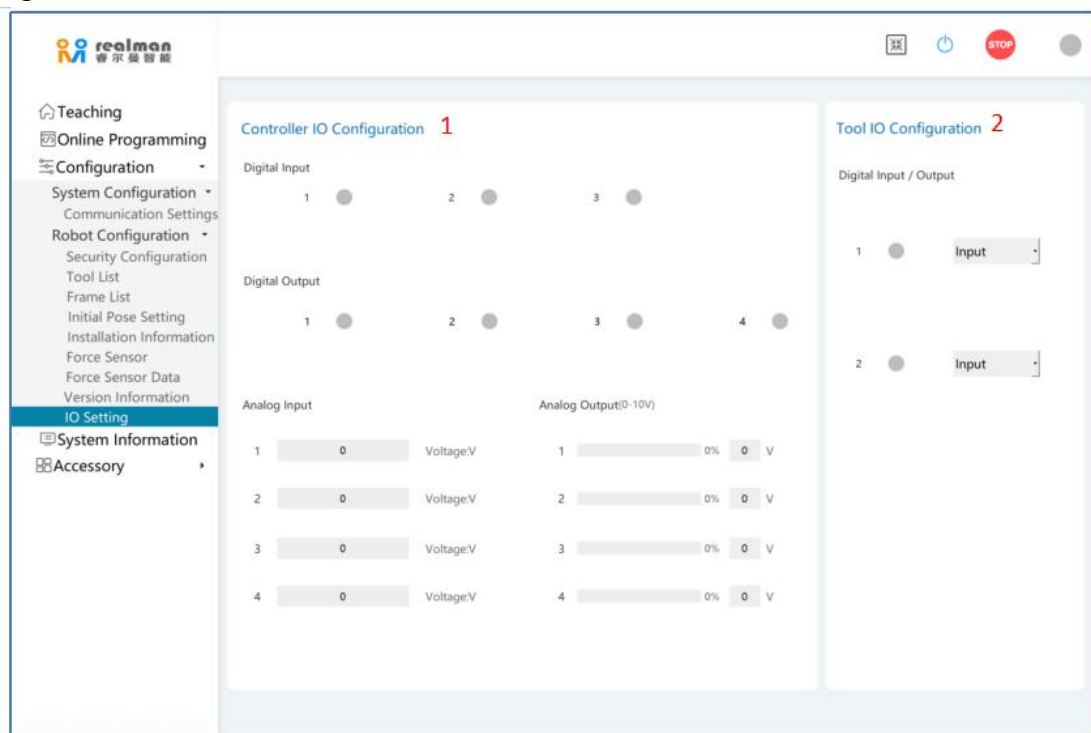


Fig. 8-138 I/O setting demo.

1. Controller I/O Setting:

The I/O configuration interface in the teach pendant software can display the status of the controller I/O and configure the controller I/O, as shown in the following figure.

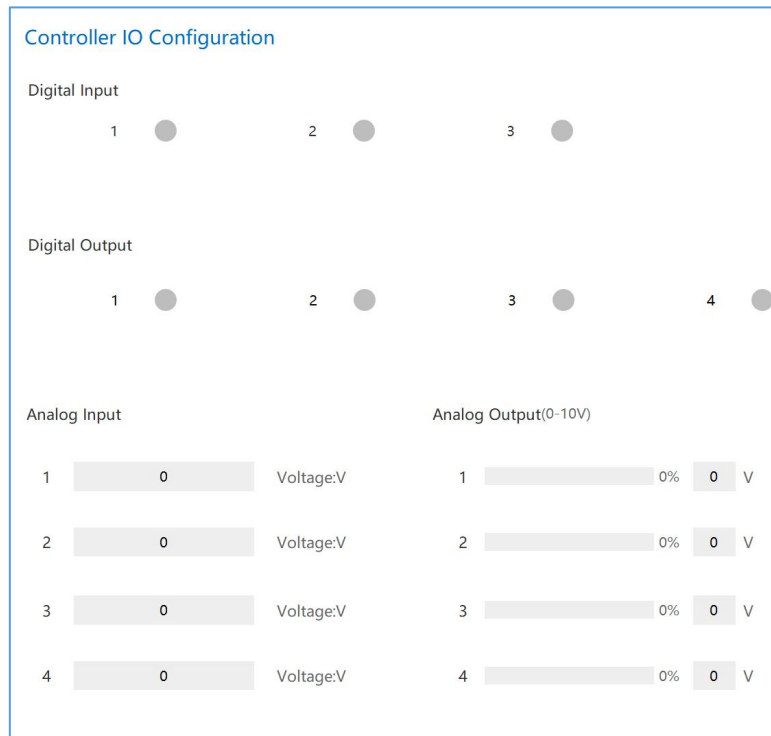


Fig. 8-139 Controller I/O setting demo.

Digital Input: This section displays the status of digital I/O inputs, with gray circles representing low inputs and green circles representing high inputs.

Digital output: This part is to configure digital I/O outputs. Press the button and the color turns to green, and the output status of the corresponding channel is set to high. The button turns gray when it is released, indicating that the output of the corresponding channel is low.

Analog Input: This section displays the voltage values of the four analog I/O input channels.

Analog output: This feature can configure the corresponding analog I/O output channel voltage value in range of 0~10V.

2. Tool I/O Configuration

The tool I/O interface in the teach pendant software can display the status of the tool I/O and configure the I/O as shown in the following figure.

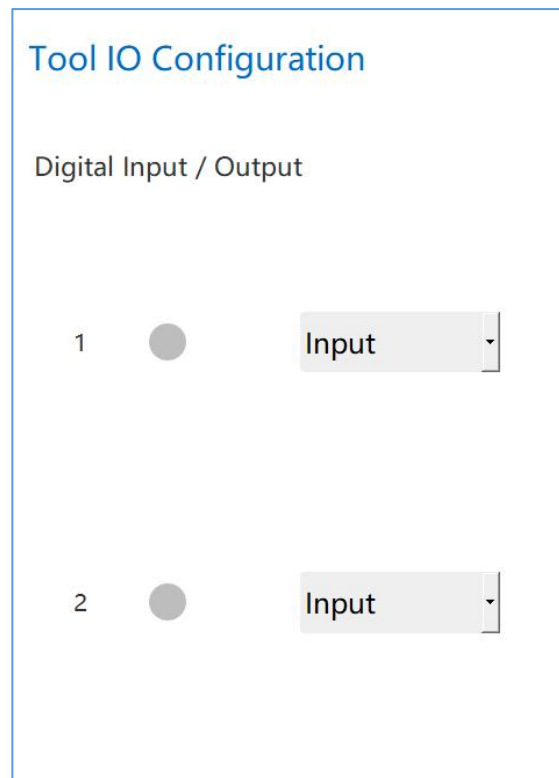


Fig. 8-140 Tool I/O setting demo.

Digital input/output: This part shows the status of the digital I/O. The gray circle represents the low level, the green circle represents the high level, and the user sets the input or output interface by the actual needs.

8.5 System Information

System information includes controller status and joint status, as well as system logs.

System information: including controller input voltage, output current, temperature, pose and error code.

Robot arm information: including voltage, current, temperature, enabling status and error code of all 6 joints. When the joint error is eliminated, click the “Clear” button to clear the error code before the joint movement can be controlled.

System log: contains all the operation instructions of the teach pendant software and the error types of the robot and controller, and it is displayed in the text box with time stamps. At the same time, you can also save the log information to the specified location through the “Save” button. When the “Clear” button is clicked, all displayed system logs are cleared.

System Error: displays the alarm status when the robot is running abnormally.

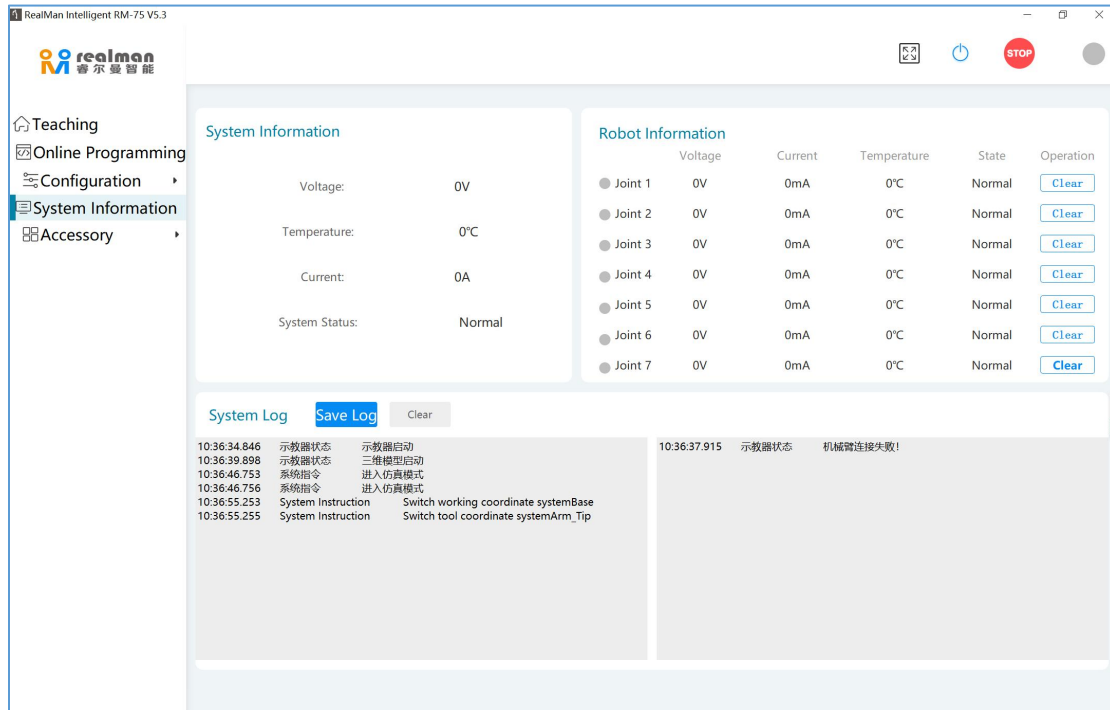


Fig. 8-141 The system information.

8.6 Extension

The configuration of the end tools and the settings for drag teaching in the extended interface of the teach pendant software are shown in the following figure.

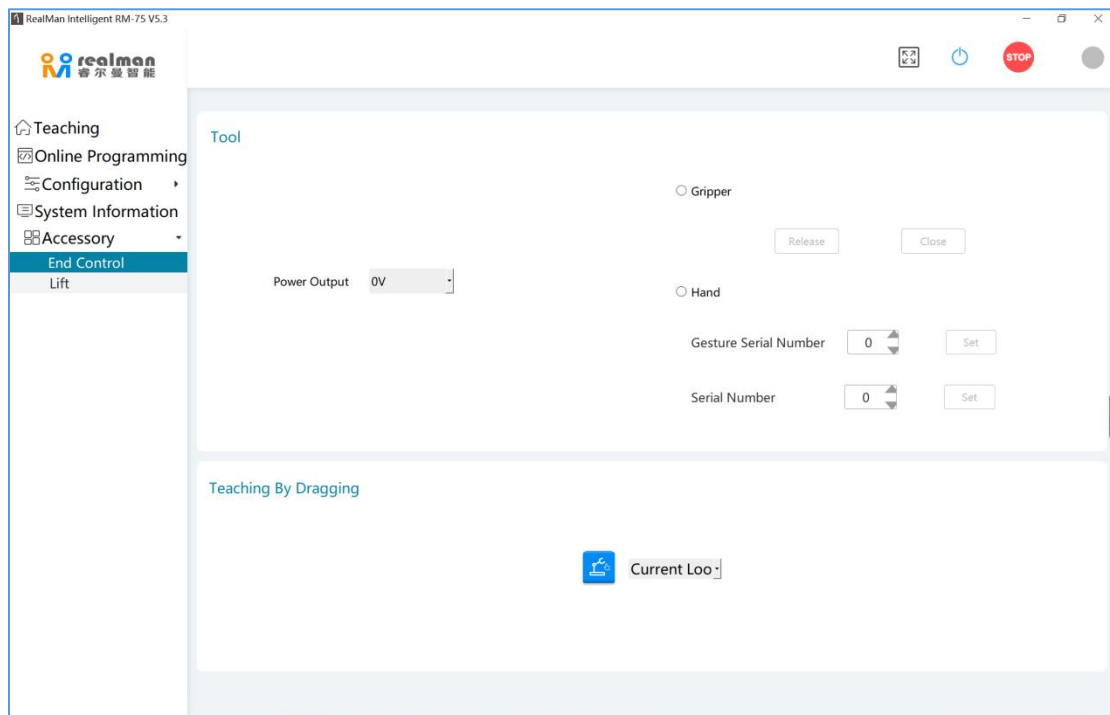


Fig. 8-142 Extension information.



8.6.1 Tool I/O Configuration

The end tool can be configured at the extended interface in the teach pendant software. The external output voltage of the tool end can be switched to perform simple control of the end gripper, as shown in the following figure.

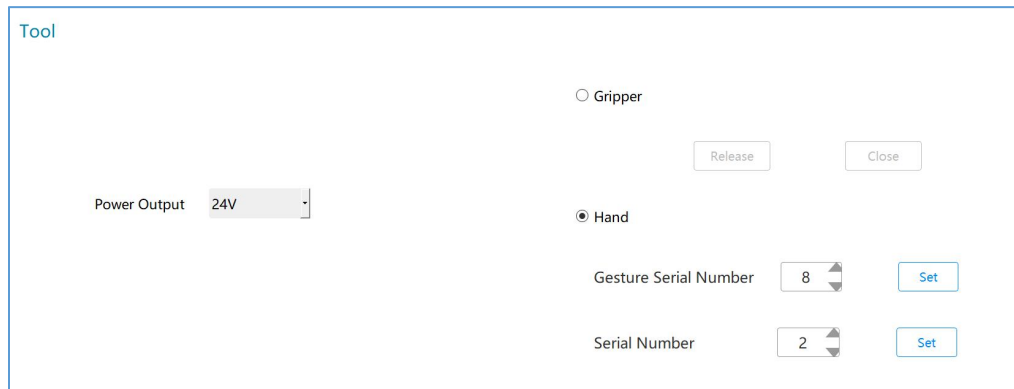


Fig. 8-143 Tool end I/O configuration.

Output power: This part configures the external output power of the end interface board, which can be one of 0V, 5V, 12V and 24V.

Peripheral equipment: By far, the tool end by default adds gripper and dexterous hand, and other devices can be added later. The gripper controls the release and close of the gripper. The dexterous hand can set the gesture and action sequences.

8.6.2 Drag Teaching

In addition to recording the waypoints and then running trajectory through the robot teach pendant software, the robot also supports the drag teaching function. We can press and hold the green button at the robot end for trajectory recording, and after

completing the action, release the green button. It is also possible to tap the



button in the teach pendant software and drag the robot. Click  again when user completes the track recording. It pops up the save window, and you can choose whether to save the trajectory file according to the actual needs.

After the track recording is complete, press the blue button at the robot end to reproduce the trajectory.

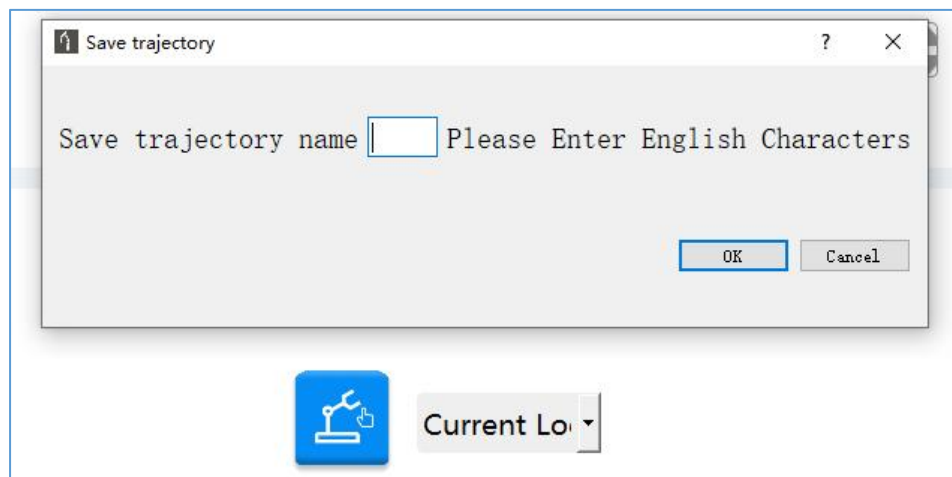


Fig. 8-144 Saving the trajectory recorded by drag teaching.

Drag teaching has four ways, that is, current loop, move position only, move posture only, and position-posture combined.

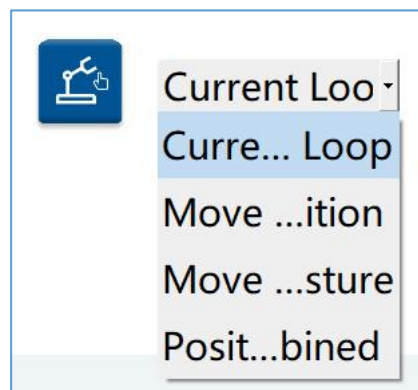


Fig. 8-145 Drag teaching ways.

Note that the move position, move posture only and position-posture combined need to be used with the six-axis force sensor, otherwise there will be an error prompt.

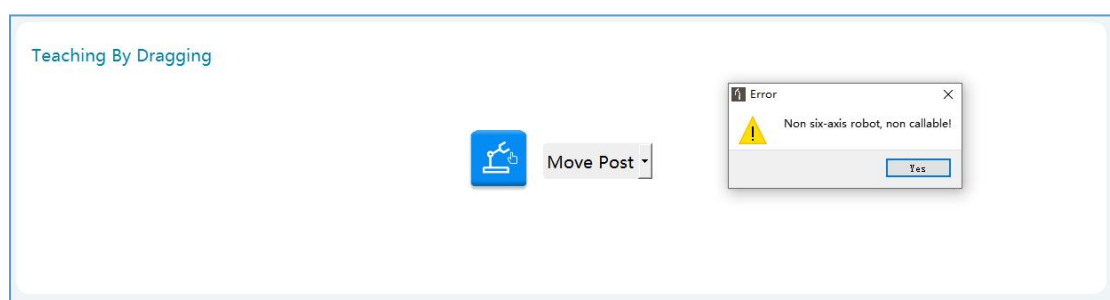


Fig. 8-146 Drag teaching error prompt.

When the robot end tool is our company's standard two-finger gripper, in addition to recording the trajectory of the robot movement, the gripper action can also be recorded by drag teaching. While long pressing the green button to teach by dragging,



long press the blue button, the gripper closes; short press the blue button, the gripper opens.

8.6.3 Lift Control

The lift control can be configured in the accessory interface of the teach pendant software as shown in the following figure.

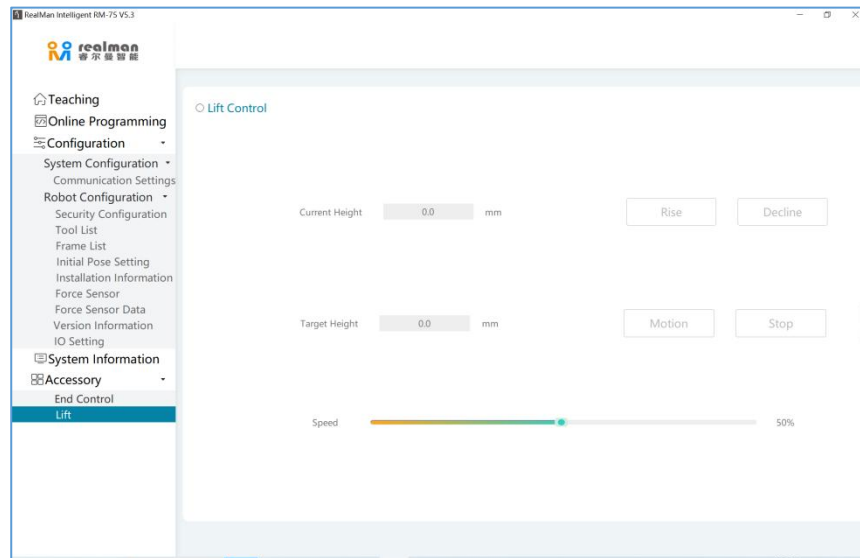


Fig. 8-146 The lift control demo.

● Lift Control

command is used to control the movement of a robot's extended joint lift or slide. The height can be raised or lowered, and a target height can be set so as to bring the lift to the target height by clicking the motion button. This is shown in the following figure.

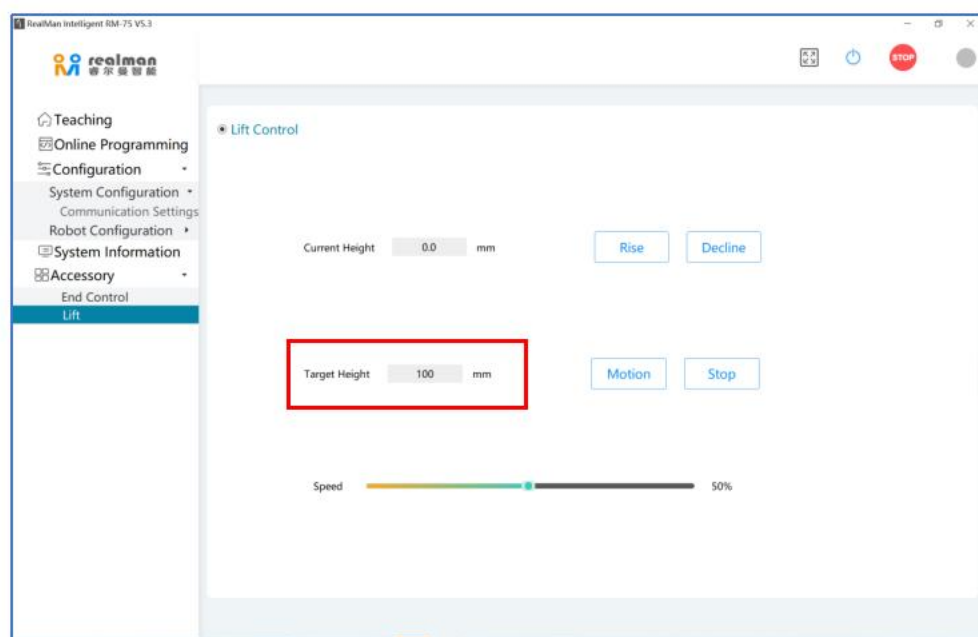




Fig. 8-147 Lift control setting.

9. Online Programming Demo

1. Click the “Online Programming” button.
2. Select the instruction line.
3. Click the “Move” button.

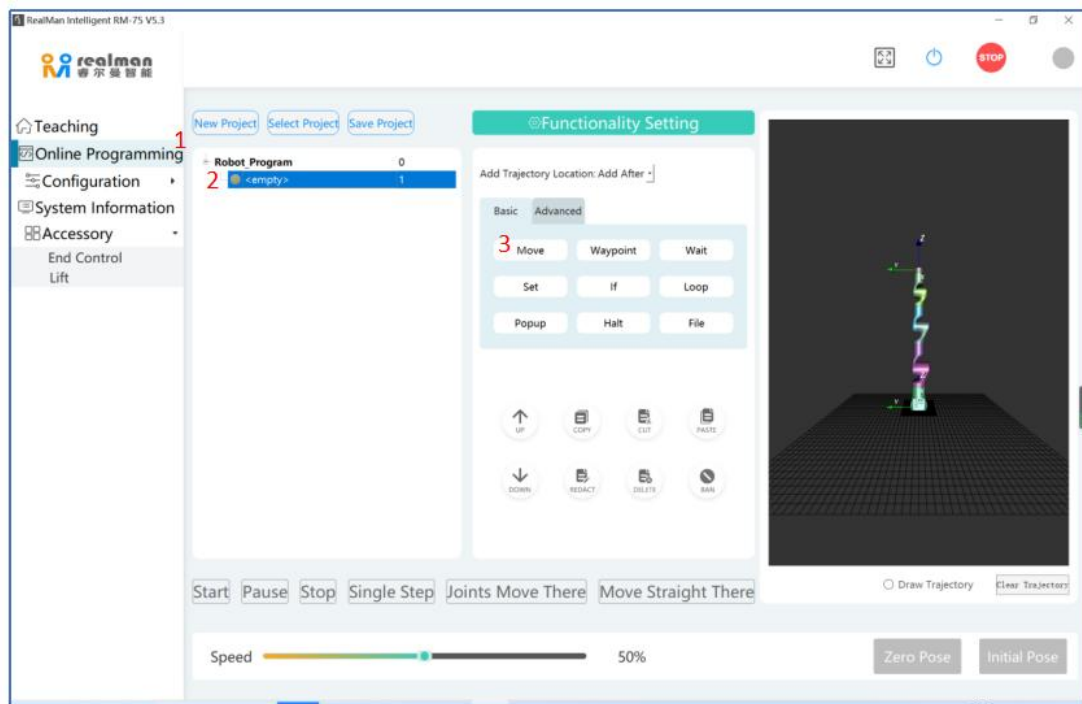


Figure 9-1 Add "Move" Command

4. In the tree diagram on the left side of the interface, a “MOVEJ” command and a waypoint are automatically added.
5. Double-click the "MOVEJ" command line, it pops up the parameter setting window, and click the “OK” button to save it after setting.

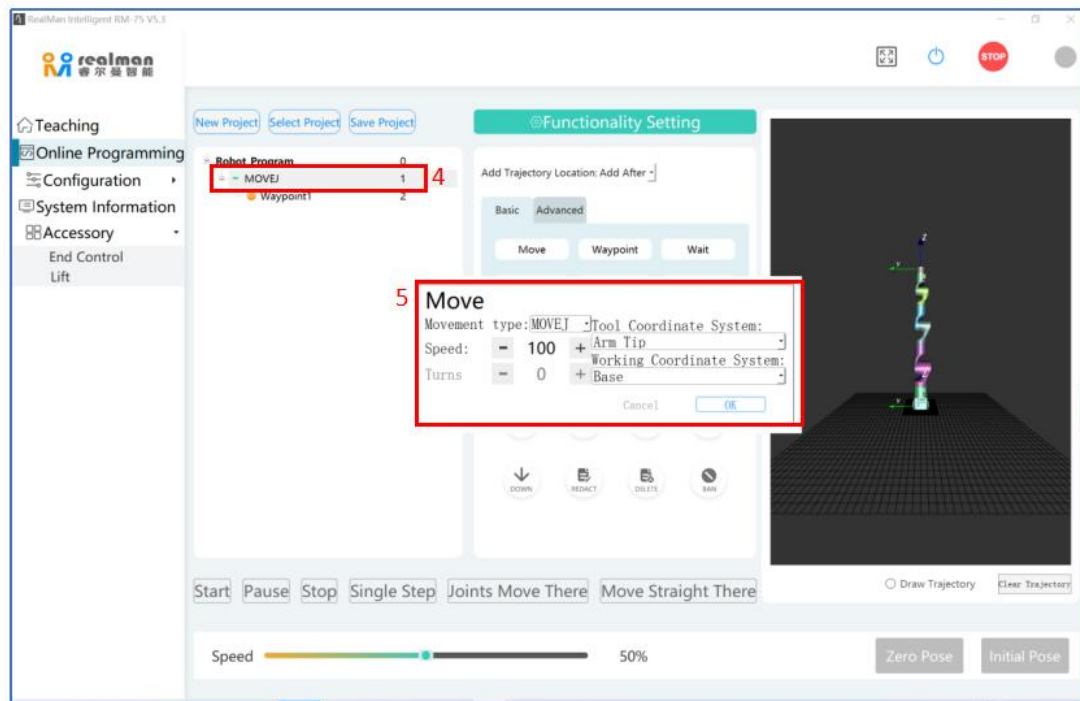


Figure 9-2 MOVEJ command parameter setting.

6. Double-click the “Waypoint1” command line to set the waypoint parameters.

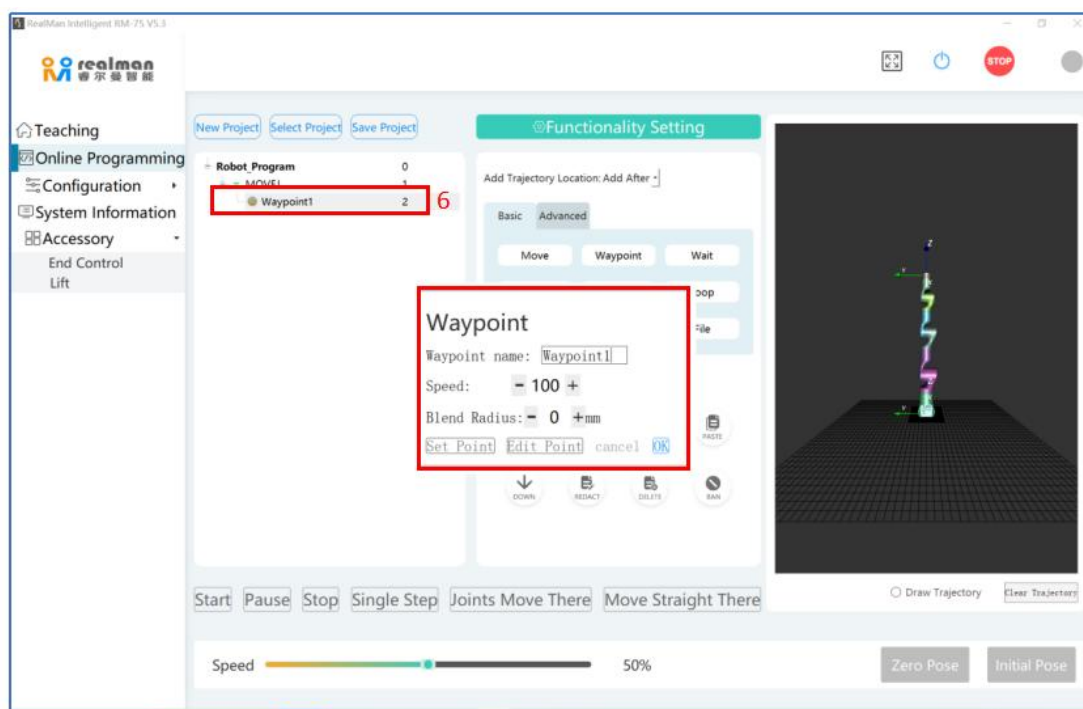


Figure 9-3 Waypoint command parameter setting.

7. Click the **Set Point** button, it pops up the robot teaching interface to set the waypoint pose.

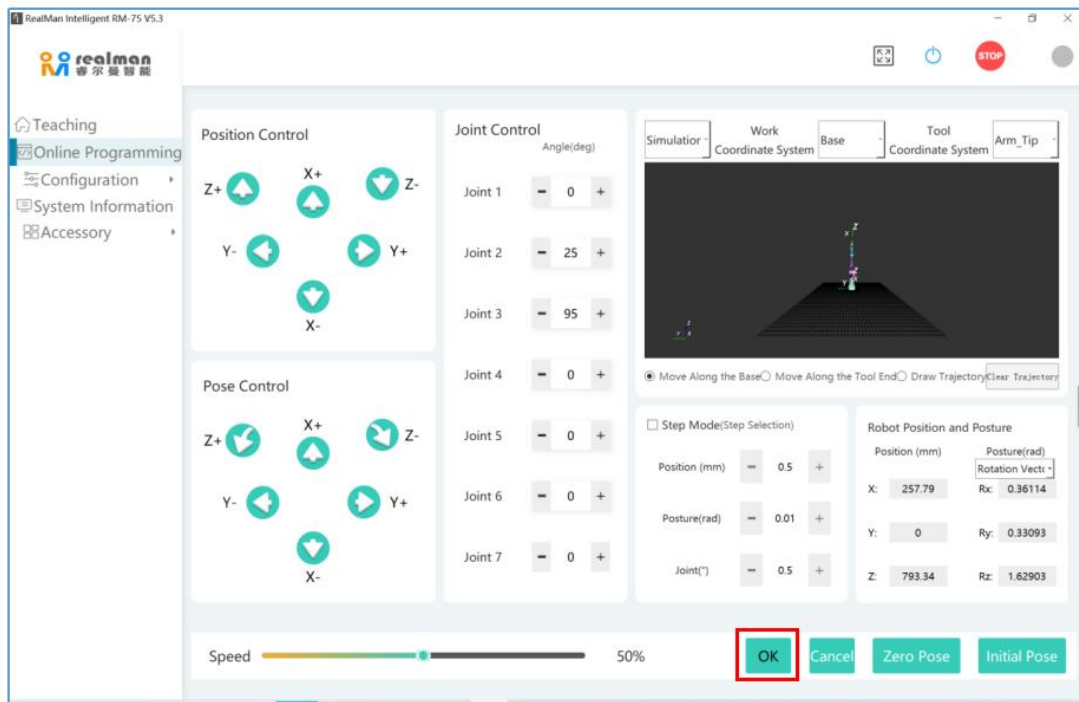


Fig. 9-4 Waypoint1 setting in the teach software.

8. Select the reference command line, click **Waypoint**, and it pops up the Waypoint parameter setting window.

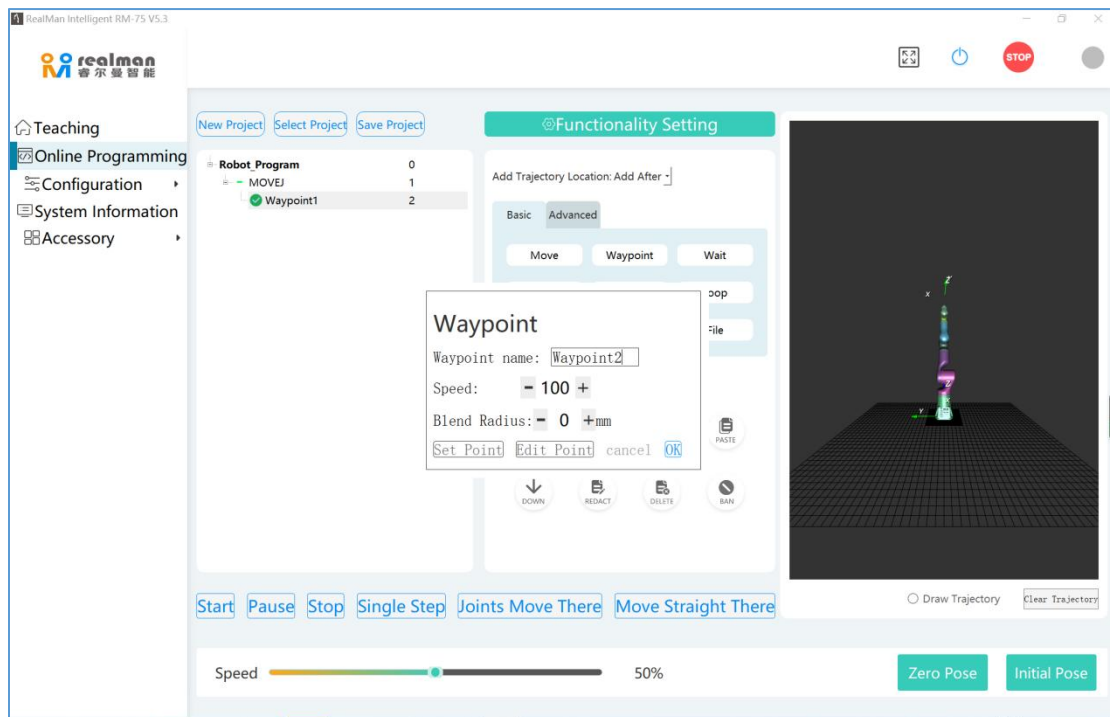


Fig. 9-5 Add the 2nd waypoint, i.e., Waypoint2.

9. After setting the location, click the **OK** button to add a second waypoint. The system will automatically name it "Waypoint2".

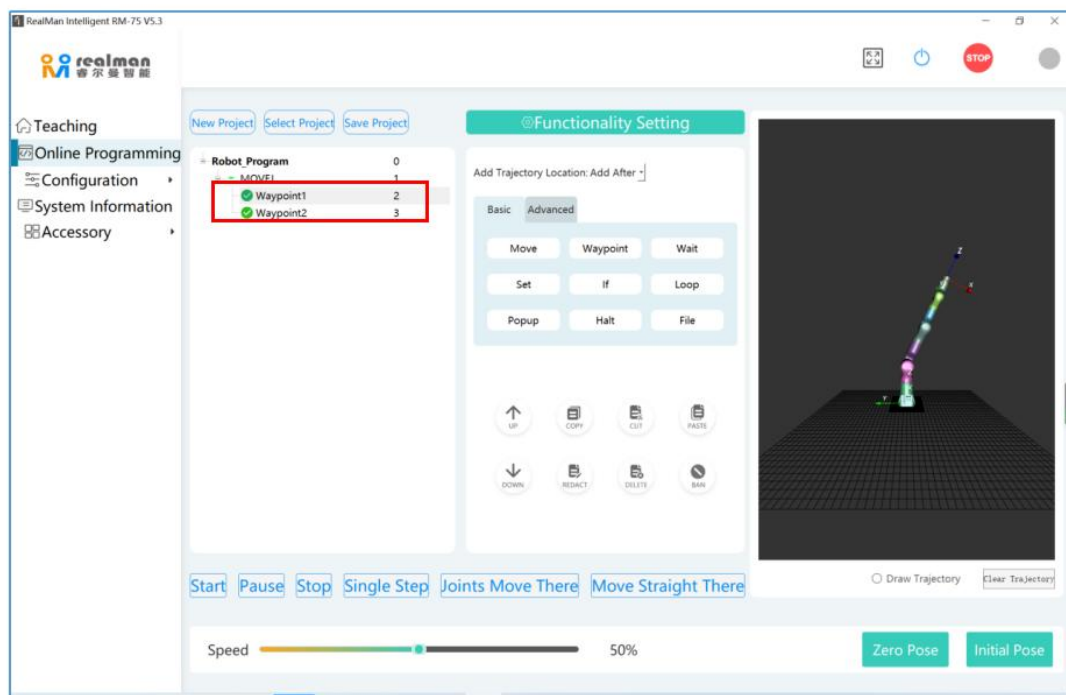


Fig. 9-6 Waypoint2 setting.

10. After the program is set, the command is displayed with an  icon before it.

Run the demo

1. To run the online-programming demo, click the “Start” button and the trajectory tracking will run automatically.
2. Press the “Pause” button, and the movement will be paused in the trajectory. After the pause, press the “Continue” button to continue the movement.
3. Press the “Single Step” button to perform single step movement.
4. Press the “Stop” button to stop the movement. To prevent accidents, manually click the “Stop” button after the trajectory tracking finished, so that the functions of the buttons can resume.

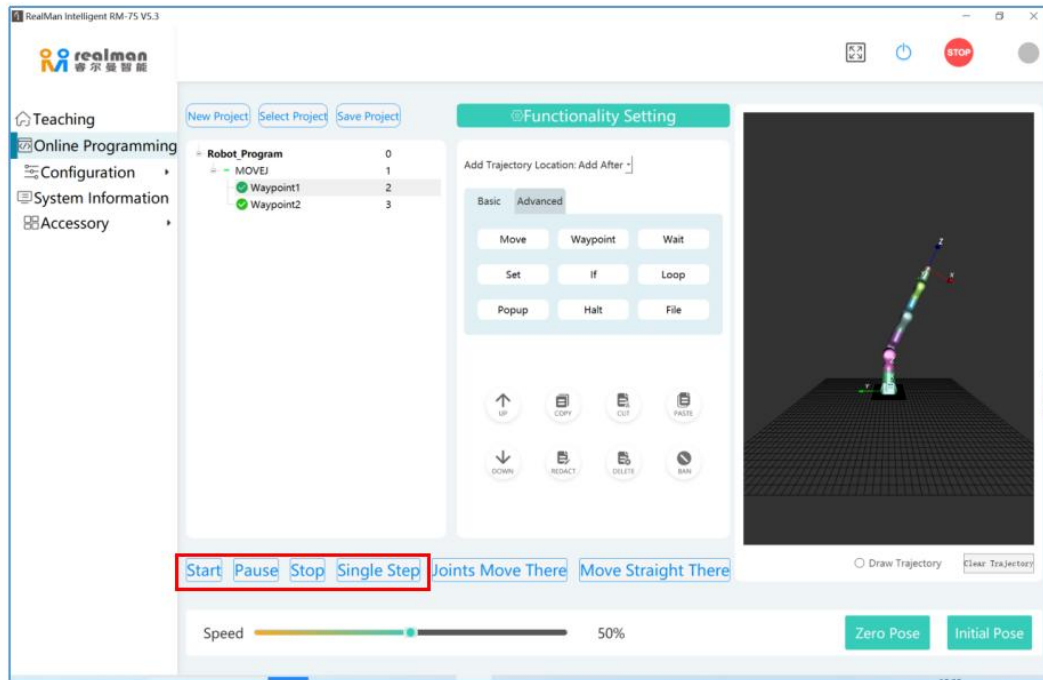


Fig. 9-7 Running the online-programming demo.

Note: Not all waypoints can be reached by the robot. If the programmable waypoint cannot be reached, please set a new waypoint.

10. System Update via USB Flash Drive

The software system in the robot controller can be upgraded through the USB flash drive. The specific operation steps are as follows:

- (1) Turn off the power supply of the robot.
- (2) Copy the .bin update file(s) provided by the manufacturer to the *bin* directory of the USB flash drive. (If there is no *bin* folder, create it yourself in the root directory and copy the .bin files to the folder.)
- (3) Plug the USB flash drive into the USB port of the controller, as shown below.



Fig. 10-1 The USB port for system update.

(4) Power on the robot to start the update. Multiple system files can be upgraded at a time. When all files are updated, the buzzer will ring long. (If the buzzer rings for once, do not perform subsequent operations.)

(5) After the buzzer sounds long, power off the robot and pull out the USB flash drive.

(6) Turn on the power, and the robot with updated software system can work normally.

Note: The controller bin file(s) will be updated within 30s. But the robot arm end interface board and joints will be updated in 70s, so please be patient. Please do not power off during the update!

11. Technical Specifications

Robot	RM65-B
DoF	6
Payload	5kg/11.0lbs
Weight	7.2kg/15.9lbs
Repeat Ability	$\pm 0.05\text{mm}/\pm 0.002\text{in}$
Reach	610mm/24in



Voltage	DC 24V (range: DC24V~27V)	
Max Energy Consumption	$\leq 200\text{W}$	
Combined Energy Consumption	$\leq 100\text{W}$	
Material	Aluminum Alloy	
Controller	Built-in	
Communication	WIFI/Ethernet/Bluetooth/USB/RS485	
Teach&Development	Tablet+API	
IP Rating	IP 54	
I/O Power	5V/12V	
Digital I/O Ports	Input×3	Output×4
Analog I/O Ports	Input×4 (0-10V), Output×4 (0-10V)	
Joint Speed	Joint1~2: 180°/s, Joint3~6: 225°/s	
Joint Movement Range	Joint1: ±180°, Joint2: ±130°, Joint3: ±135°, Joint4: ±180°, Joint5: ±180°, Joint6: ±360°.	