DOBOT

Dobot Magician User Guide

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Shenzhen Yuejiang Technology Co.,Ltd.|China

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Before using our product, please thoroughly read and understand the contents of this document and related technical documents that are published online, to ensure that the robotic arm is used on the premise of fully understanding the robotic arm and related knowledge. Please use this document with technical guidance from professionals. Even if follow this document or any other related instructions, damages or losses may happen in the using process. Dobot shall not be considered as a guarantee regarding to all security information contained in this document.

The user has the responsibility to make sure following the relevant practical laws and regulations of the country, in order that there is no significant danger in the use of the robotic arm.

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Preface

Purpose

This document describes the working principle, technical specifications, connection and functions of Dobot Magician, making it easy for users to fully understand and use it.

Intended Audience

This document is intended for:

- Customer Engineer
- Sales Engineer
- Installation and Commissioning Engineer
- Technical Support Engineer

Change History

Date	Change Description
2022/12/08	Update software operations according to latest UI interface (V2.3.1) Add wiring description of stick controller kit
2022/5/27	The first release

Symbol Conventions

The symbols that may be found in this document are defined as follows.

Symbol	Description
⚠DANGER	Indicates a hazard with a high level of risk which, if not avoided, could result in death or serious injury
⚠WARNING	Indicates a hazard with a medium level or low level of risk which, if not avoided, could result in minor or moderate injury, robotic arm damage
⚠NOTICE	Indicates a potentially hazardous situation which, if not avoided, can result in robotic arm damage, data loss, or unanticipated result
🕮NOTE	Provides additional information to emphasize or supplement important points in the main text

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1. Security Precautions

This topic describes the security precautions that should be noticed when using this product. Please read this document carefully before using the robotic arm for the first time. This product needs to be used in an environment meeting design specifications. You cannot remold the product without authorization, otherwise it could lead to product failure, and even personal injury, electric shock, fire, etc. The installation personnel, operators, teaching personnel, and programmers of the robotic arm must read this document carefully and use the robotic arm strictly according to the regulations of this document strictly.

1.1 General Security

⚠DANGER

Robotic arm is an electrical equipment. Non-professional technicians cannot modify the wire, otherwise it is vulnerable to injury the device or the person.

The following security rules should be followed when using the robotic arm.

- You should comply with local laws and regulations when operating the robotic arm. The security precautions in this document are only supplemental to local laws and regulations.
- The DANGER, WARNING, and NOTICE marks in this document are only supplemental to the security precautions.
- Please use the robotic arm in the specified environment scope. If not, exceeding the specifications and load conditions will shorten the service life of the product even damage the equipment.
- Before operating and maintaining the robotic arm, the personnel responsible for the installation, operation and maintenance must be trained to understand the various security precautions and to master the correct methods of operation and maintenance.
- Highly corrosive cleaning is not suited to cleaning the robotic arm. The anodized components are not suitable for immersion cleaning.
- People cannot repair and disassemble the robotic arm without professional training. If there is a problem with the robotic arm, please contact Dobot technical support engineer in time.
- Please comply with the relevant laws to deal with the product which is scrapped, and protect the environment.
- There are small parts in the packing box, Please keep them away from children, to avoid any accidents.
- DO NOT let children play with the robotic arm alone. All processes need to be monitored while running. After processes have finished, please turn off the equipment promptly.
- DO NOT put hands into the workspace of the robotic arm while running, to avoid bruising or pinching.
- Be careful during the robotic arm carrying or installing. Please follow the instructions on

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the packing box to put down the robotic arm gently and place it correctly in direction of arrow.

- Commissioning of the incomplete machine is prohibited until it has been installed in a machine and the whole machine complies with the provisions of the Machinery Directive (2006/42/EC).
- It is prohibited to modify or remove the nameplates, instructions, icons and marks on the robotic arm and the related equipment.
- Please refer to Dobot Magician User Guide along with the packing box before using.

1.2 Precautions

- Please make the Dobot Magician in the workspace with a 45° angle between the Forearm and Rear Arm (as shown in Figure 1.1) before starting up. If the LED indicator turns red after starting up, it indicates that the Dobot Magician is at a limited position. Please make the Dobot Magician in the workspace.

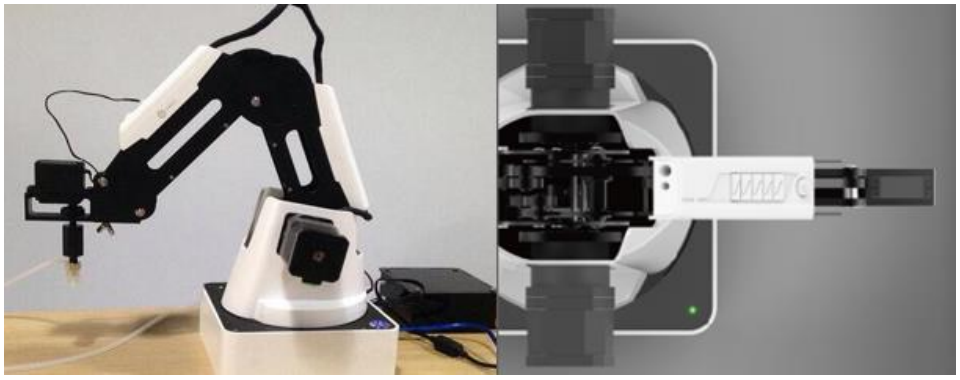

Figure 1.1 The Forearm and Rear Arm position

- Dobot Magician will move slowly to the specific position when shutdown. DO NOT put hands into the workspace of the Dobot while running, to avoid bruising or pinching. Only once the LED indicator completely turns off, the Dobot Magician can be powered down.
- If the coordinates of the Dobot Magician shown on DobotLab are abnormal, please press the Reset button on the back of the base to reset Dobot Magician or click Home on DobotLab to perform homing.
  - During resetting, Dobot Magician will disconnect from the PC automatically and the LED indicator on the base turns yellow. About 5 seconds later, if the LED indicator turns green, it indicates that the reset is successful.
  - During homing, Dobot Magician will rotate clockwise to the limited position and then return to the homing point automatically, and the LED indicator on the base turns blue and is blinking. After homing, if there is a beep sound and the LED indicator turns green, it indicates that the homing is successful.
- Please turn off the Dobot Magician completely first before connecting or disconnecting external equipment, such as Bluetooth, WIFI, stick controller, infrared sensor, color sensor, etc. Or, it causes damage to your device.

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- Please wear the lasing protective eyeglass when using the laser module. Please protect your eyes and skin from the laser.
- The heating rod will produce high temperature up to 250℃ when you use the 3D printing module. Please be careful.
- Please DO NOT operate or turn off Dobot Magician when burning firmware, to avoid machine damage.

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2. Introduction

2.1 Overview

Dobot Magician is a multifunctional desktop robotic arm for practical training education, supporting teaching and playback, blockly programming, script programming, writing and drawing, laser engraving, 3D printing, etc. It also supports secondary development by various extensible I/O interfaces.

2.2 Appearance

Dobot Magician consists of a base, rear arm, forearm, and end-effector, etc. Figure 2.1 shows the appearance.

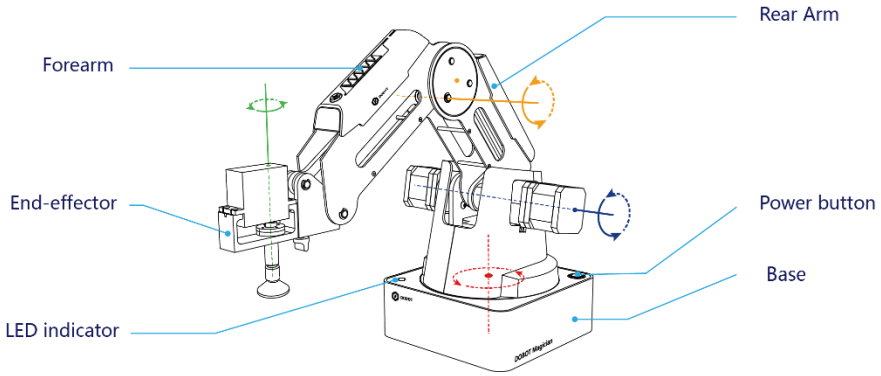

Figure 2.1 Appearance of Dobot Magician

2.3 Working Principle

This section describes the workspace, principle, size and technical specifications of Dobot Magician.

2.3.1 Workspace

Figure 2.2 and Figure 2.3 shows the workspace of Dobot Magician.

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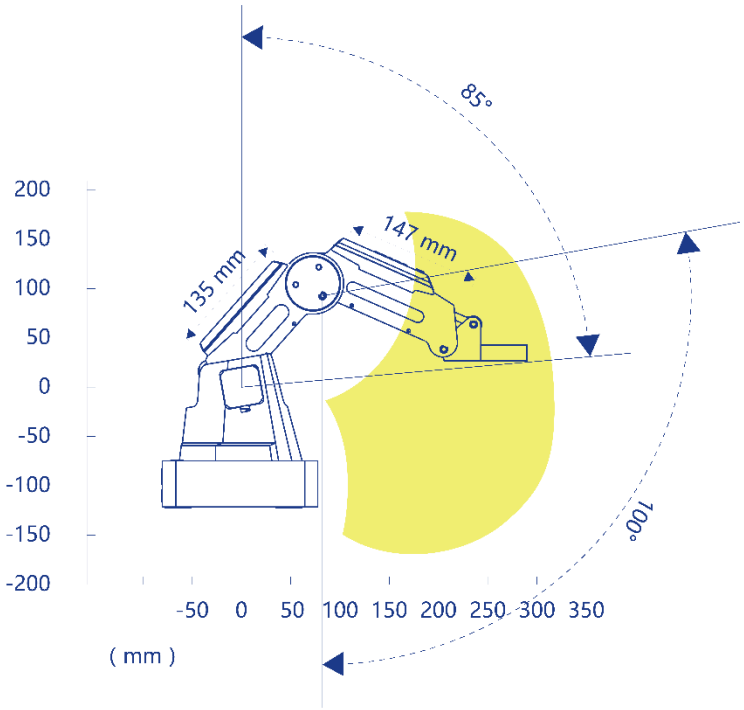

Figure 2.2 Workspace of Dobot Magician (1)

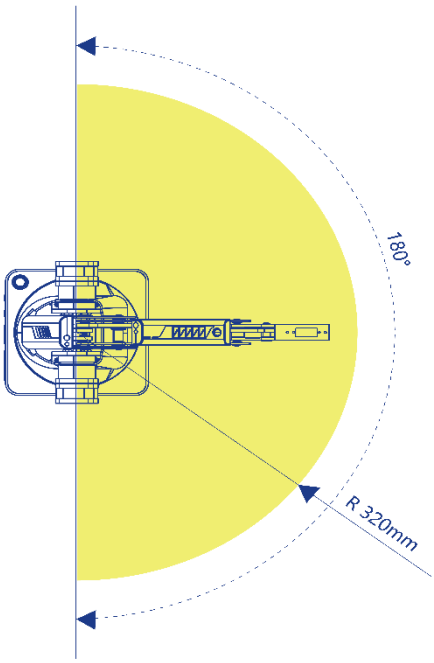

Figure 2.3 Workspace of Dobot Magician (2)

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2.3.2 Coordinate System

Dobot Magician has two types of coordinate system, the joint one and the Cartesian one, as shown in Figure 2.4 and Figure 2.5 respectively.

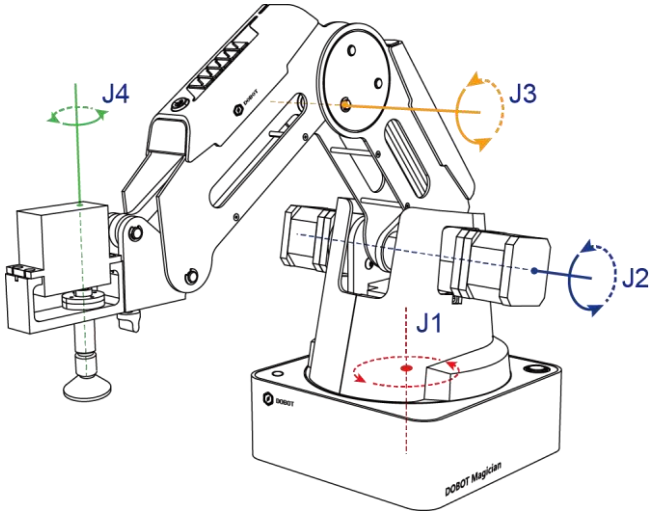

Figure 2.4 Joint coordinate system

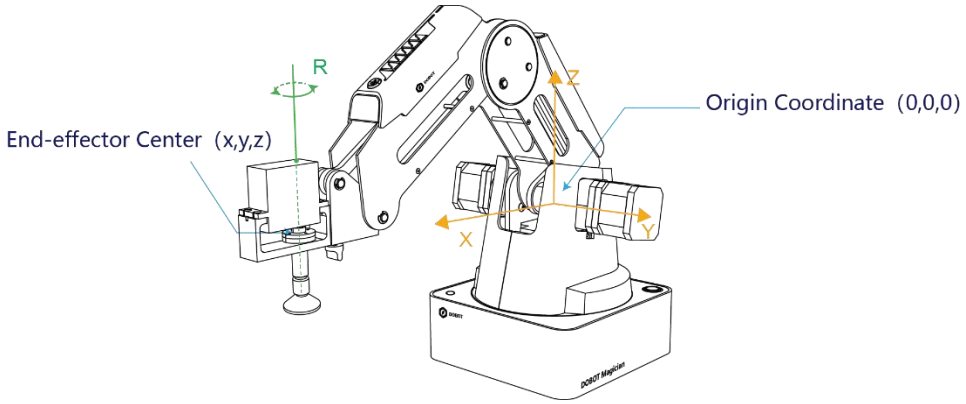

Figure 2.5 Cartesian coordinate system

Joint coordinate system: The coordinates are determined by motion joints.

- If the end-effector is not installed, Dobot Magician contains three joints: J1, J2 and J3, which are all rotating joints. The positive direction of these joints is counter-clockwise.
- If the end-effector with servo is installed, such as suction cup kit, gripper kit, Dobot Magician contains four joints: J1, J2, J3 and J4, which are all rotating joints. The positive direction of these joints is counter-clockwise.

Cartesian coordinate system: The coordinates are determined by the base.

- The origin is the center of the three motors (rear arm, forearm, base).
- The direction of X-axis is perpendicular to the base forward.

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- The direction of Y-axis is perpendicular to the base leftward.
- The direction of Z-axis is vertical upward, which is based on the right hand rule.
- The R-axis is the attitude of the servo center relative to the origin of the robotic arm, of which the positive direction is counter-clockwise. The R-axis only exists once the end-effector with servo is installed.

2.3.3 Motion Function

The motion modes of Dobot Magician include Jogging, Point to Point (PTP), ARC.

2.3.3.1 Jogging Mode

Jogging mode is the mode jogging Dobot Magician along the Cartesian coordinate system or Joint coordinate system when teaching.

Cartesian coordinate system mode

- Click **X+**, **X-** and Dobot Magician will move along X-axis in the negative or positive direction.
- Click **Y+**, **Y-** and Dobot Magician will move along Y-axis in the negative or positive direction.
- Click **Z+**, **Z-** and Dobot Magician will move along Z-axis in the negative or positive direction.
- Click **R+**, **R-** and Dobot Magician will rotate along R-axis in the positive or negative direction.

⚠NOTICE

If the end-effector with servo is installed on the Dobot Magician, the R-axis will move together with Y-axis, to make sure that the terminal posture relative to the origin stays constant.

Joint coordinate system mode

- Click **J1+**, **J1-** and control the base motor to rotate in the negative or positive direction.
- Click **J2+**, **J2-** and control the rear Arm motor to rotate in the negative or positive direction.
- Click **J3+**, **J3-** and control the forearm motor to rotate in the negative or positive direction.
- Click **J4+**, **J4-** and control the servo to rotate in the negative or positive direction.

2.3.3.2 Point to Point (PTP)

PTP mode, which means point to point movement. supports MOVJ, MOVL and JUMP. The trajectory of playback depends on the motion mode.

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- MOVJ: Joint movement. From point A to point B, each joint runs from initial angle to its target angle, regardless of the trajectory, as shown in Figure 2.6.

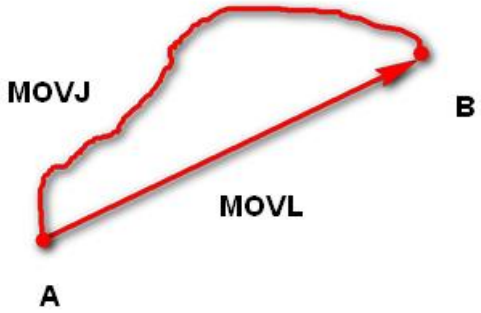

Figure 2.6 MOVL & MOVJ mode

- MOVL: Rectilinear movement. The joints perform a straight-line trajectory from point A to point B, as shown in Figure 2.6.
- JUMP: From point A to point B, the joints move in MOVJ mode, of which the trajectory looks like a door, as shown in Figure 2.7.
  1. Move up the lifting Height in MOVJ mode.
  2. Move horizontally to a point that is above B by Height.
  3. Move down to point B.

Figure 2.7 JUMP mode

2.3.3.3 ARC

The trajectory of ARC mode is an arc, which is determined by three points (the current point, any point on the arc and the end point), as shown in Figure 2.8.

⚠NOTICE

In ARC mode, it is necessary to confirm the three points combined with other motion modes, and the three points cannot be in a line.

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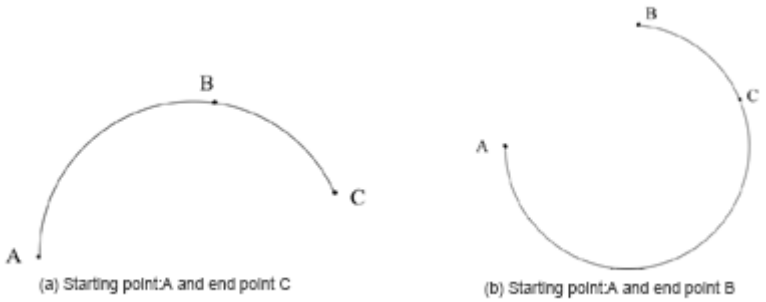

Figure 2.8 ARC mode

2.3.3.4 Application Scenarios

The application scenario depends on the trajectory in a motion mode, as shown in Table 2.1.

Table 2.1 Application scenario

Motion mode	Application scenario
MOVL	If the trajectory of playback is required as a straight line, you can select MOVL
MOVJ	If the trajectory of playback is not required but high speed is required, you can select MOVJ
JUMP	If the movement of two points is required to lift upwards by amount of height, such as sucking up, grabbing, you can select JUMP
ARC	If the trajectory of playback is required as an arc, such as dispensing, you can select ARC

2.4 Technical Specifications

2.4.1 Technical Parameters

Table 2.2 Technical parameters

Name	Dobot Magician	
Maximum payload	500g	
Maximum reach	320mm	
Motion range	Base	- 90°~+90°
	Rear Arm	0°~85°
	Forearm	- 10°~+90°
	End-effector rotation	- 90°~+90°
Maximum speed (with 250g	Rotational speed of Rear arm, Forearm and base	320°/s

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payload)	Rotational speed of servo	480°/s
Repeated positioning accuracy	0.2mm	
Power supply	100V-240V AC, 50/60Hz	
Power in	12V/7A DC	
Communication	USB, WIFI, Bluetooth	
I/O	20 extensible I/O interfaces	
Software	DobotLab	
Working temperature	-10°C~60°C	

2.4.2 Dimensions

Figure 2.9 shows the size of Dobot Magician and Figure 2.10 shows the size of the end mounting hole.

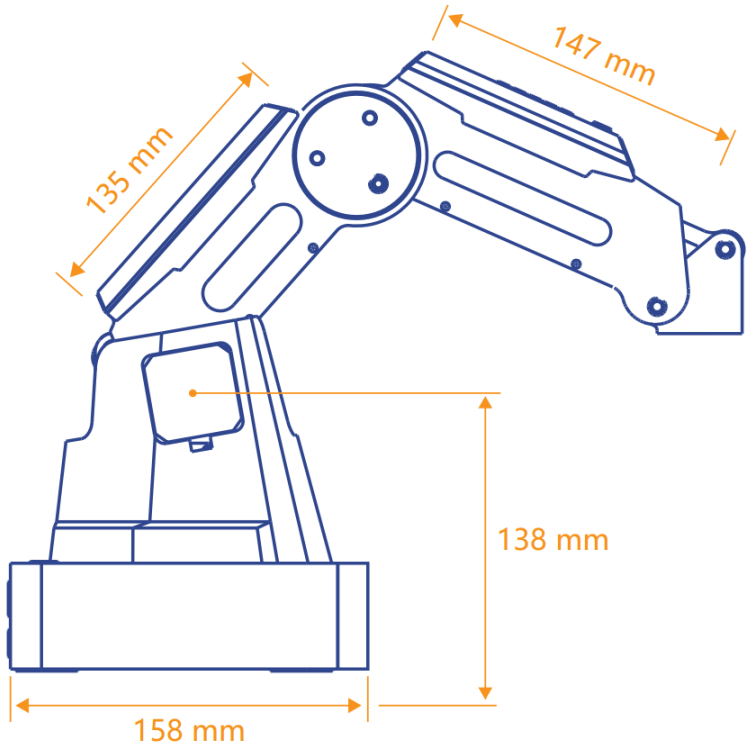

Figure 2.9 Size of Dobot Magician

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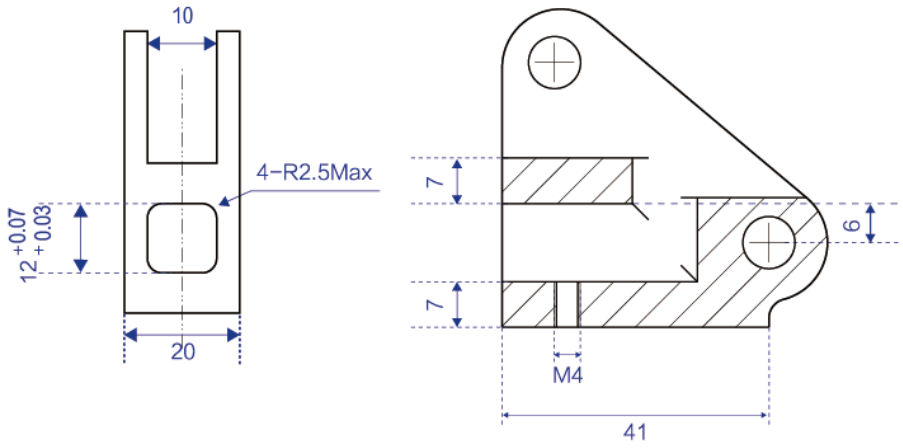

Figure 2.10 Size of end mounting hole

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3. Robot Connection

This section describes how to connect the Dobot Magician and power it on/off .

3.1 Connecting Cables to Dobot Magician

Step 1 Connect the Dobot Magician to your computer with the supplied USB cable, as shown in Figure 3.1.

Step 2 Connect the Dobot Magician to the power source with the supplied power adapter, as shown in Figure 3.1.

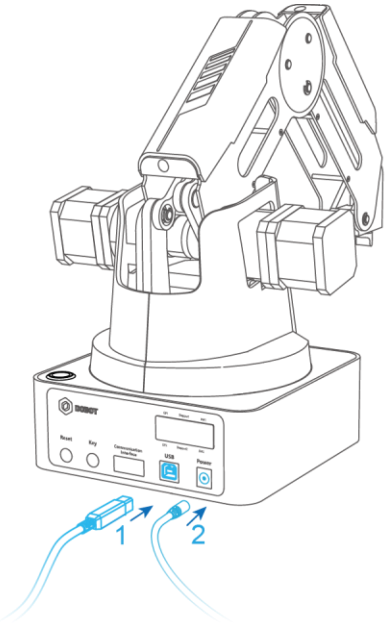

Figure 3.1 Connect the Dobot Magician to your computer

3.2 Powering on/off Dobot Magician

- **Power on:** align the Dobot Magician into its neutral position with its Forearm and Rear Arm constructing a 45-degree angle, and press down the power button in the base, as shown in Figure 3.2. Once the robotic arm is powered on, the LED indicator turns yellow, and all the stepper motors lock. And then wait about seven seconds, a short beep sound will be heard, and the LED indicator turns from yellow to green. Now the Dobot Magician is powered on.

  ⚠NOTICE

  If the LED indicator is red after the Dobot Magician is powered on, it means that the robotic arm reaches its limited position. To return to the workspace, press and hold the unlock button on the forearm to move the robotic arm to another desired position.

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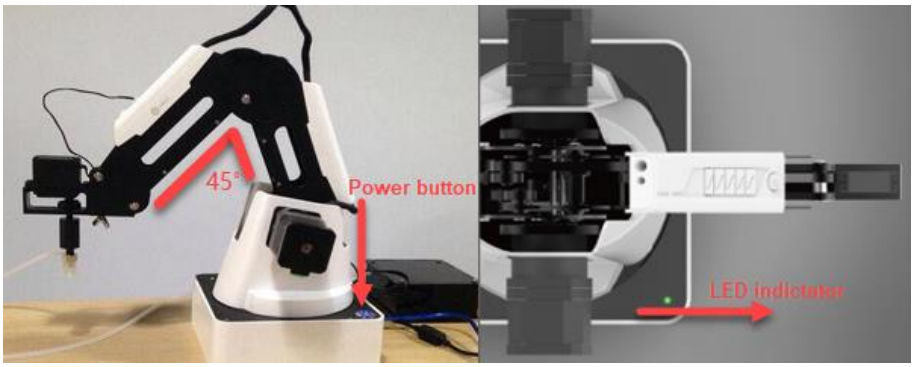

Figure 3.2 Gesture of Dobot Magician before power-on

- **Power off**: When the LED indicator is green, press down the power button to turn off the robotic arm. In this case, the forearm moves slowly to the rear arm while the angle between them becomes small. Finally, the two arms reach a specific position.

  ⚠NOTICE

  Watch your hand during the shutdown process.

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4. Interface Description

4.1 Interface Board

The interfaces of Dobot Magician are located on the back of the base and the forearm respectively. Figure 4.1 shows the interfaces on the back of the base, and Table 4.1 lists the description.

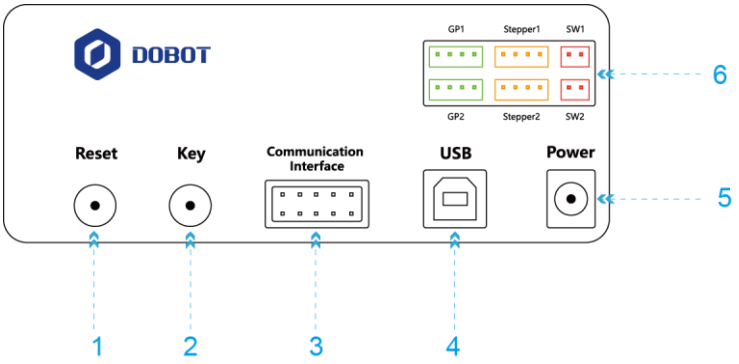

Figure 4.1 Interfaces in the base

Table 4.1 Interface Description

No.	Description
1	Reset key: Reset MCU program During resetting, the LED indicator on the base turns yellow. About 5 seconds later, if the LED indicator turns green, it indicates that the reset is successful
2	Functional key: • Short press: Start running offline program • Long press for 2 seconds: Starting homing procedure
3	Communication interface/UART interface: Connect with Bluetooth, WIFI and so on The Dobot protocol is adopted.
4	USB interface: Connect with PC
5	Power interface: Connect with power adaptor
6	Peripheral interface: Connect with air pump, extruder, sensor and other peripheral equipment. For details about peripheral interfaces, see Table 4.2

Table 4.2 lists the description on peripheral interface.

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Table 4.2 Peripheral interface description

Interface	Description
SW1	Power interface of air pump; output 12V of controllable power
SW2	Output 12V of controllable power
Stepper1	User-defined stepper interface; extruder interface (3D printing mode)
Stepper2	User-defined stepper interface
GP1	Signal interface of air pump; color sensor interface; infrared sensor interface; user-defined general interface
GP2	User-defined general interface

Figure 4.2 shows the peripheral interface on the forearm, and Table 4.3 lists the description of the peripheral interfaces.

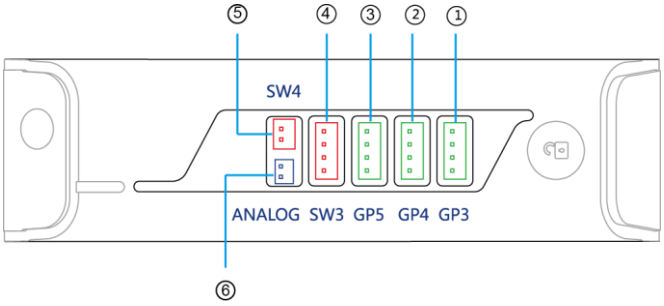

Figure 4.2 Peripheral interface in the Forearm

Table 4.3 Peripheral interface description

No.	Description
1	GP3, End-effector interface; R-axis servo interface; user-defined general interface
2	GP4, Auto levelling interface, user-defined general interface
3	GP5, Signal interface of laser engraving; user-defined general interface
4	SW3, Hot end interface (3D printing mode); Output 12V of controllable power
5	SW4, Fan interface (3D printing mode); Power interface of laser engraving; Output 12V of controllable power
6	ANALOG, Thermistor interface (3D printing mode)

4.2 LED Indicator

The LED indicator is located on the base, Table 4.4 lists the description on its status.

Table 4.4 LED indicator description

Status	Description
Green On	Dobot Magician works normally
Yellow On	Dobot Magician is in the starting status
Blue On	Dobot Magician is in the offline mode
Blue Blinking	Dobot Magician is running homing procedure or auto levelling
Red On	• Dobot Magician is at the limited position • Alarm is not cleared • Connection of 3D printing kit is abnormal

4.3 Multiplexed I/O Interface

The addresses of the I/O interfaces in Dobot Magician are unified. Most of I/O interfaces have multiple functions. You can obtain the level output and input through I/O interfaces to control the peripheral equipment.

4.3.1 Multiplexed Base I/O Interface

4.3.1.1 Multiplexed UART Interface

Figure 4.3 shows the UART interface on the base, Table 4.5 lists the description on multiplexed I/O interfaces.

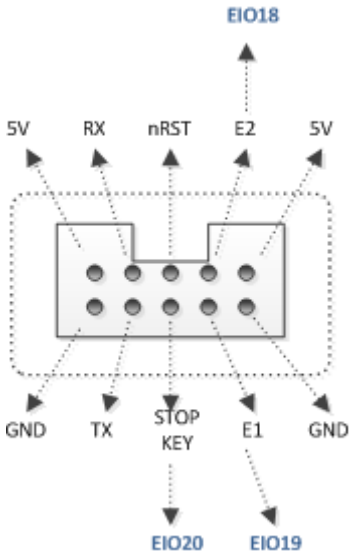

Figure 4.3 UART interface

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Table 4.5 Multiplex I/O Description

Pin	Description	Level output	PWM	Level input	ADC	Whether pull up or pull down
5V	-	5V/1A output	-	-	-	-
GND	Ground	-	-	-	-	-
E2 (EIO18)	-	3.3V_20mA output	-	-	-	No pulling
E1 (EIO19)	-	-	-	3.3V/5V_20mA input	-	Pull up 1M to 3.3V
nRST	Hardware reset	-	-	3.3V_20mA input	-	Pull up 1M to 3.3V
STOP KEY (EIO20)	-	-	-	3.3V/5V_20mA input	-	Pull up 10K to 3.3V
RX	UART receive	-	-	3.3V/5V_20mA input	-	Pull up 1M to 3.3V
TX	UART send	3.3V/5V_20mA output	-		-	No pulling
5V	-	5V/1A output	-	-	-	-
GND	Ground	-	-	-	-	-

4.3.1.2 Multiplexed Peripheral Interface Description

Figure 4.4 shows the peripheral interface on the base, and Table 4.6 lists the multiplexed I/O description.

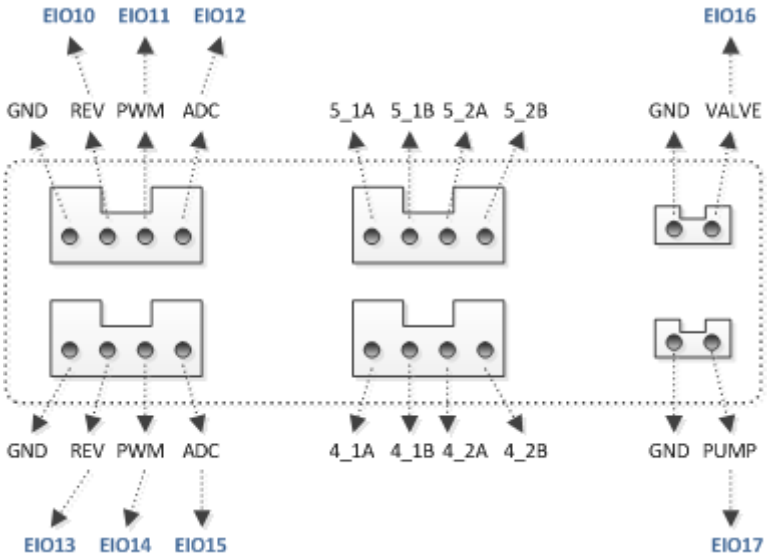

Figure 4.4 Peripheral Interface

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Table 4.6 Multiplexed I/O Description

Interface	Pin	Description	Level output	PWM	Level input	ADC	Whether pull up or pull down
SW1	VALVE (EIO16)	-	12V/1A output	-	-	-	-
	GND	Ground	-	-	-	-	-
SW2	PUMP (EIO17)	-	12V/1A output	-	-	-	-
	GND	Ground	-	-	-	-	-
Stepper1	5_1A		Default phase voltage and current: 12V/0.9A output	-	-	-	-
	5_1B			-	-	-	-
	5_2A			-	-	-	-
	5_2B			-	-	-	-
Stepper2	4_1A			-	-	-	-
	4_1B			-	-	-	-
	4_2A			-	-	-	-
	4_2B			-	-	-	-
GP1	ADC (EIO12)	-	-	-	3.3V/5V_ 20mA input		Pull up 1M to 3.3V
	PWM (EIO11)	-	3.3V_20mA output	√	-	-	No pulling
	REV (EIO10)	-	5V/1A output	-	-	-	-
	GND	Ground	-	-	-	-	-
GP2	ADC (EIO15)	-	3.3V_20mA output	-	3.3V/5V_ 20mA input	√ Notice: The maximum input voltage is 5V in ADC mode.	Pull down 1M to GND
	PWM (EIO14)	-	3.3V_20mA output	√	3.3V/5V_ 10mA	-	Pull up 1M to 3.3V

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					input		
	REV (EIO13)	-	5V/1A output	-	-	-	-
	GND	Ground	-	-	-	-	-

4.3.2 Multiplexed Forearm I/O Interface Description

Figure 4.5 shows the peripheral interface on the forearm, Table 4.7 lists the multiplexed I/O description.

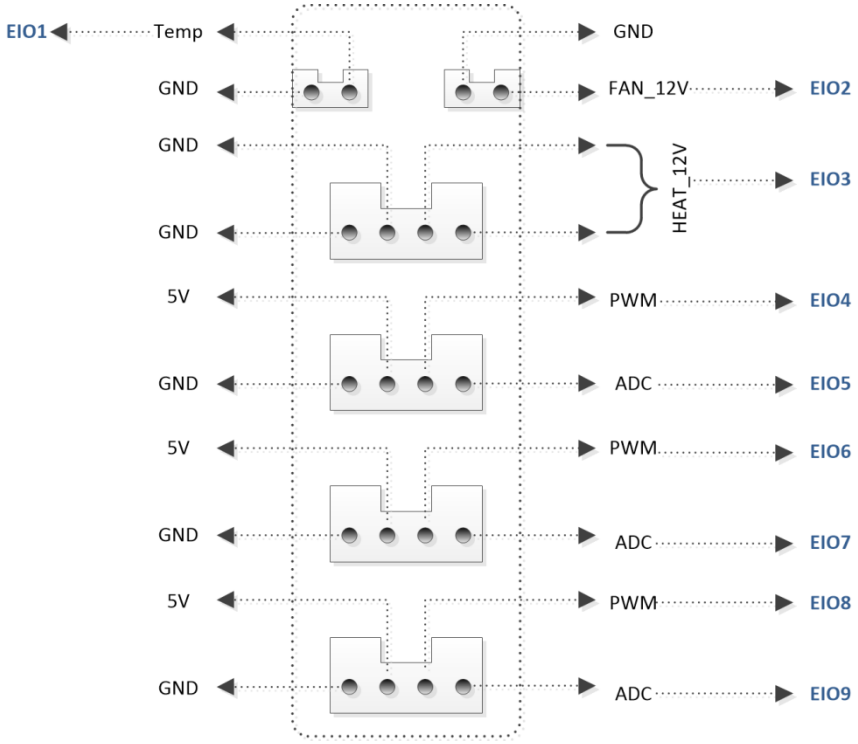

Figure 4.5 Peripheral interface in the Forearm

Table 4.7 Multiplexed I/O description

Interface	Pin	Description	Level output	PWM	Level input	ADC	Whether pull up or pull down
ANALOG	Temp (EIO1)	-	-	-	-	-	Pull up 4.7K to 3.3V
	GND	Ground	-	-	-	-	-
SW4	FAN_12V (EIO2)	Fan power	12V/1A output	-	-	-	-
	GND	Ground	-	-	-	-	-

SW3	HEAT_12V (EIO3)	Heating-wire power	12V/3A output	-	-	-	-
	GND	Ground	-	-	-	-	-
	GND	Ground	-	-	-	-	-
GP5	ADC (EIO5)	-	-	-	3.3V/5V_20mA input		Pull up 1M to 3.3V
	PWM (EIO4)	-	3.3V_20mA output	√			No pulling
	5V	-	5V/1A output	-	-	-	-
	GND	Ground	-	-	-		-
GP4	ADC (EIO7)	-	-	-	3.3V/5V_20mA input		Pull up 1M to 3.3V
	PWM (EIO6)	-	3.3V_20mA output	√	-	-	No pulling
	5V	-	5V/1A output	-	-	-	-
	GND	Ground	-	-	-	-	-
GP3	ADC (EIO9)	-	-	-	3.3V/5V_20mA input	√ Notice: The maximum input voltage is 5V in ADC mode.	Pull down 1M to GND
	PWM (EIO8)	-	3.3V_20mA output	√	-	-	No pulling
	5V	-	5V/1A output	-	-	-	-
	GND	Ground	-	-	-	-	-

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4.3.3 Internal I/O Circuit

Pull up 1M to 3.3V

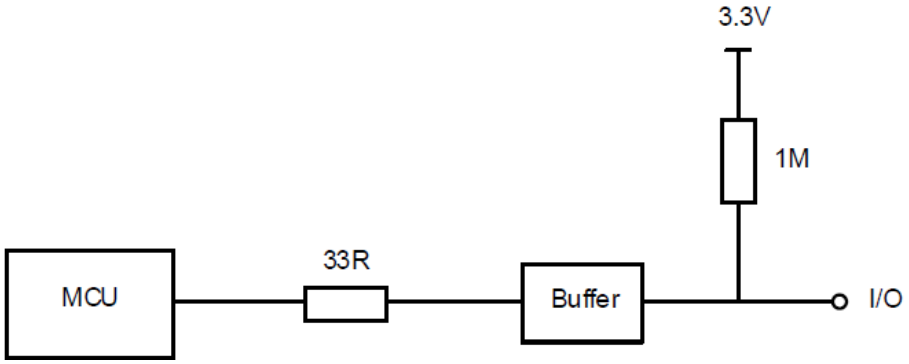

Figure 4.6 Pull up 1M to 3.3V

3.3V Pull up 10K to 3.3V

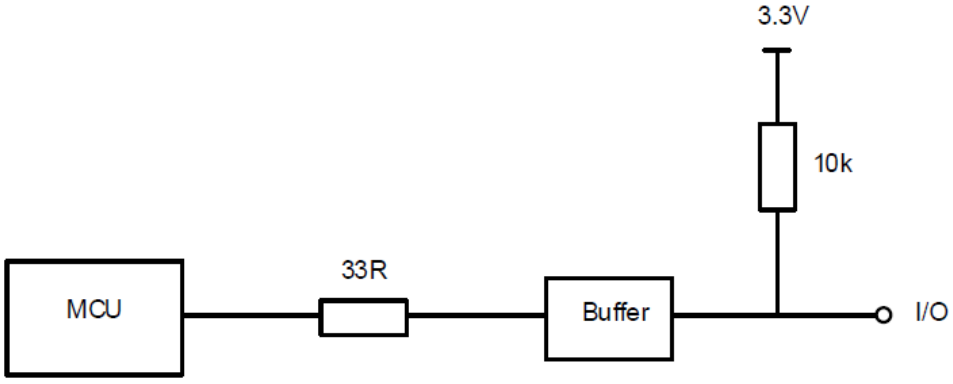

Figure 4.7 Pull up 10K to 3.3V

Pull down 1M to ground

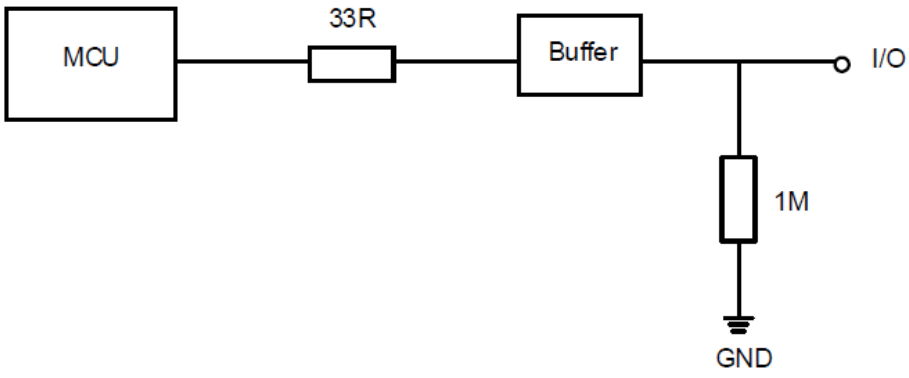

Figure 4.8 Pull down 1M to ground

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No pulling

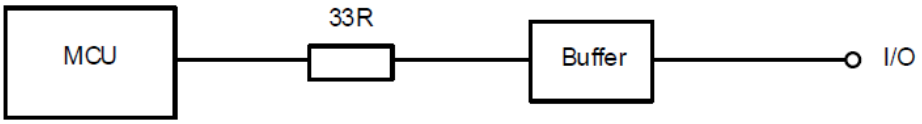

Figure 4.9 No pulling

4.3.4 Example of External Device Connection

This section takes air-pump connection as an example to illustrate the external device connection. The red box in Figure 4.10 shows the external drive circuit.

- 12(I/O) is the output voltage of the I/O interface, OUTx is the output of the I/O interface (assuming that OUT1), GND is the ground of the I/O interface. Please select the proper outputs based on site requirements.
- 12V(External) is the external voltage, GND(External) is the ground corresponding to the external voltage.

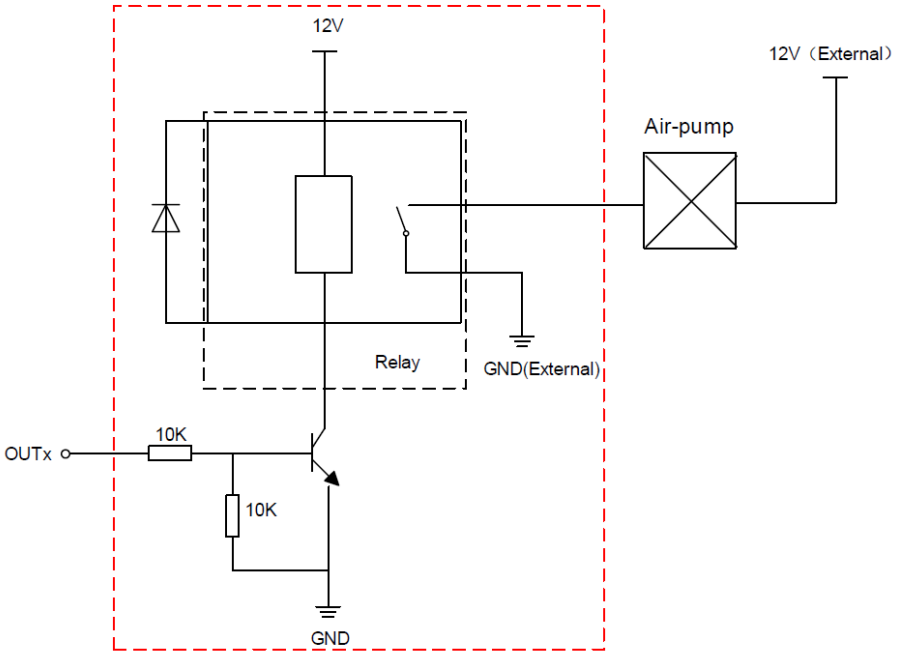

Figure 4.10 Example of external device connection

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5. Operation

5.1 Introduction on DobotLab

Dobot Magician has multiple functions including teaching and playback, writing and drawing, blockly programming, script control, etc., which can be realized through DobotLab, an integrated software platform specially designed for artificial intelligence (AI) education. You can enter DobotLab through https://dobotlab.dobot.cc/.

The main interface of DobotLab is shown in Figure 5.1, and its specific modules are described in Table 5.1.

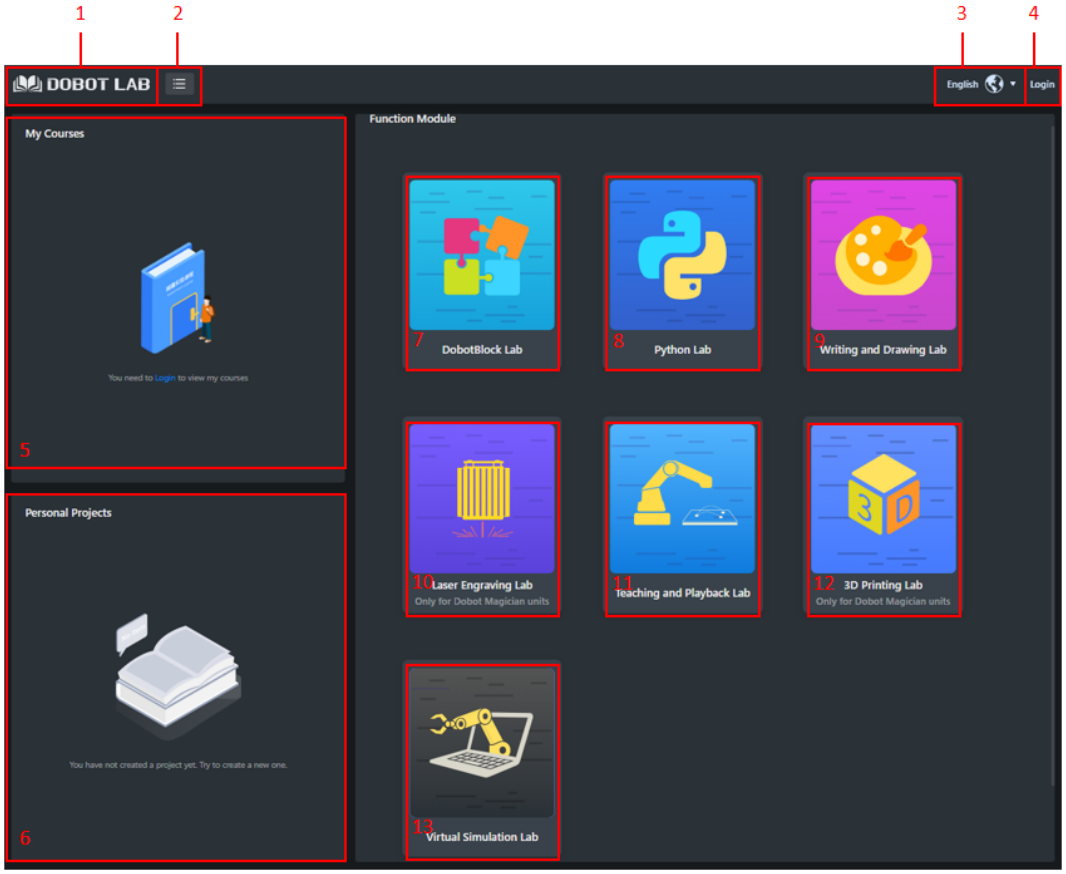

Figure 5.1 DobotLab main page

Table 5.1 Description on DobotLab main page

No.	Modules	Description
1	Main page	Click to return DobotLab main page
2	Menu	Currency: View the guidance for using DobotLab Help: View and download documents related to DobotLab Feedback: Enter your feedback about DobotLab experience About: View the basic information of DobotLab
3	Language	Select a language

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No.	Modules	Description
4	Login	Log in with your account
5	My Course	Provide free online courses
6	Personal Works	View and edit the saved project
7	DobotBlock Lab	Control the Dobot Magician through blockly programming
8	Python Lab	Control the Dobot Magician through script programming
9	Writing and Drawing Lab	Control the Dobot Magician to write and draw
10	Laser Engraving Lab	Control the Dobot Magician to engrave a bitmap image using a laser
11	Teaching and Playback Lab	Teach the Dobot Magician how to move and then record the movement to make Dobot Magician accomplish the recorded movements
12	3D Printing Lab	Control the Dobot Magician for 3D printing
13	Virtual Simulation Lab	Simulate robot movements through programming, combined with a virtual scene and robot model

5.2 DobotLink Installation

As DobotLink is the driver software of DobotLab hardware devices, you need to install and run DobotLink before using the hardware devices. When DobotLab is started, if DobotLink is not installed or started, the “DobotLink is not started” window will be displayed, as shown below.

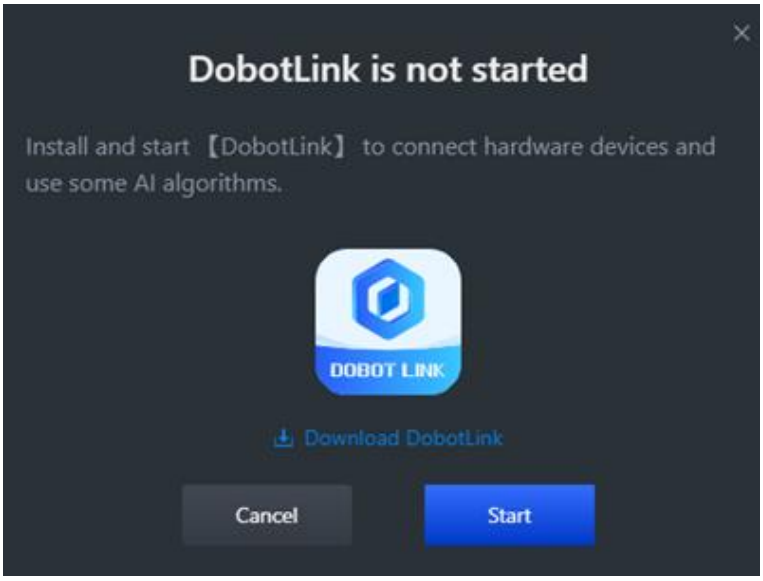


Figure 5.2 Start DobotLink

If you do not download DobotLink, click Download DobotLink, and install it as prompted.

If you have downloaded DobotLink, click Start. Now you will see two pop-up windows:

"DobotLink is starting" and "Open DobotLink?", as shown below.

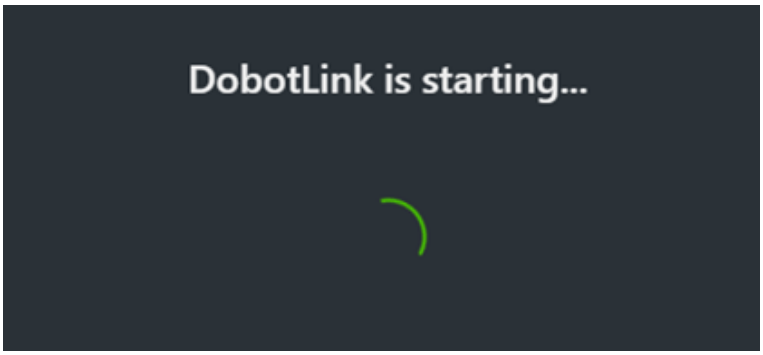


Figure 5.3 DobotLink is starting

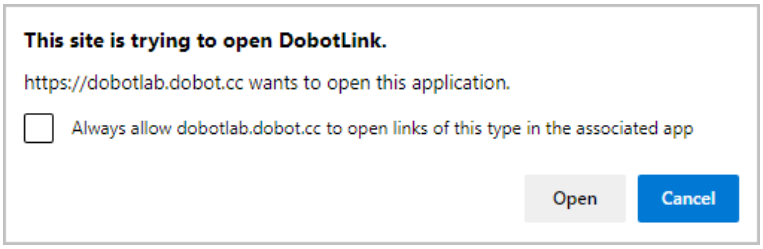


Figure 5.4 Open DobotLink

You need to click **Open DobotLink**. Now "DobotLink started successfully" is displayed.

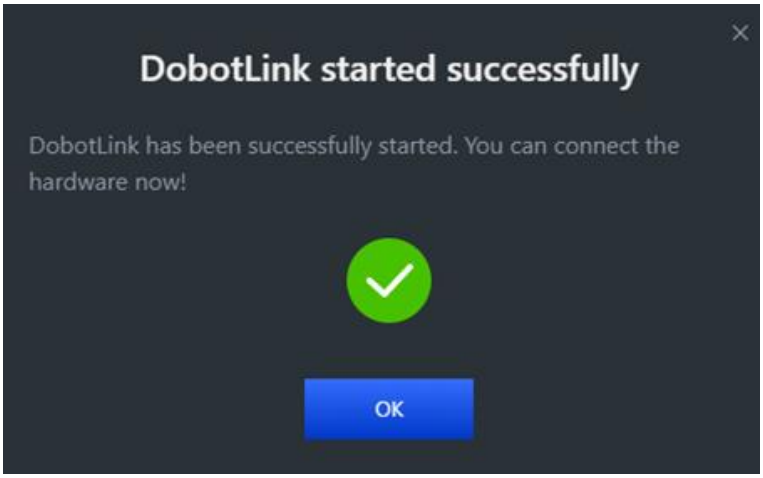


Figure 5.5 DobotLink started successfully

5.3 Blockly

DobotBlock Lab is specially designed for beginners in programming. You can program by dragging blocks to control the movement of Dobot Magician.

Prerequisites

Dobot Magician has been powered on, and connected to DobotLab.

Procedure

Step 1 Click in the main page of DobotLab to enter DobotBlock Lab.

Step 2 Click . Select Magician on "Choose a Device" page, as shown below.

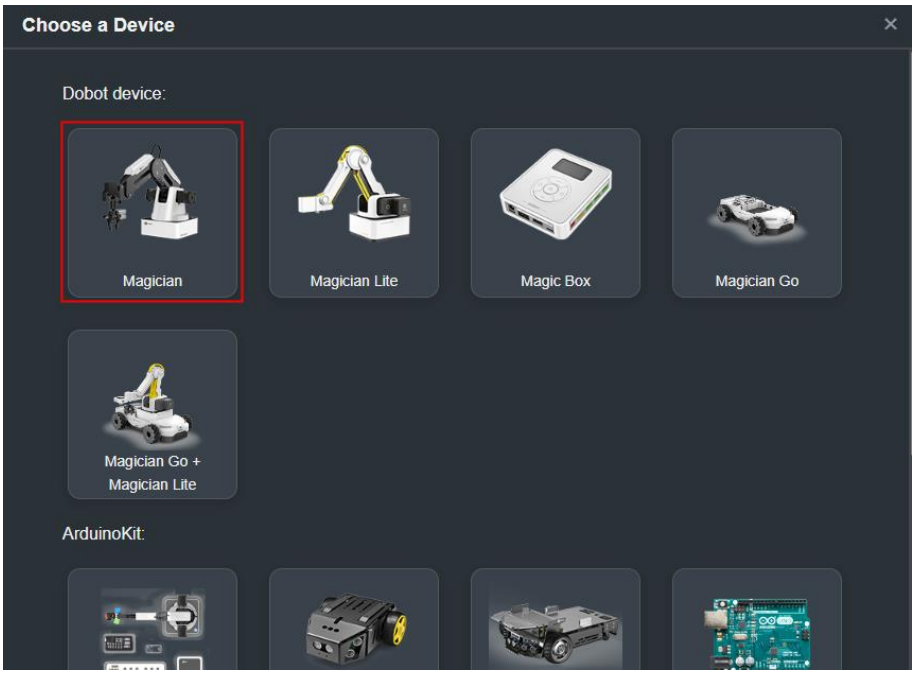
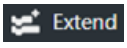


Figure 5.6 Choose device

Step 3 (optional) Click  on the left-bottom corner of block area to enter "Choose an Extension" page, as shown below. Select corresponding extensions according to your needs, and click **Add extension** for direct calling when you program.

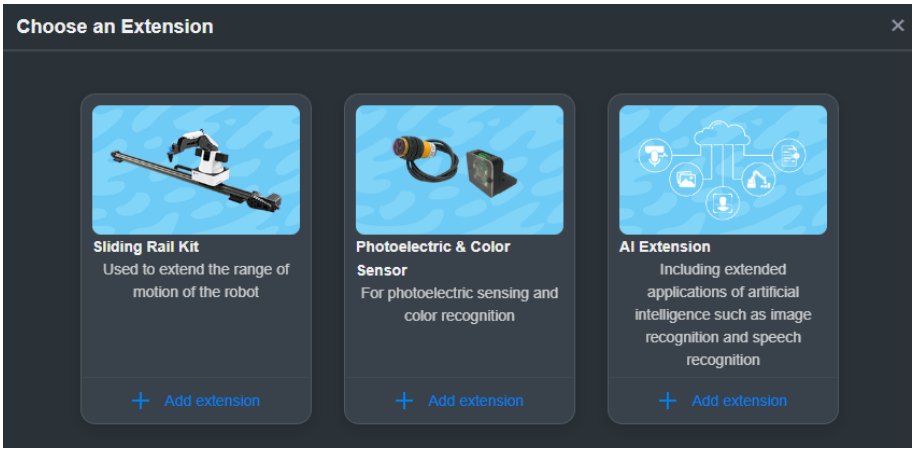


Figure 5.7 Add an extension

Step 4 Click in **Magician** tab.

Step 5 Click **Connect**, as shown below.

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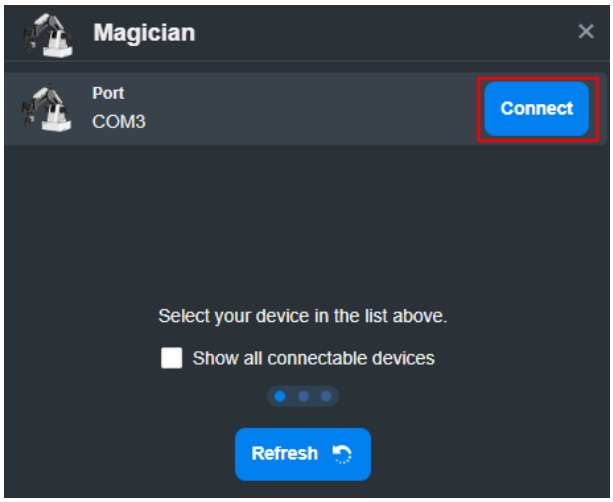

Figure 5.8 Connect device

You will see the page below if Magician and DobotLab are connected successfully.

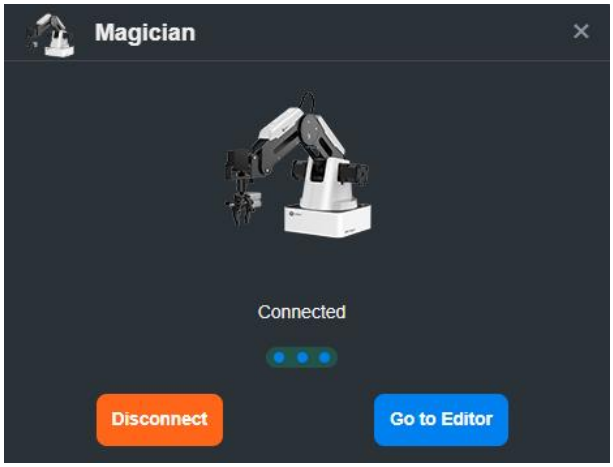

Figure 5.9 Device connected

Step 6 After connecting Magician and DobotLab, you can program in the code area.

- Set parameters corresponding to each block based on actual requirements.
- The program written with blocks requires triggering conditions to run. Therefore, you need to select a command from the event block as the triggering condition. For example,

means the program starts to run once you click .

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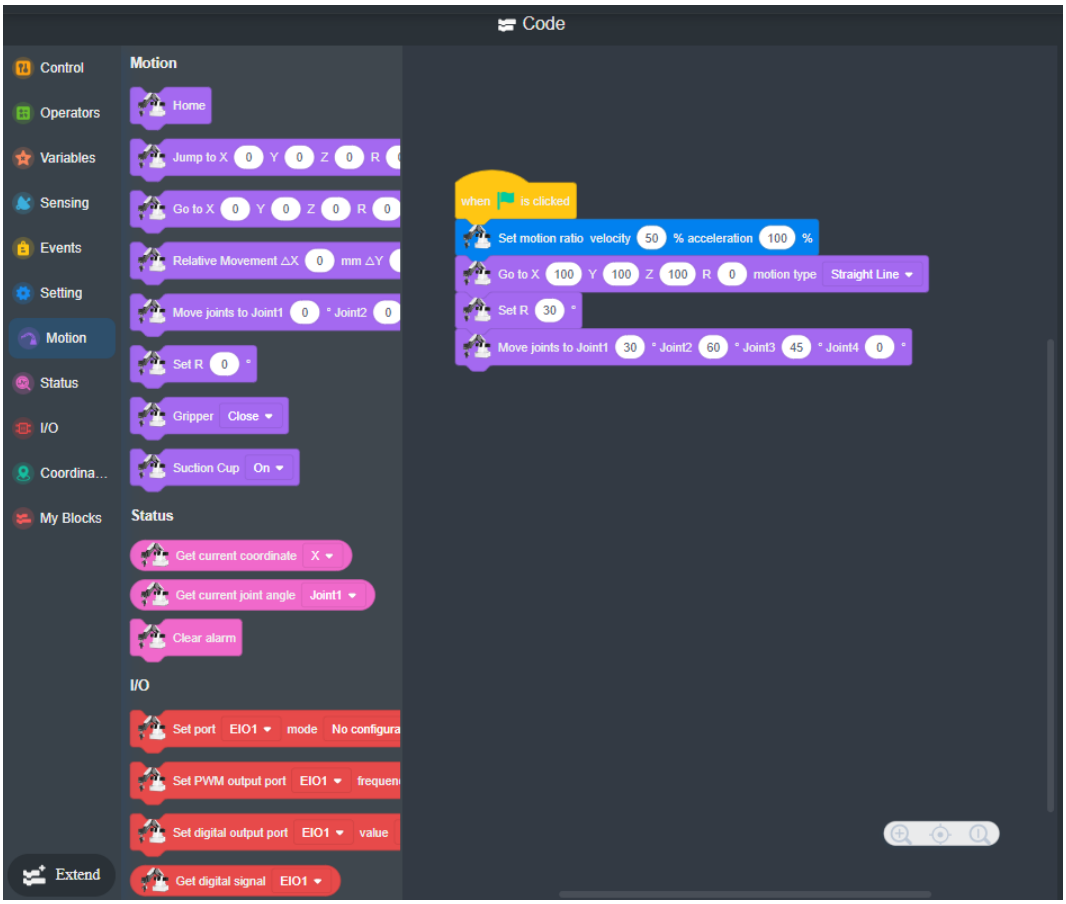

Figure 5.10 Blockly programming

If you need to set sprites and stages in the program, follow Step 7~ Step 10.

Step 7 Click under **Sprite** tab. The sprites that DobotBlock Lab supports are shown as follows.

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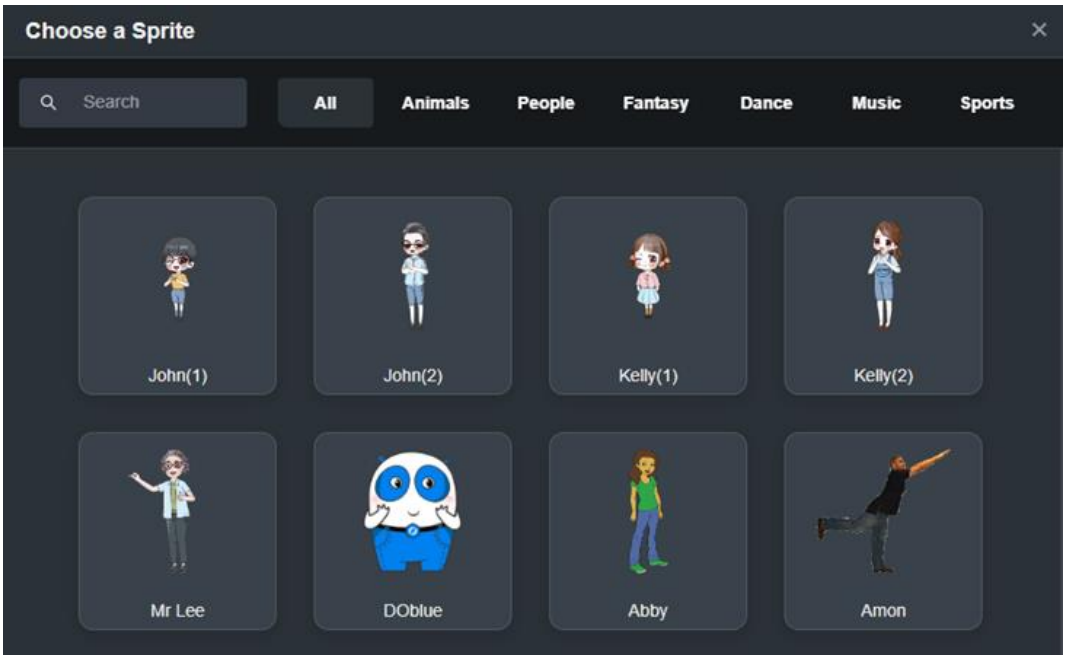

Figure 5.11 Sprite list

Step 8 After selecting a sprite, click Extend if you need to add extension blocks. Click corresponding extension kits to add programming blocks into the block area.

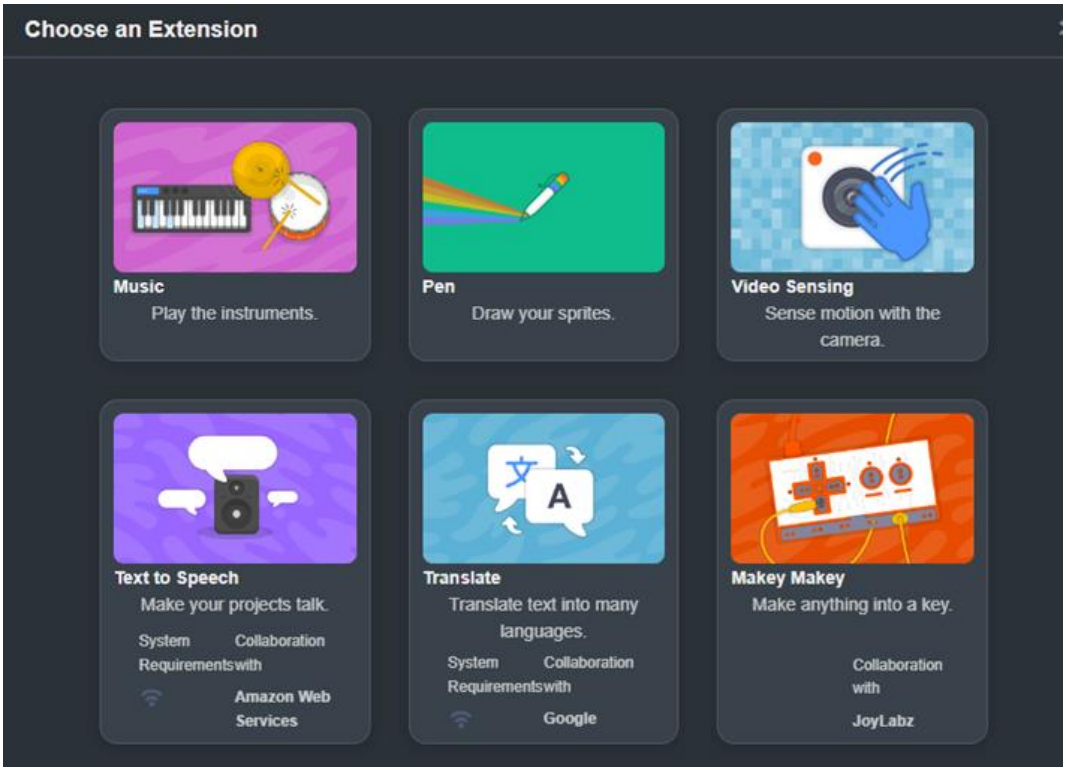

Figure 5.12 Sprite extension kit

Step 9 Click . Select a backdrop, as shown below. You can also upload or draw a

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backdrop.

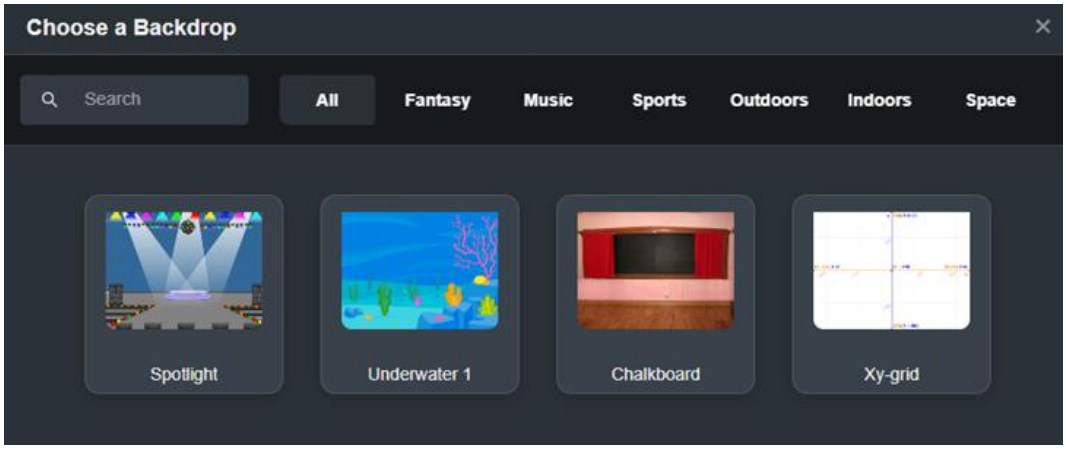

Figure 5.13 Choose stage

Step 10 Drag the blocks to code area to control the sprite and stage.

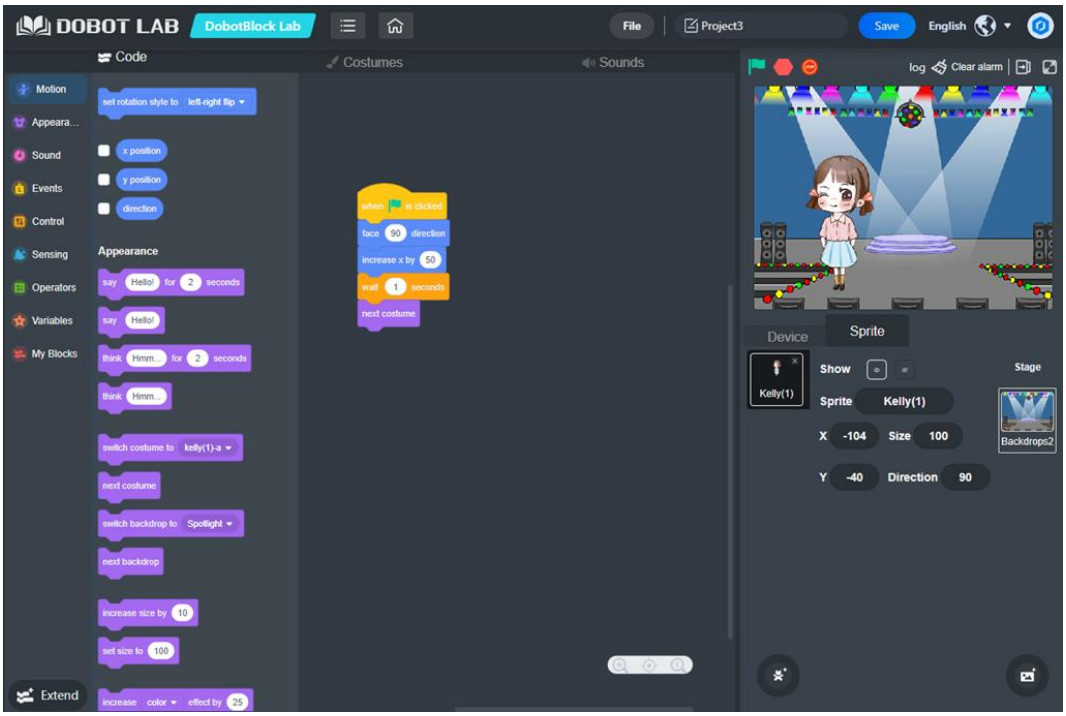

Figure 5.14 Sprite programming

5.4 Python Programming

You can control Dobot Magician through script. Dobot Magician supports various APIs, such as velocity/acceleration setting, motion mode setting, and I/O configuration, which uses Python language for secondary development. For details about the Dotot Magician API interface and their functions, see *Dobot Magician API Description*.

Download path:

https://en.dobot.cn/service/download-center?keyword=&products%5B%5D=316.

The main interface of Python Lab is shown in Figure 5.15, and described in Table 5.2.

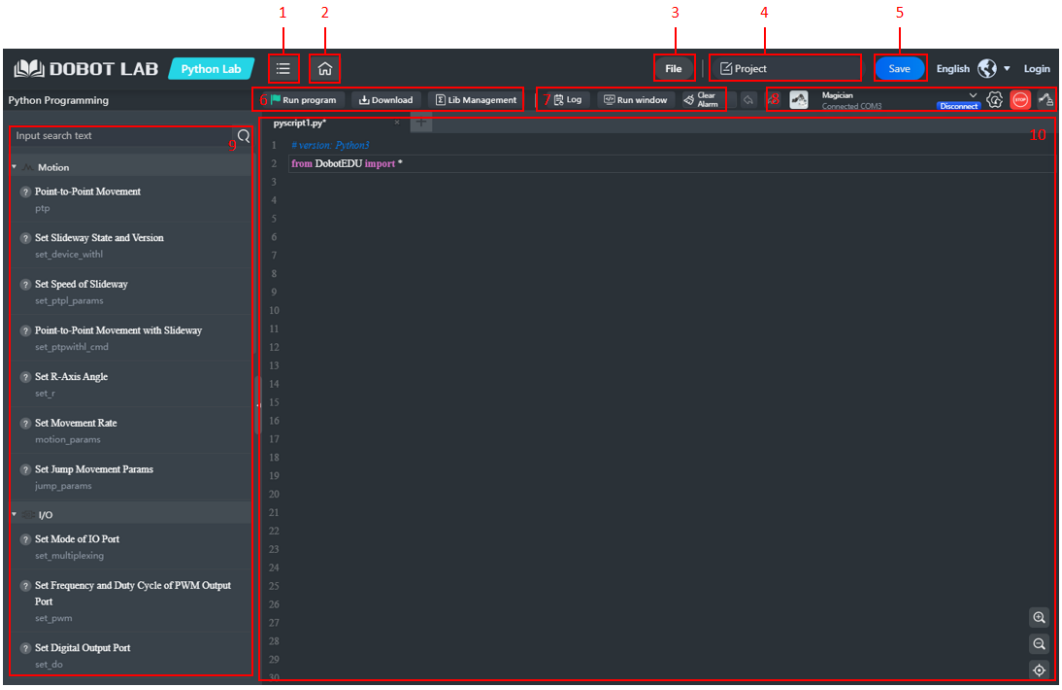

Figure 5.15 Python main page

Table 5.2 Python Lab main interface

No.	Function	Description
1	Menu	Currency: View the guidance for Python Lab Help: View and download documents related to DobotLab Feedback: Enter your feedback about DobotLab experience About: View the basic information of DobotLab
2	Home	Back to the main page
3	File	• It includes functions such as new, open, save as, upload from local, etc. • **Import** and **Upload from Local** can be used to open script files in Python Lab, but for **Import**, the file should be in .py format, and for **Upload from Local**, the file should be in .json format. The format requirements for **Export** and **Save to Local** are the same as **Import** and **Upload from Local** respectively.
4	Project name	Display the name of the current project
5	Save	Save the current project to My Works
6	Program control	Running program: Start to run the program in the code area, and

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		will appear on the screen : Download the current program in the code area to the device : Install the Python extension library, after which you can call the library functions in the extension library
7	Running information	Log: Display alarm information. You can click **Clear Alarms** or click to clear alarms Run window: Display running process
8	Device control	: Select a target device and establish a communication connection with the device : Press to stop running in emergencies : Control Dobot Magician
9	Command list	Provide programming commands. Double click the commands to display their corresponding codes in the code area
10	Code area	Edit programs using Python

Prerequisites

Dobot Magician has been powered on and connected to DobotLab.

Procedure

Step 1 Click on DobotLab main page to enter Python Lab.

Step 2 Click the drop-down list of device connection panel, as shown below. Select **Magician** and click **Connect**.

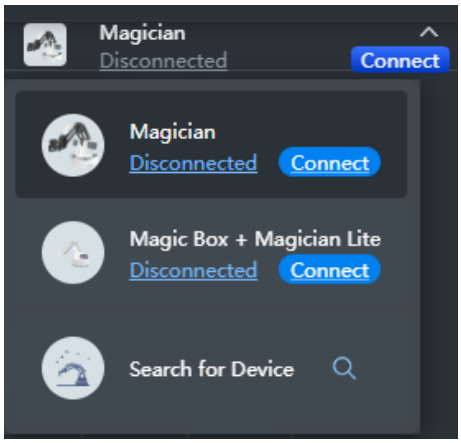

Figure 5.16 Connect device

Now the Magician is connected to DobotLab successfully.

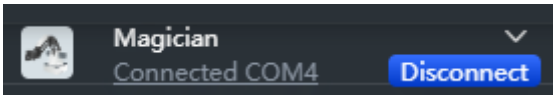

Figure 5.17 Device connected

Step 3 After connecting Magician Lite to DobotLab, you can start to write programs. Enter the script in the code area, or double-click commands in the command list, and modify the parameters according to your actual use.

Step 4 Click Running program to run the current program.

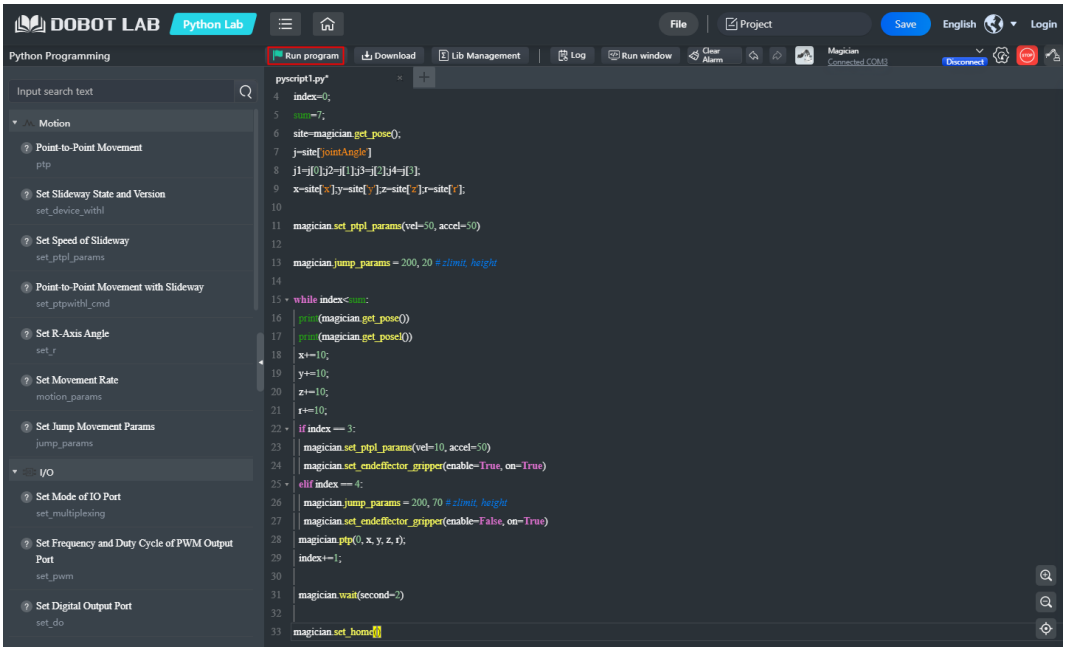

Figure 5.18 Run program

Step 5 Click Save. Enter the project name and save the project to My Works.

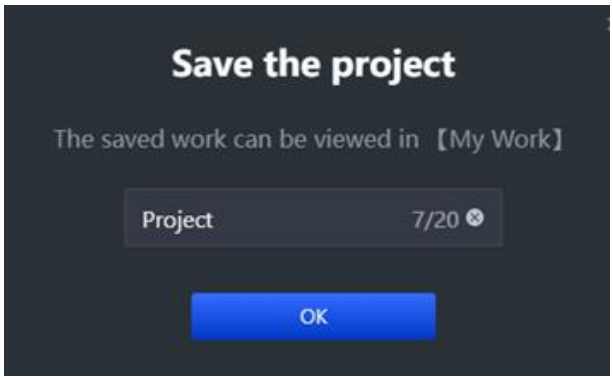

Figure 5.19 Save the project

Step 6 (optional) Click Download to download the script to Magician.

NOTE

The script can be downloaded from DobotLab to Magician only in wired control mode.

5.5 Writing and Drawing

Figure 5.20 shows the process of writing and drawing.

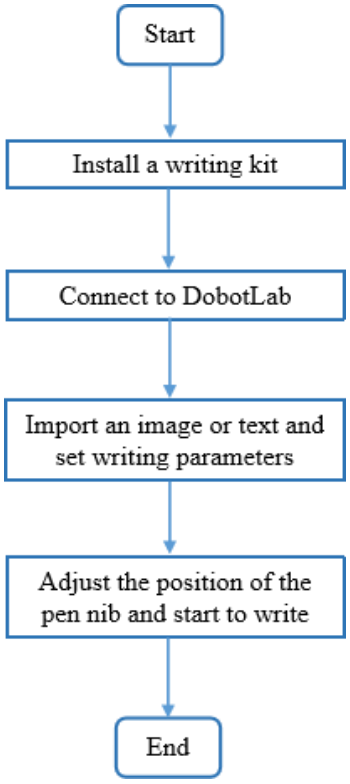

Figure 5.20 The process of writing and draw

5.5.1 Installing a Writing and Drawing Kit

A writing and drawing kit consists of a pen and a pen holder. The specific installation steps are shown below.

Step 1 Place a pen in the pen holder.

Step 2 Fasten the writing and drawing kit to the end of Dobot Magician with a clamp fixing screw, as shown in Figure 5.21.

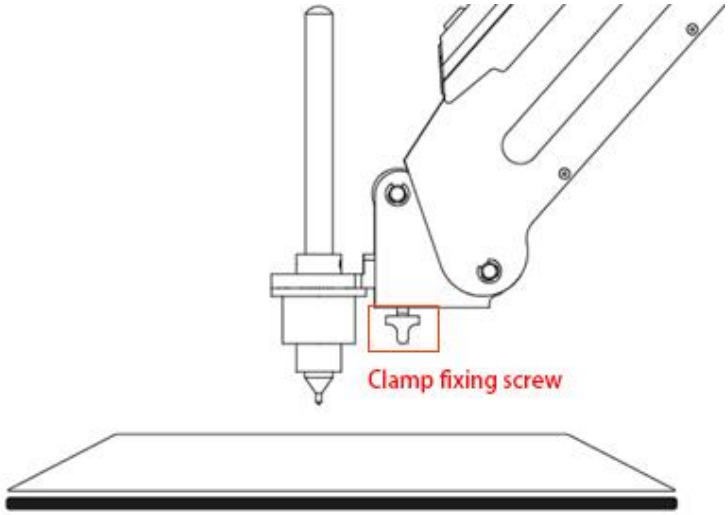

Figure 5.21 Install a writing and drawing kit

NOTE

To change a new pen, unfasten the four M3*5 set screws in the pen holder with a 1.5mm hexagon wrench, as shown in Figure 5.22.

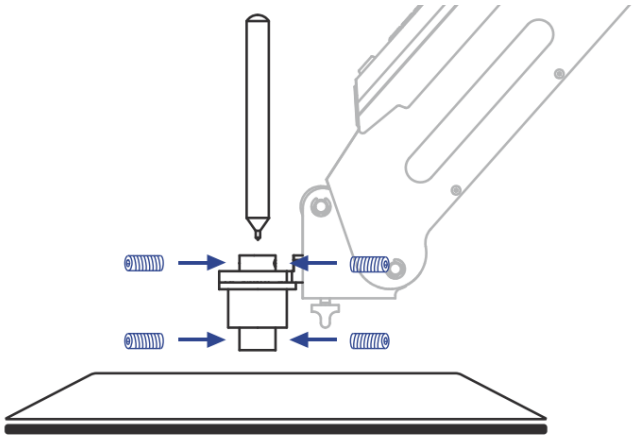

Figure 5.22 Change to a new pen

Step 3 Place a sheet of paper on the work surface within the workspace of the Dobot Magician.

5.5.2 Drawing Operations (Without Sliding Rail)

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5.5.2.1 Connecting DobotLab

Step 1 Click on DobotLab main page to enter Writing and Drawing Lab.

Step 2 Click the drop-down list of device connection panel, as shown below. Select **Magician** and click **Connect.**

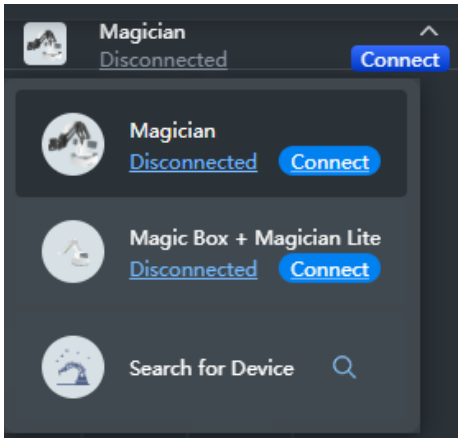

Figure 5.23 Connect device

Now Magician is connected to DobotLab successfully.

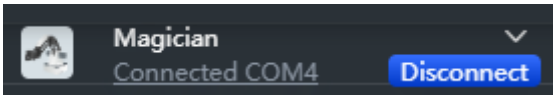

Figure 5.24 Device connected

5.5.2.2 Importing Image Files and Setting Writing Parameters

Before the Magician starts to write and draw, you need to import an image or enter characters as the target model.

Step 1 Enter the text in the rectangle box (such as 10), and click Add. Now the graphic appears in the drawing area.

Figure 5.25 Add text

If you need to insert an image, click Open to select an image from local. If the image format is not SVG, the “SVG Format Conversion” prompt box will pop up. In this case, select the conversion scale and click **OK**.

Step 2 Drag the graphic to an appropriate area. You can set the position, size, rotation angle or flip mode of the graphic through the image settings in the upper left corner.

📖NOTE

The image in the drawing area should be placed within the annular area. If not, the robot arm reaches its limited position and cannot draw or write. In this case, the image is highlighted with a red border, as shown below.

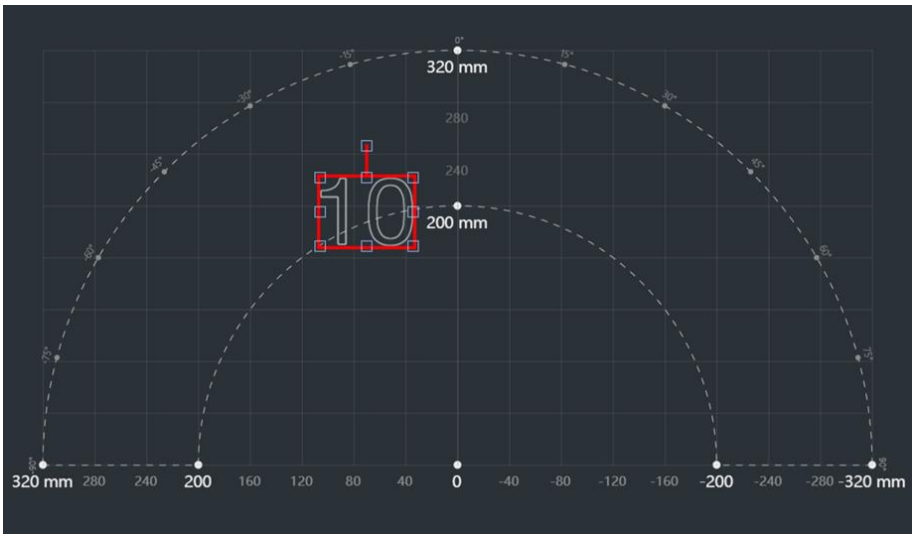

Figure 5.26 Image beyond bound

Step 3 Click Settings to set the pen lifting height, descent height and speed.

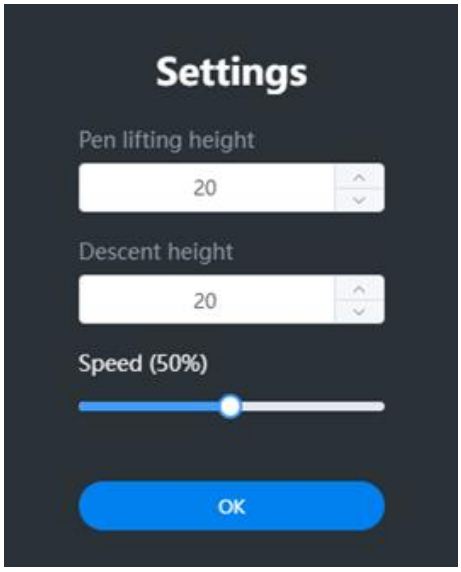

Figure 5.27 Set pen lifting height, descent height and speed

NOTE

Generally, you can set the pen lifting height and descent height to 20 by default.

Step 4 Press and hold the **Unlock** button on the forearm to move Magician to lower the pen nib until it slightly squeezes the paper. You can also jog Magician in Arm Control Panel to slowly pull the Z coordinates down to a suitable position for writing. Click Auto Z to obtain and save the current value of Z axis.

Step 5 Click Synchronize to move the nib over the starting point of drawing.

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NOTE

If you do not click **Synchronize** before running, the image can also be drawn normally. After you click **Running program**, the robot arm moves directly over the starting point to draw.

5.5.2.3 Drawing

Step 1 Click Running program, and Magician starts to draw the image. Now the cursor shows the position of the nib in real time. The running progress is displayed below the drawing area. You can click Pause to pause or click Stop to stop drawing.

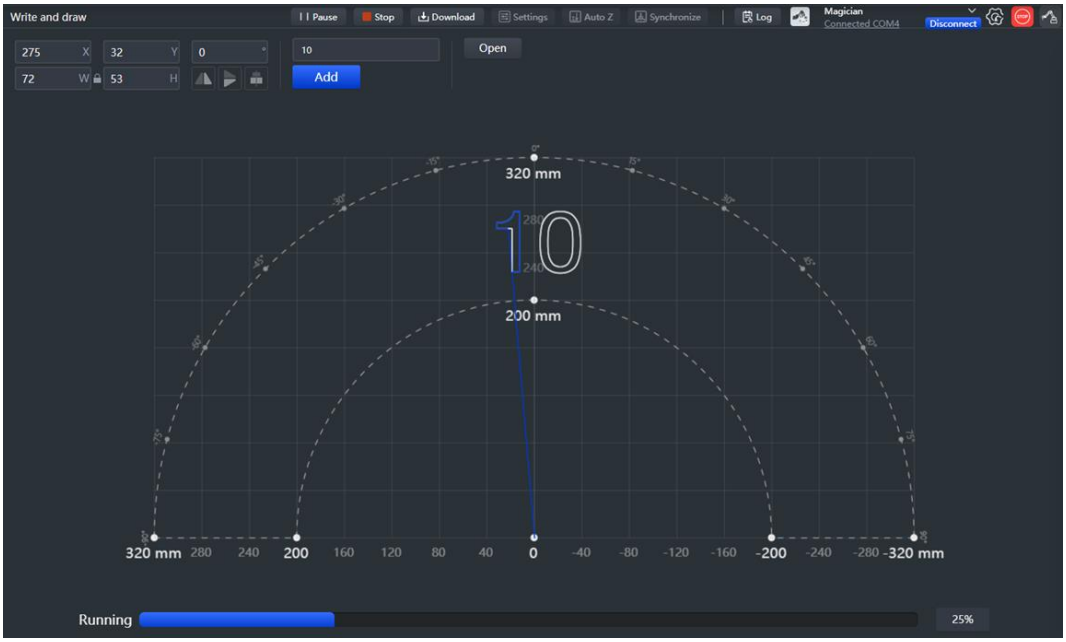

Figure 5.28 Drawing progress

Step 2 (optional) Click Save. Enter the project name and save the project to My Works.

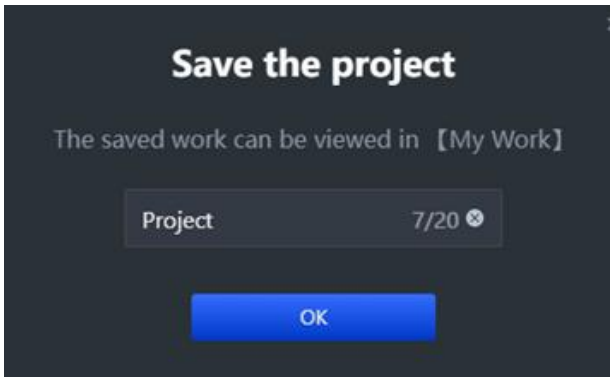

Figure 5.29 Save the project

Step 3 (optional): Click Download to download the file to the device.

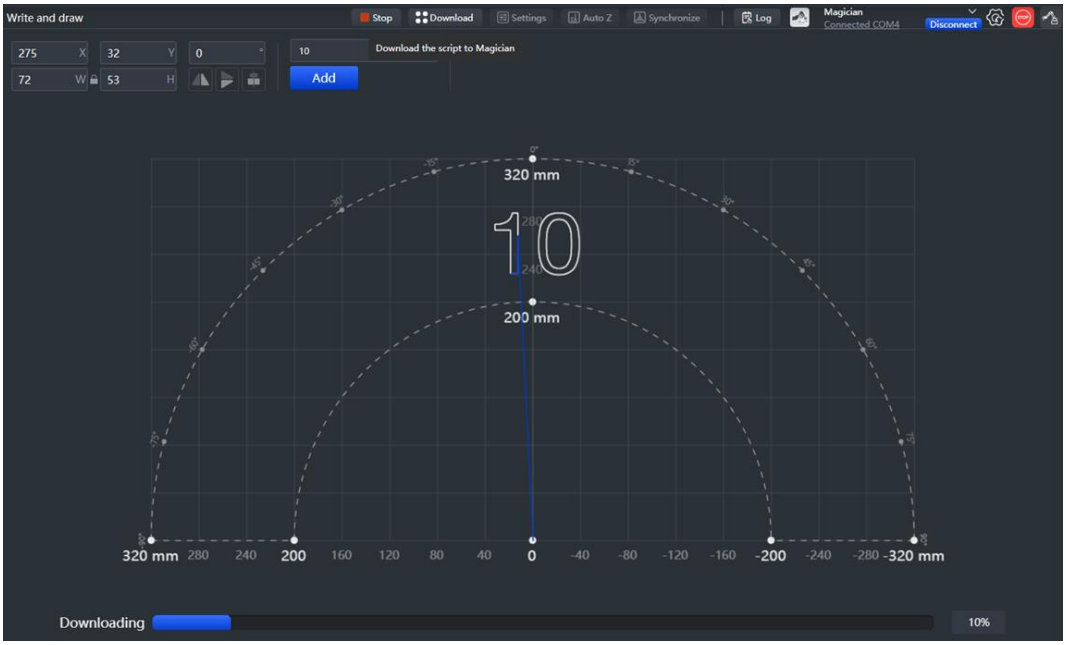

Figure 5.30 Download the file

5.5.3 Installing a Sliding Rail Kit

When the workspace of Dobot Magician is not enough, you can extend the space with a sliding kit, so as to realize such tasks as long-distance picking, writing couplets and so on.

Procedure

Step 1 Mount Dobot Magician on the plate a with four M3*10 countersunk head cap screws Make The counter bore of plate a outward), as shown in Figure 5.31.

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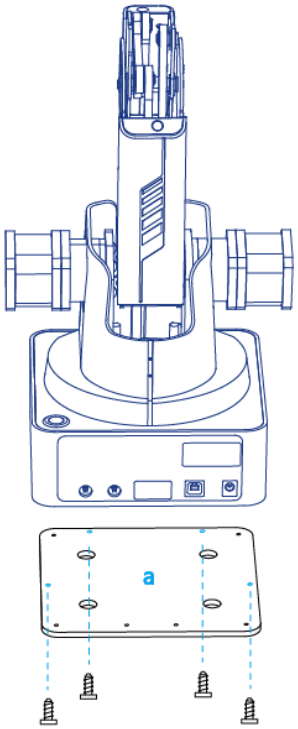

Figure 5.31 Fix plate a

Step 2 Fix the plate a (with Dobot Magician) on the plate b with three M3*8 hexagon socket head cap screws. Please make the back of the base of Dobot Magician towards the rabbet on the plate b, as shown in Figure 5.32.

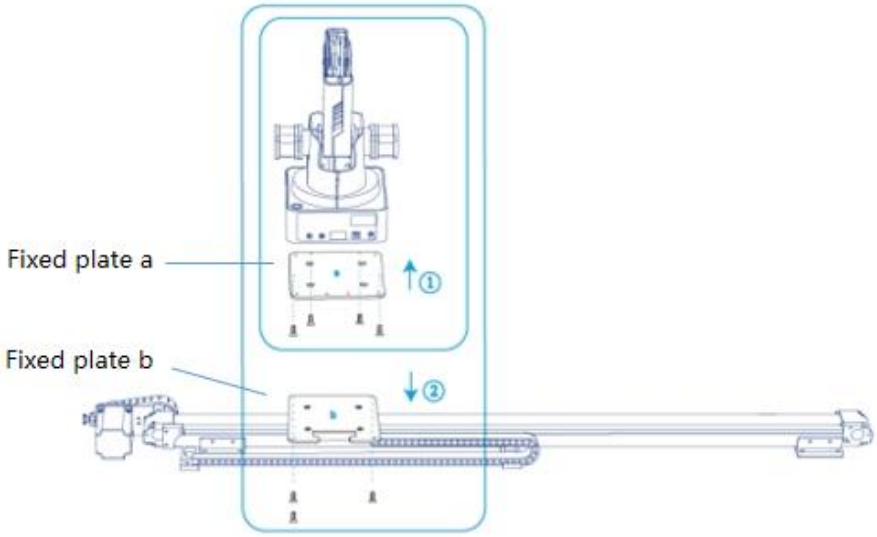

Figure 5.32 Fix Magician

Step 3 Connect the end of the wire set to the plate b with a M3*6 countersunk head hexagon screw, as shown in Figure 5.33.

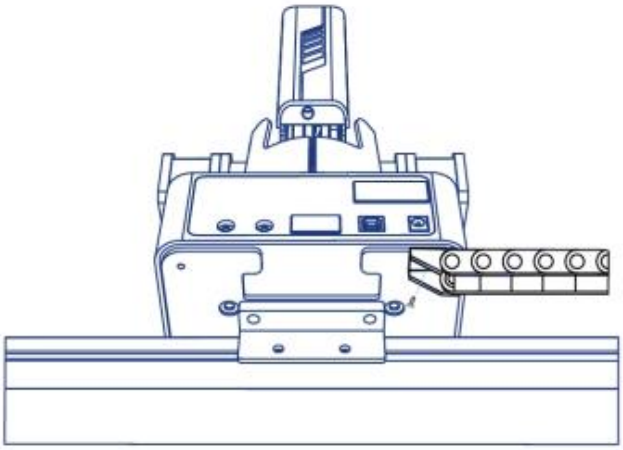

Figure 5.33 Connect to wire set

Step 4 Connect the interfaces on the end of the wire set to Dobot Magician, as shown in Figure 5.34.

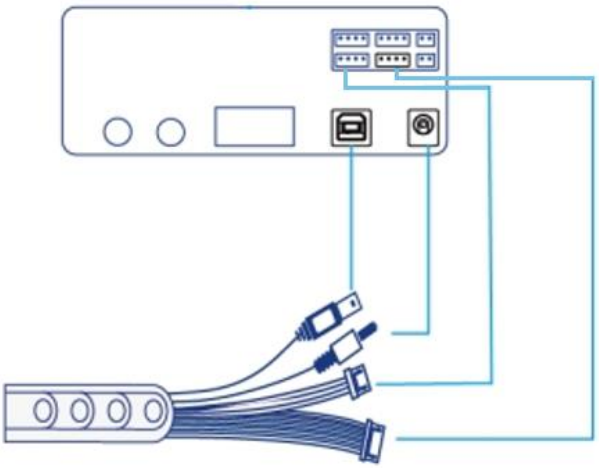

Figure 5.34 Connect to Dobot Magician

Step 5 Connect the interfaces on the other end of the wire set to the power adapter, USB interface of PC, motor interface and homing interface of the sliding rail respectively. Figure 5.35 shows the interfaces on the other end of the wire set.

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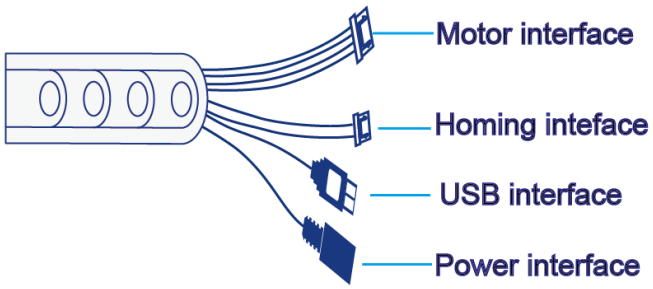

Figure 5.35 Interfaces on the other end of the wire set

Figure 5.36 shows the connection between the sliding rail and the wire set.

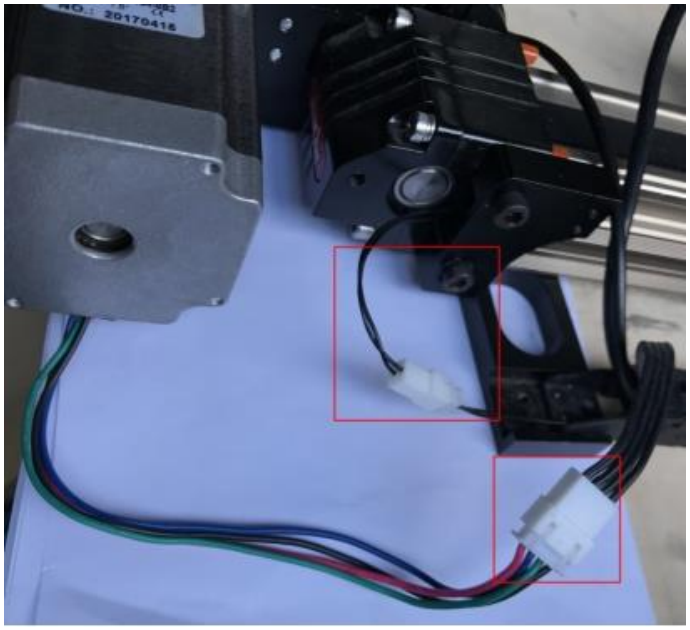

Figure 5.36 Connect sliding rail and wire set

5.5.4 Drawing Operations (with a Sliding Rail)

This section describes how to use a sliding rail for writing.

Prerequisites

- The sliding rail kit has been installed and connected to the Dobot Magician. See *5.5.3 Installing a Sliding Rail Kit* for details.
- Dobot Magician has been powered on and connected to DobotLab successfully.
- The writing kit has been installed, and ink, inkstone and paper have been prepared.

5.5.4.1 Connecting DobotLab

Step 1 Click on DobotLab main page to enter Writing and Drawing Lab.

Step 2 Click the drop-down list of device connection panel, as shown below. Select **Magician** and click **Connect**.

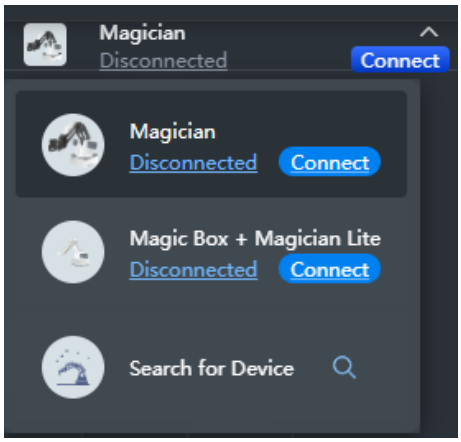

Figure 5.37 Connect device

Now Magician is connected to DobotLab successfully.

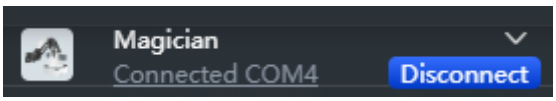

Figure 5.38 Device connected

5.5.4.2 Connecting Sliding Rail

Step 1 Enable **Rail** on the arm control panel, as shown in Figure 5.39.

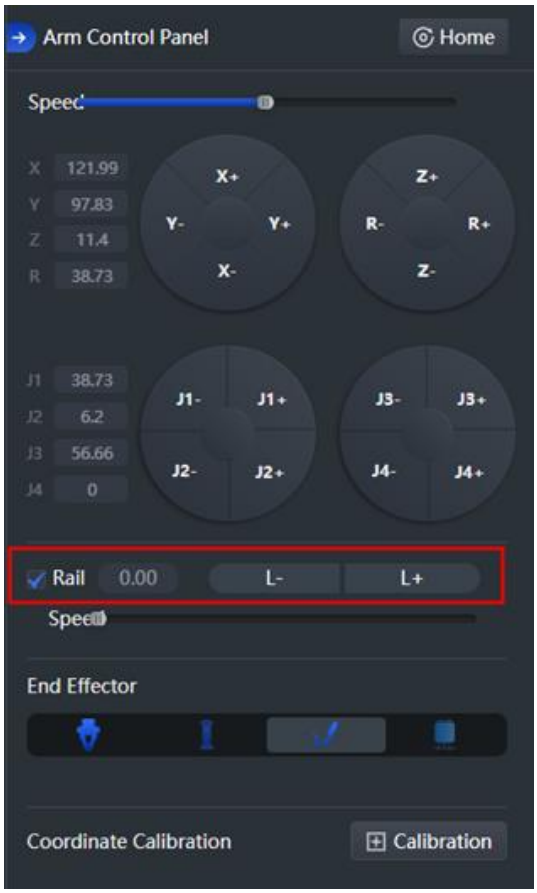

Figure 5.39 Enable sliding rail

The drawing area is shown in Figure 5.40.

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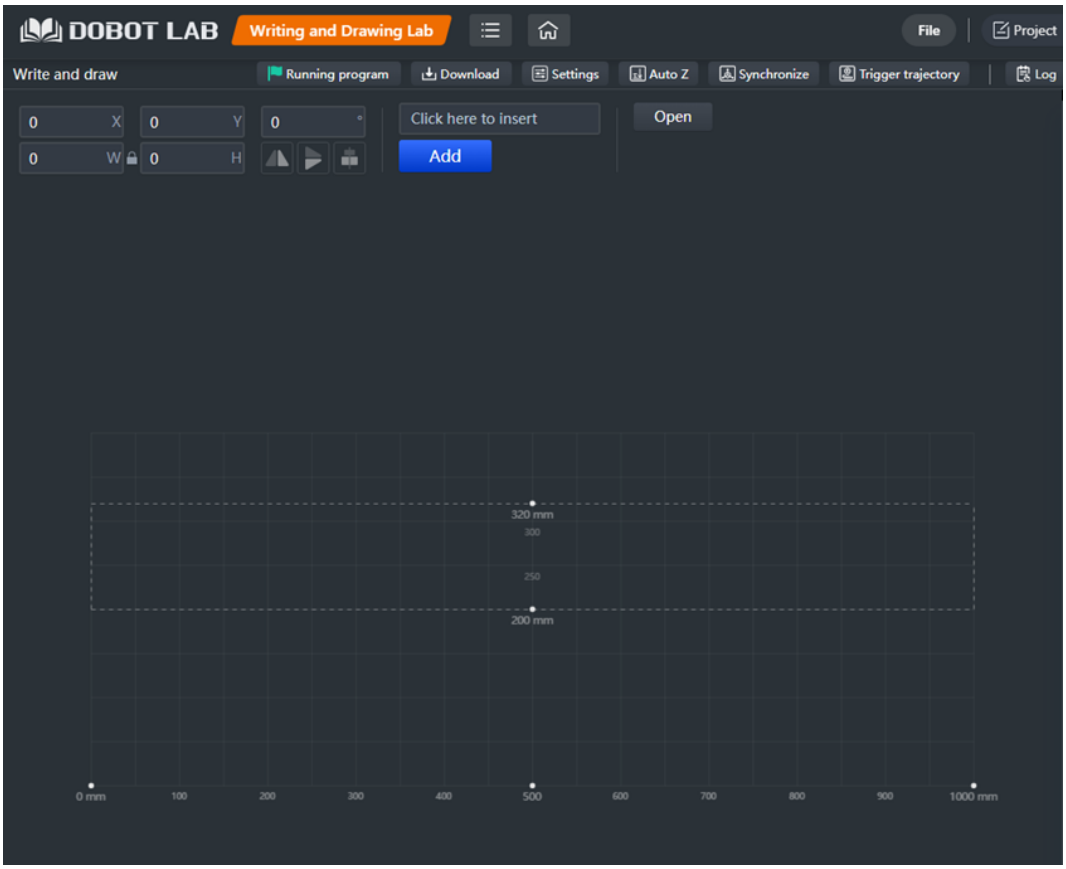

Figure 5.40 Drawing area (sliding rail connected)

Step 2 Click **L+** or **L-** to test whether the sliding rail can move properly.

Step 3 Click **Home** on the arm control panel.

The sliding rail moves to its home point, and then the Dobot Magician starts homing.

⚠ NOTICE

Before you click **Home**, please take the pen off or raise the Dobot Magician arm up.

5.5.4.3 Importing Image/Text and Setting Parameters

Step 1 Enter the text in the rectangle box (take “AI Application” as an example), and click Add. Now the graphic appears in the drawing area.

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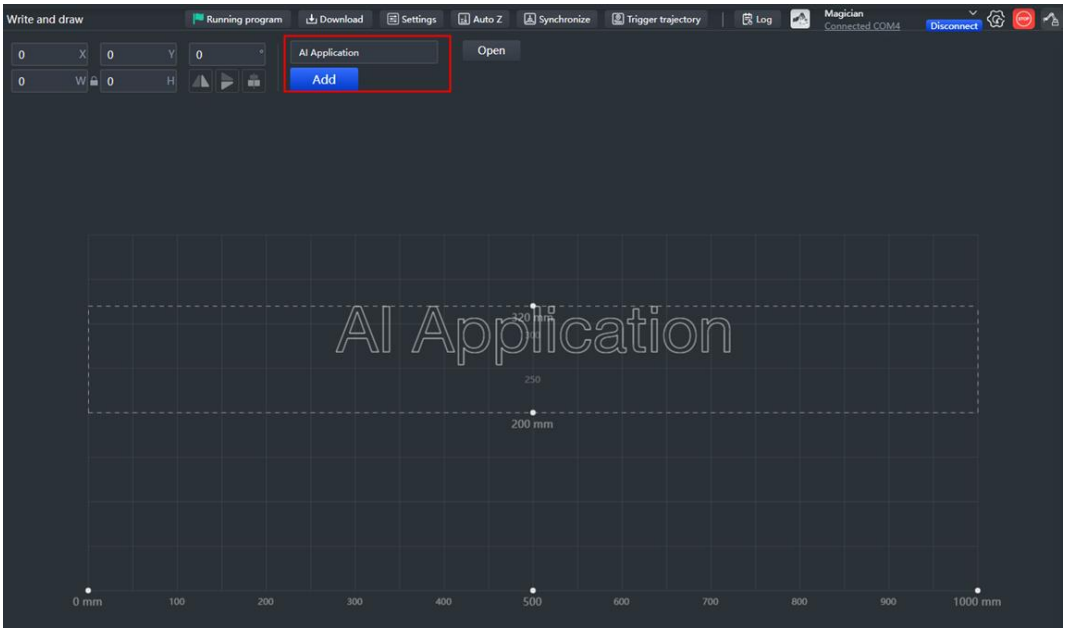

Figure 5.41 Add image

If you need to insert an image, click Open to select an image from local. If the image format is not SVG, the "SVG Format Conversion" prompt box will pop up. In this case, select the conversion scale and click **OK**.

NOTE

- If the coordinate system of the imported image and the drawing area are set differently, the imported image will be displayed in an inverted direction. In this case, you can flip the image to the correct direction.
- If you want to write the text in a certain order, you need to import an image with a defined point order. If you enter the text and click **Add**, the Magician will write the text overall from left to right.

Step 2 Drag the graphic to an appropriate area. You can set the position, size, rotation angle or flip mode of the graphic through the image settings in the upper left corner.

NOTE

The image in the drawing area should be placed within the rectangular area. Otherwise, the robot arm reaches its limited position and cannot draw or write. In this case, the image is highlighted with a red border.

Step 3 Click Settings to set the pen lifting height, descent height and speed.

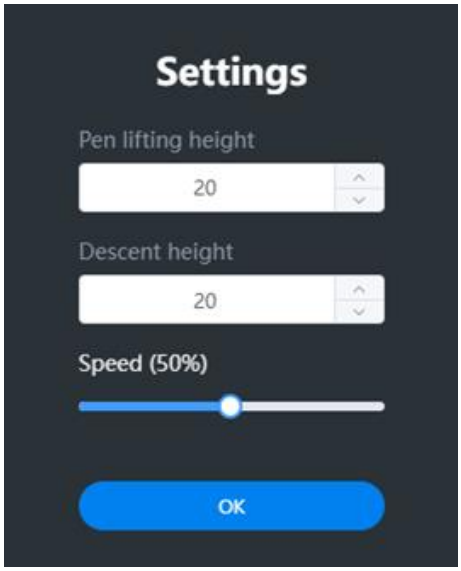

Figure 5.42 Set pen lifting height, descent height and speed

Step 4 Press and hold the **Unlock** button on the forearm to move Magician to lower the pen nib until it slightly squeezes the paper. You can also jog Magician in Arm Control Panel to slowly pull the Z coordinates down to a suitable position for writing.

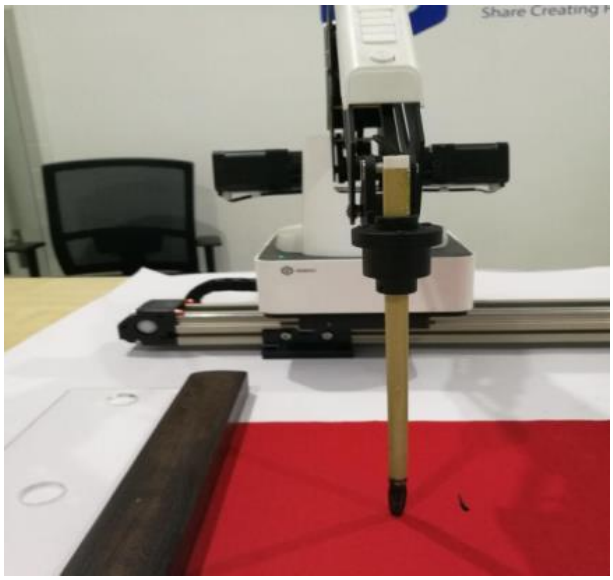

Figure 5.43 Height of brush pen

Step 5 Click

to obtain and save the current value of Z axis.

Step 6 (Optional) Set trigger line and ink dipping position.

⚠NOTICE

If you want to set an action to dip the pen into the ink, you can press **Unlock** key and drag the Dobot Magician to a point, and then release to get this point position on the command area. For details, refer to the steps below.

1. Right-click a position on the drawing area and select **Add Trigger Line**. When the brush pen finishes writing the text with a trigger line, it will automatically move to the inkstone to perform the ink dipping actions.

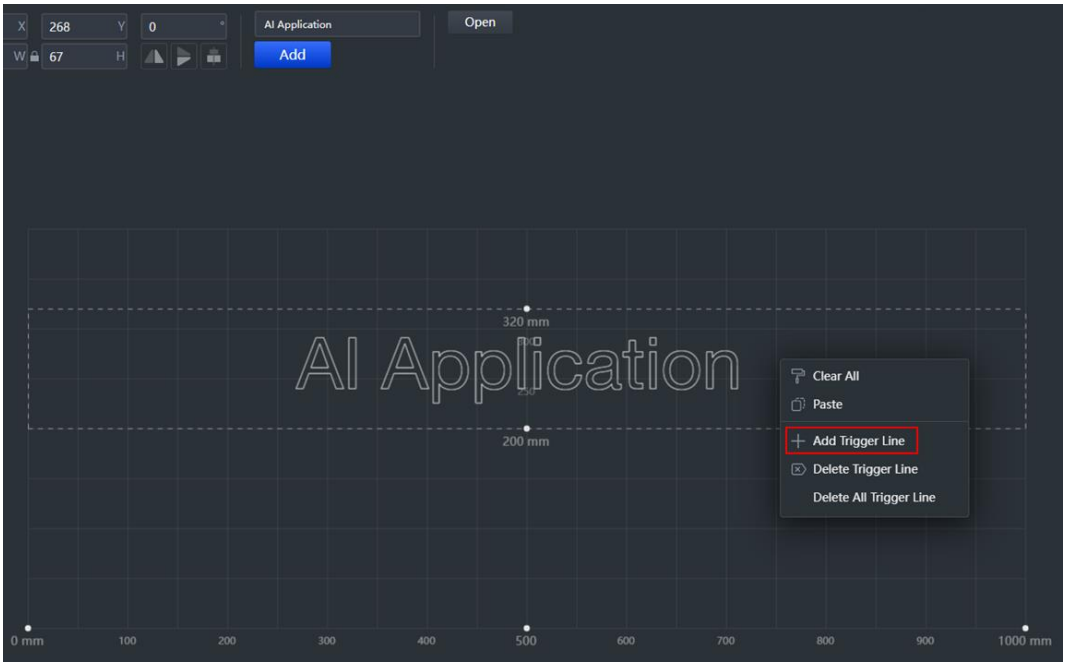

Figure 5.44 Add trigger line

A blue trigger line appears in the drawing area. Move the trigger line to a proper position, as shown in Figure 5.45.

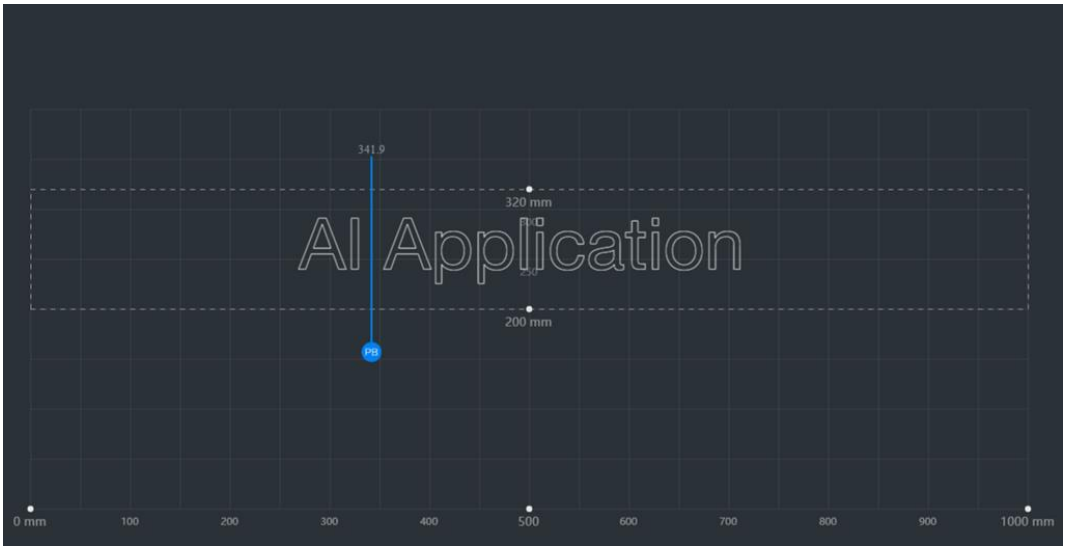

Figure 5.45 Move trigger line

2. Click Trigger trajectory to enter the “Trigger Trajectory” page for setting ink dipping actions, as shown in Figure 5.46.

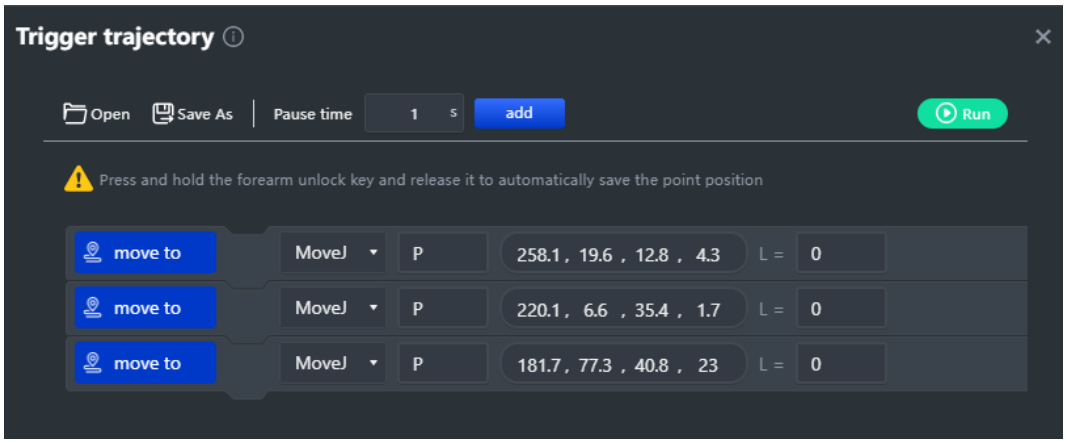

Figure 5.46 Trigger line page

3. Press the **Unlock** key on the forearm, move the forearm over the writing area, and release the **Unlock** key to record the first point. as shown in Figure 5.47.

Figure 5.47 Save the first point

NOTICE

Make this point higher within the Dobot Magician workplace to prevent the writing brush from touching the inkstone.

4. Move the forearm to the inkstone position as shown in Figure 5.48, and record these points on the “Trigger Trajectory” page.

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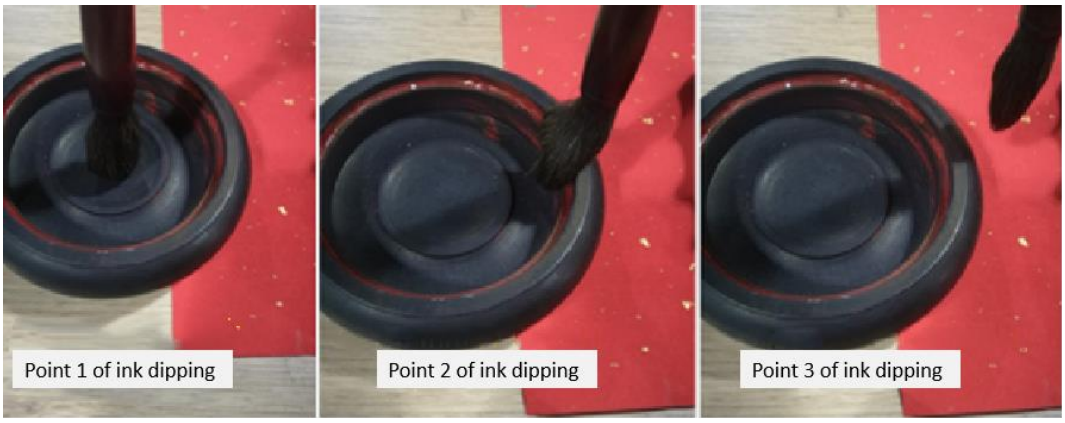

Figure 5.48 Simulate the actions of ink dipping

5. Drag the forearm to raise the writing brush up, for avoiding touching the inkstone.

⚠NOTICE

As the inkstone has its own height, you need to set a suitable rising height to prevent the writing brush from touching the inkstone. Click **Settings** to set the height that is recommended as 50mm to 70mm.

Step 7 Click Synchronize to move the nib over the starting point of drawing.

📖NOTE

If you do not click **Synchronize** before running, the text can also be written normally. After you click **Running program**, the robot arm moves directly over the starting point to draw.

5.5.4.4 Drawing

Step 1 Click Running program, and the robot arm starts to write the text. Now the cursor shows the position of the nib in real time. The running progress is displayed below the drawing area. You can click Pause to pause or click Stop to stop writing.

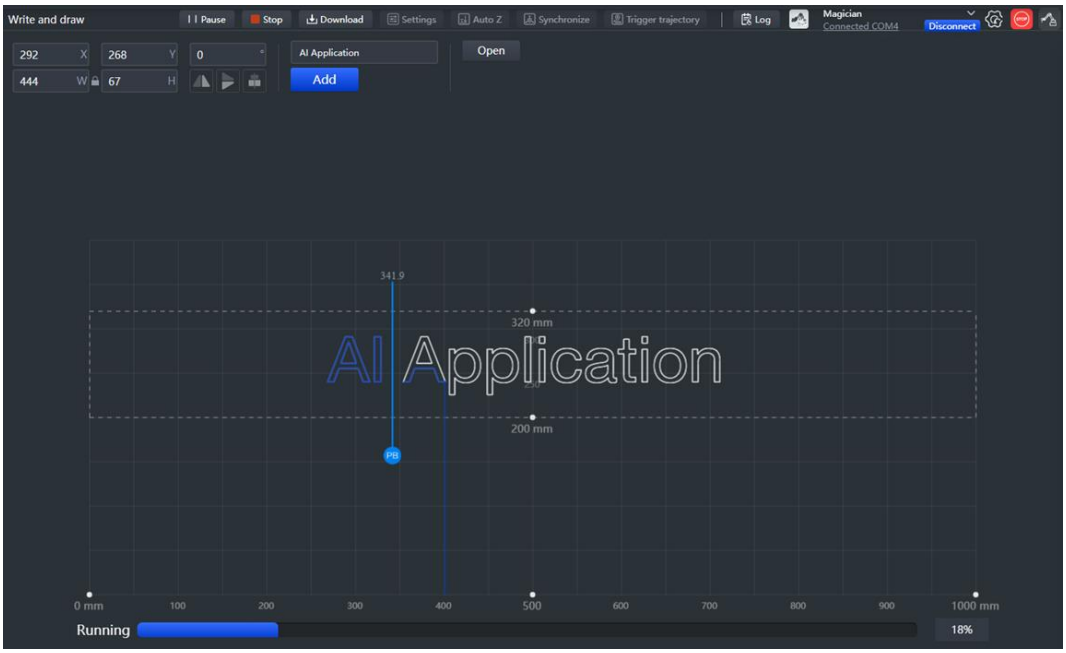

Figure 5.49 Start writing text

Step 2 (Optional) Click Save. Enter the project name and save the project to My Works.

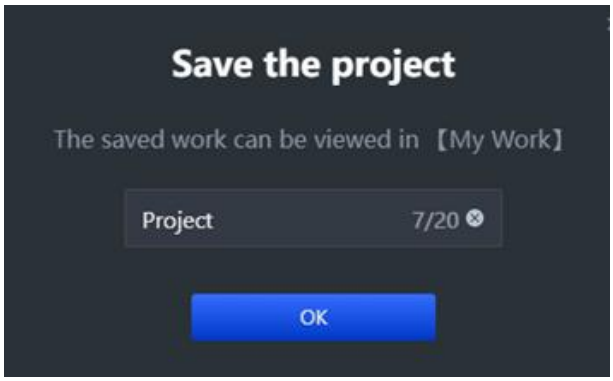

Figure 5.50 Save the file

Step 3 (Optional): Click Download to download the file to the device.

5.6 Laser Engraving

Figure 5.51 shows the process of laser engraving.

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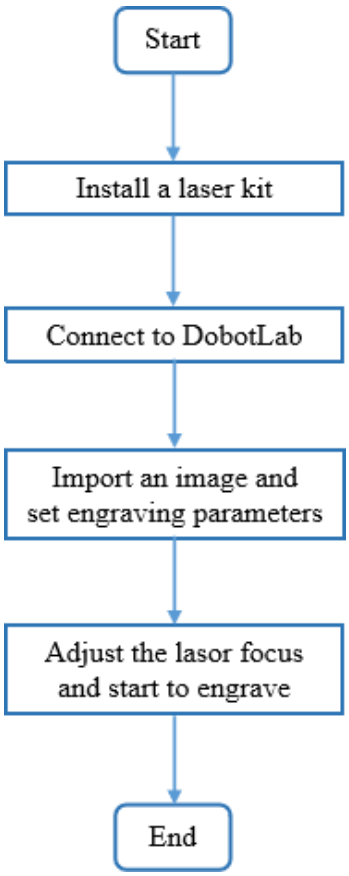

Figure 5.51 Process of laser engraving

5.6.1 Installing a Laser Kit

Procedure

A laser kit includes a laser. The installation steps are described as below.

Step 1 Fasten the laser kit to the end of Dobot Magician with a clamp fixing screw, as shown in Figure 5.52.

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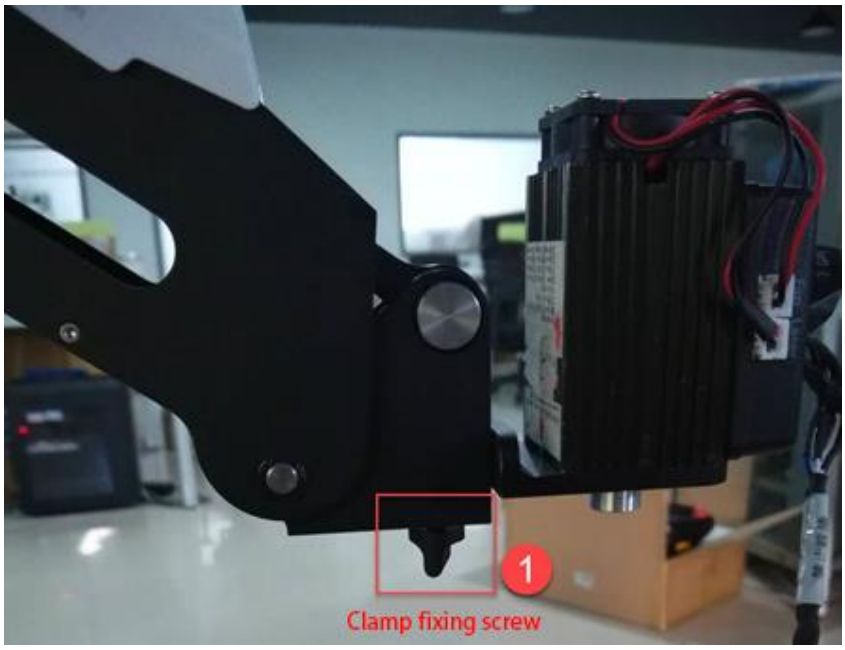

Figure 5.52 Fasten the laser with clamp fixing screw

Step 2 Connect the power cable of laser to the **SW4** connector on the forearm and the TTL control cable to the **GP5** connector.

Step 3 Place a piece of brown paper on the work surface within the workspace of Dobot Magician.

5.6.2 Laser Engraving Operations

5.6.2.1 Connecting DobotLab

Step 1 Click on DobotLab main page to enter Laser Engraving Lab.

Step 2 Click the drop-down list of device connection panel, as shown below. Select **Magician** and click **Connect**.

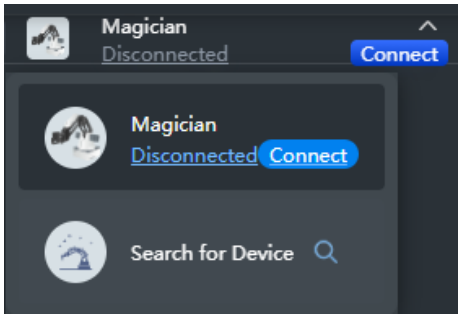

Figure 5.53 Connect device

DobotLab is connected to Magician successfully, as shown below.

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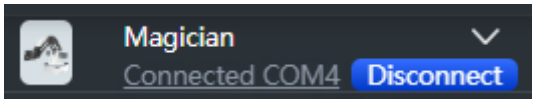

Figure 5.54 Device connected

5.6.2.2 Importing Image Files and Setting Engraving Parameters

Step 1 Click Open to import an image from local.

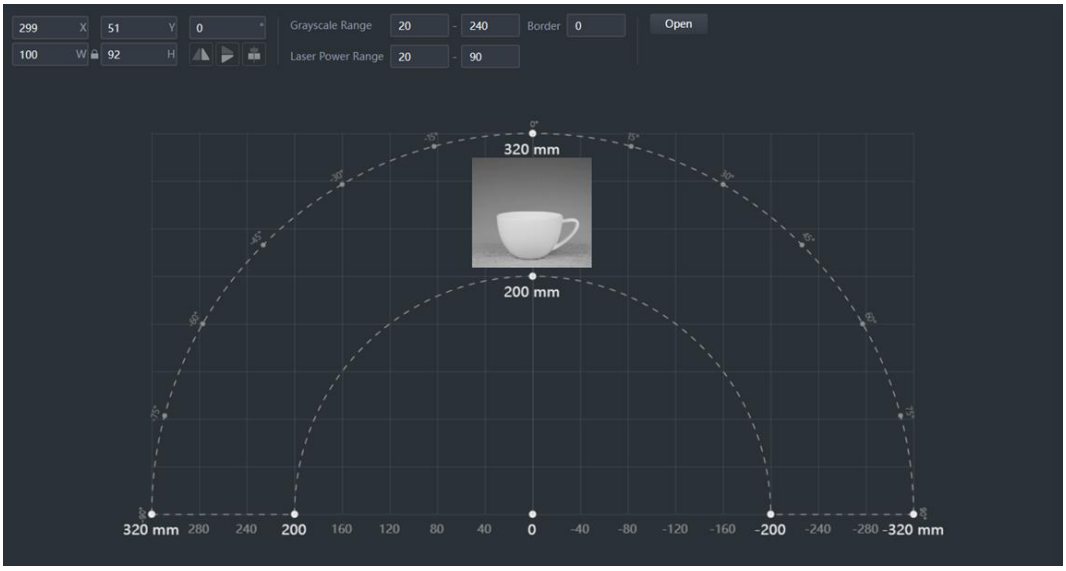

Figure 5.55

Step 2 Drag the image to an appropriate area. You can set the position, size, rotation angle or flip mode of the image, or set the grayscale and border effect.

📖NOTE

The image in the drawing area should be placed within the annular area. If not, the robotic arm reaches its limited position and cannot engrave. In this case, the image is highlighted with a red border, as shown below.

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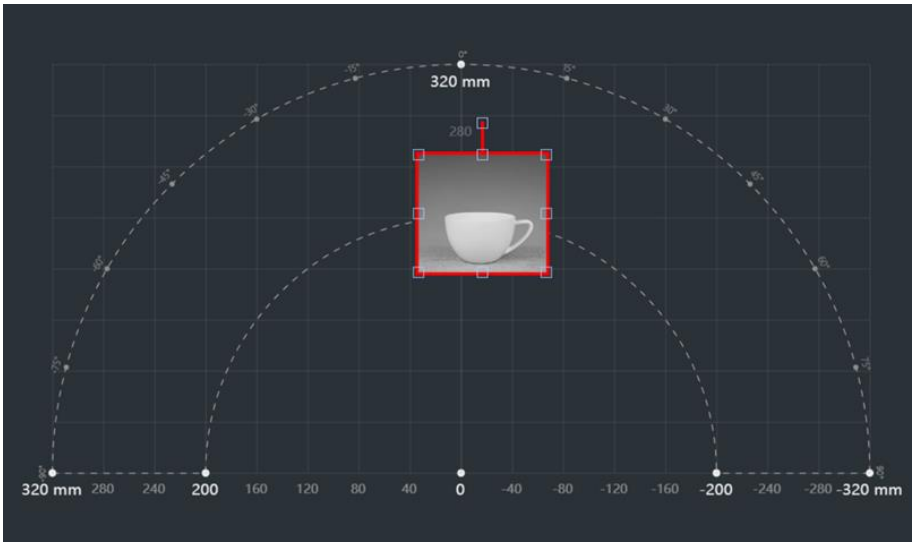

Figure 5.56 Image beyond bound

Step 3 Click Home in arm control panel.

Step 4 Select **Laser** as the end tool in arm control panel, and click **Open** after enabling it. Now the laser kit will emit laser. You can adjust the laser power range.

Figure 5.57 Select end effector

⚠ Danger

- When using a laser, wear lasing protective eyeglass.
- In the central laser focus, a high temperature heat is created and can burn materials such as papers and wooden boards.
- Never aim the laser at a person and their clothes.
- Do not allow children to play with the Dobot Magician. Monitor the robot arm while it is running and power off it once the movement is completed.

Step 5 Adjust the laser focal length. Press and hold the unlock button on the forearm to move the robotic arm to raise and lower the height of the laser kit until the laser is the brightest with a smallest possible spot size. Now you can see the laser beam burning the paper. Click Auto Z to obtain and save the current value of Z axis.

⚠NOTICE

If you cannot set the laser to be at its minimum focus, it's probably because the focal length is long. To shorten the focal length, slightly turn the screw (as shown inFigure 5.58) on the bottom of the laser kit.

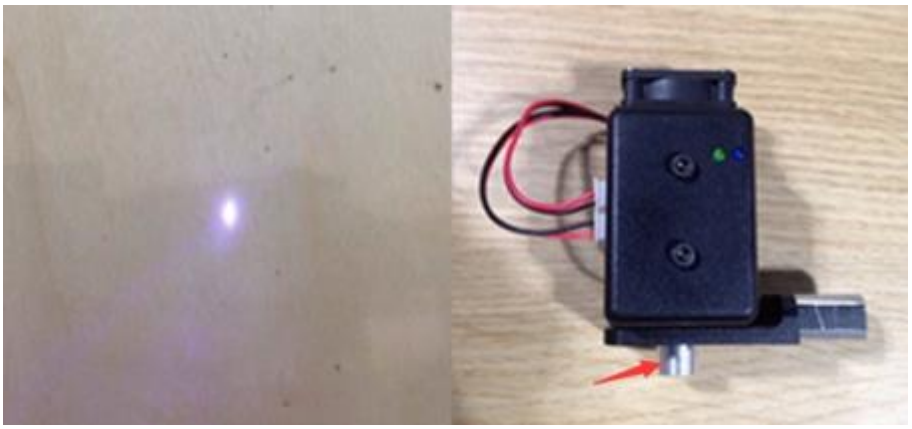

Figure 5.58 Adjust the laser focus

Step 6 Click Synchronize to move the laser kit over the starting point of engraving.

🕮NOTE

If you do not click **Synchronize** before running, the graph can also be engraved normally. After you click **Running program**, the robot arm moves directly over the starting point to start engraving.

5.6.2.3 Engraving

Step 1 Click Running program, and the Magician starts to engrave. Now the cursor shows the position of the laser in real time. The running progress is displayed below

the engraving area. You can click Pause to pause or click Stop to stop engraving.

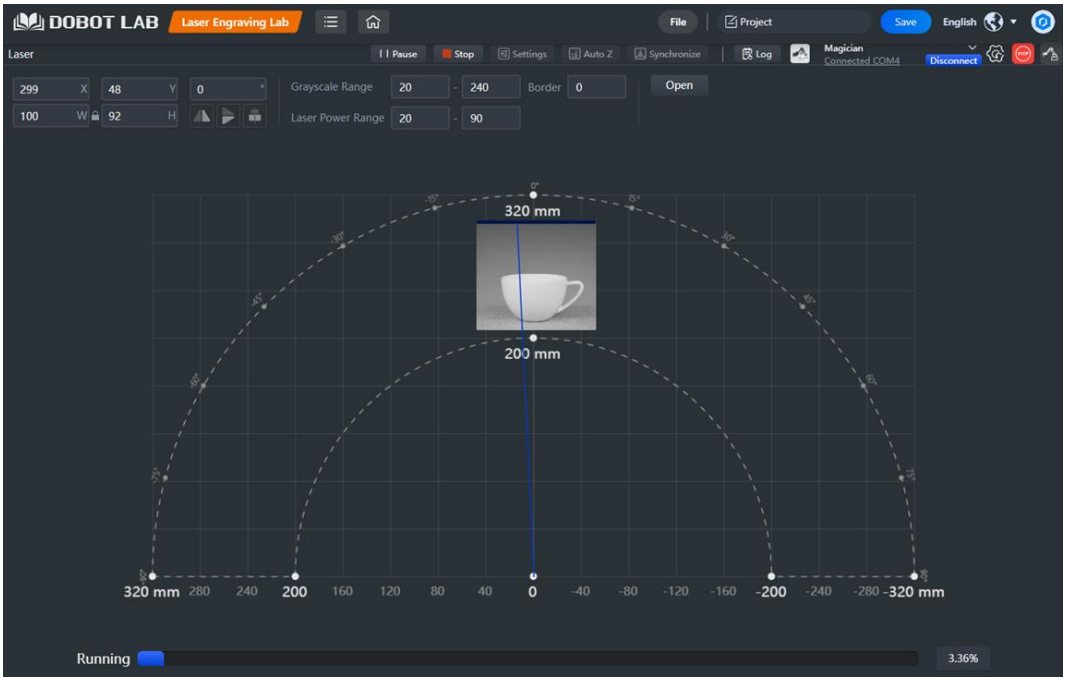

Figure 5.59 Start engraving

Step 2 (optional) Click Save. Enter the project name and save the project to My Works.

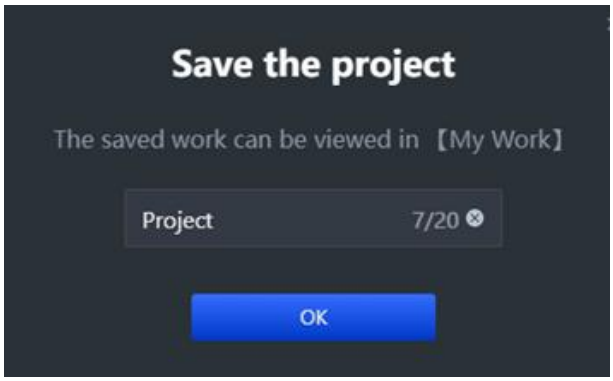

Figure 5.60 Save the project

5.7 Teaching and Playback

This section introduces how to perform a teaching & playback task to suck or grab a small object.

5.7.1 Installing a Suction Cup Kit

A suction cup kit is the default end-effector shipped with the Dobot Magician. An air pump is

necessary when you use the suction cup kit, as shown in Figure 5.61.

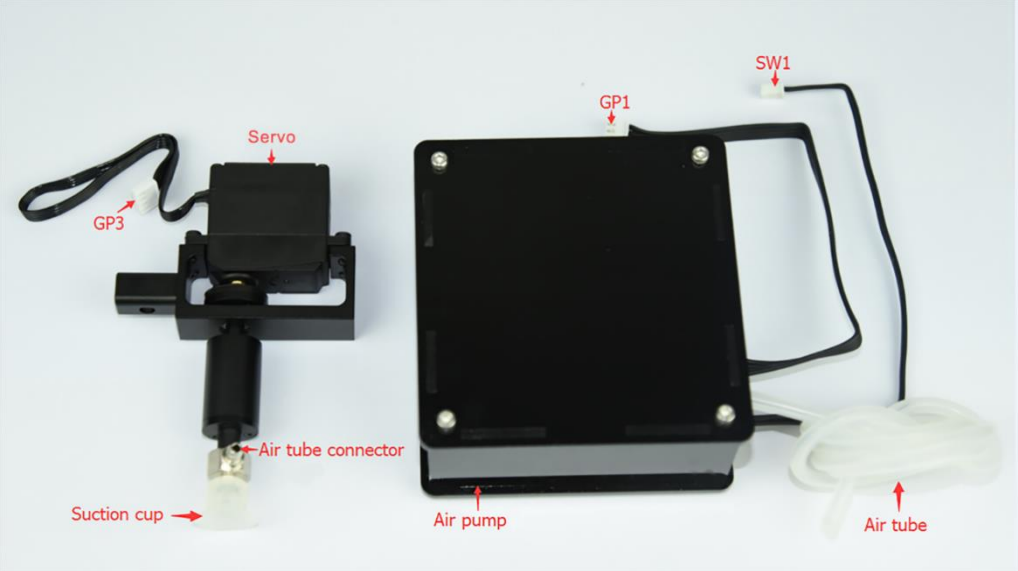

Figure 5.61 A suction cup kit

Procedure

Please install a suction cup kit based on Figure 5.62.

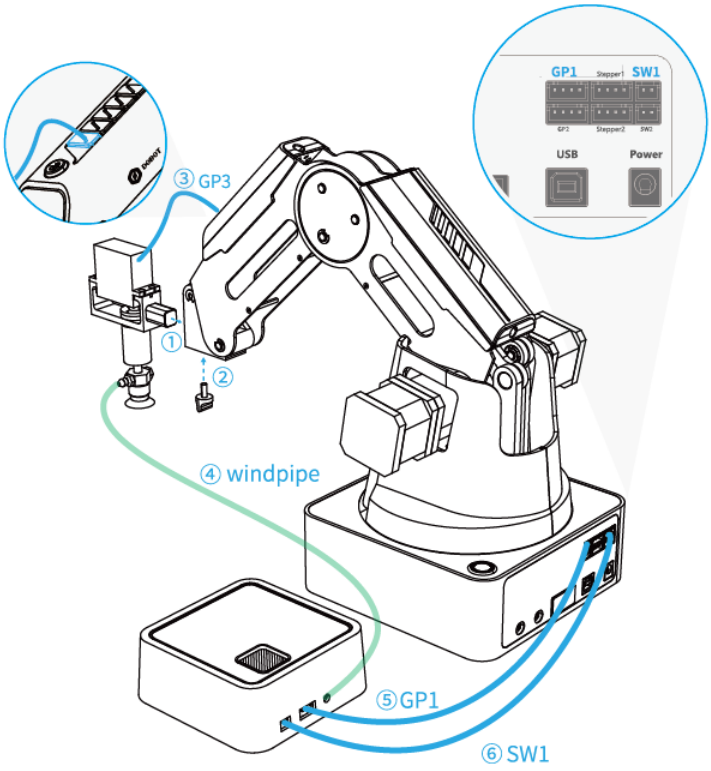

Figure 5.62 Connect the air pump to the Dobot Magician

5.7.2 Installing a Gripper Kit

An air pump should be used with the gripper kit, as shown in Figure 5.63, to open or close the gripper.

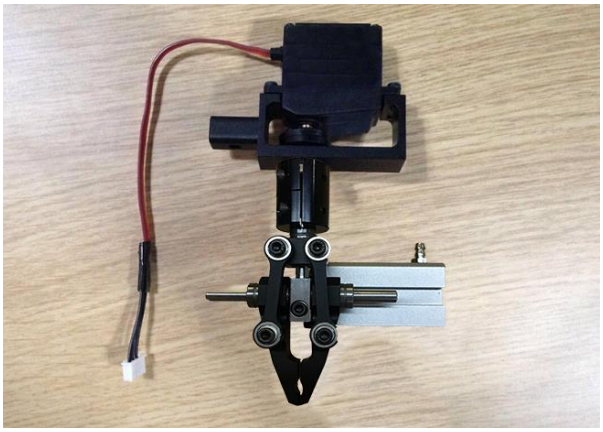

Figure 5.63 Gripper kit

Procedure

Step 1 Dismantle the suction cup by unfastening its terminal strand with a 1.5mm hexagon wrench, as shown in Figure 5.64.

Figure 5.64 Dismantle the suction cup

Step 2 Install a gripper kit to the servo with a 2.5mm hexagon wrench, as shown in Figure 5.65.

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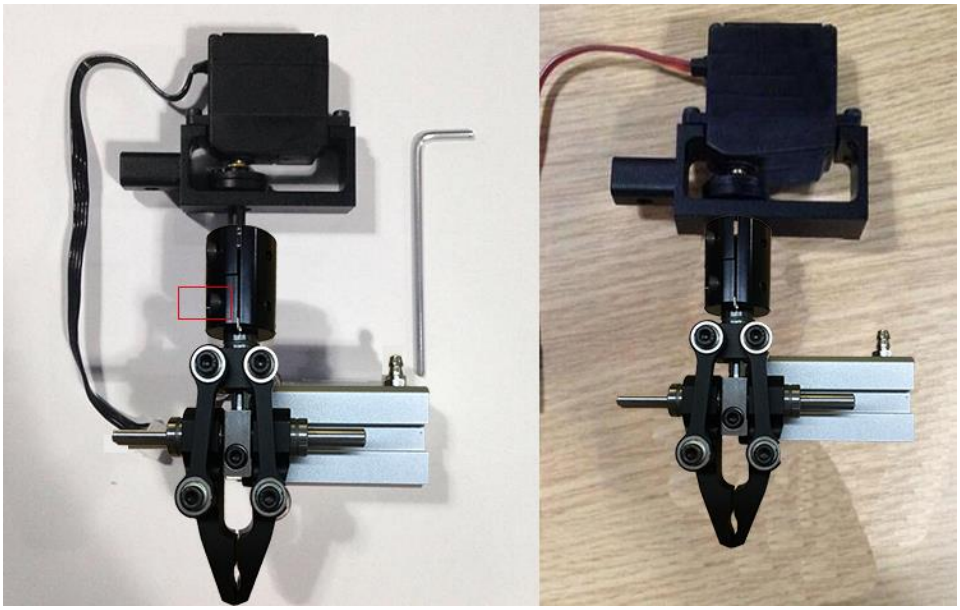

Figure 5.65 Install a gripper kit

Step 3 Connect the gripper kit and an air pump to the Dobot Magician in the same way as the suction cup kit is installed. For details, see *5.7.1 Installing a Suction Cup Kit*. Figure 5.66 shows the effect of the gripper kit installation.

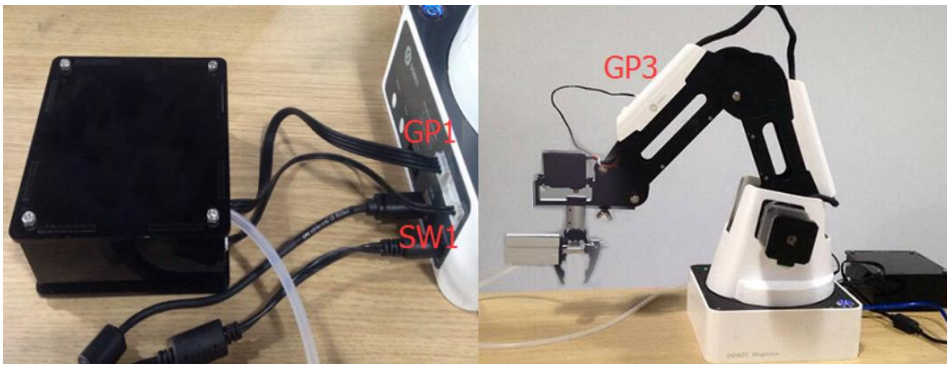

Figure 5.66 Effect of the gripper kit installation

5.7.3 Teaching and Playback

The main interface of Teaching and Playback Lab is shown in Figure 5.67, and the specific description is listed in Table 5.3.

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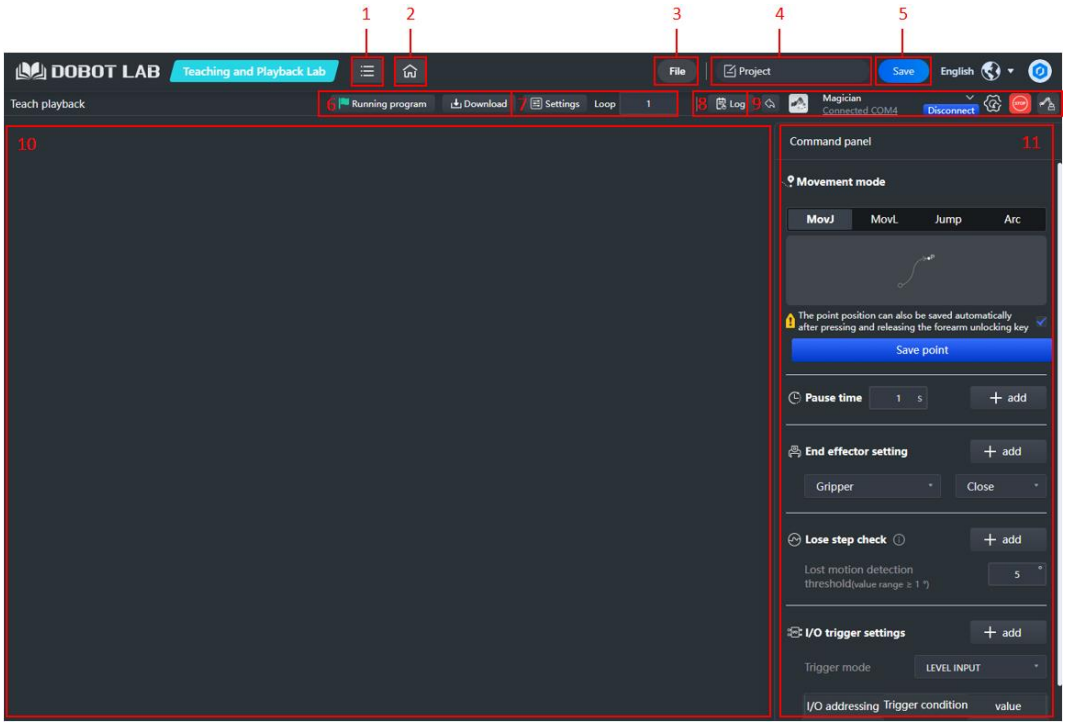

Figure 5.67 Teaching and Playback Lab interface

Table 5.3 Description on Teaching and Playback Lab

No.	Function	Description
1	Menu	Currency: View the guidance for DobotLab Help: View and download documents related to DobotLab Feedback: Enter your feedback about DobotLab experience About: View the basic information of DobotLab
2	Home	Back to DobotLab main page
3	File	It includes functions such as new, open, save as, upload from local, etc.
4	Project name	Display the name of the current project
5	Save	Save the current project to My Works
6	Program control	Running program: Start to run the program in the code area Download: Download the current program in the code area to the device
7	Running settings	Settings: Set speed and acceleration Loop: Set the number of times the commands run. range: 1~999999
8	Log	Display alarm information

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9	Device control	: Select a target device and establish a communication connection with the device : Press to stop running in emergencies : Control Dobot Magician
10	Control panel	Set motion mode, pause time, end-effector, lost step detection, I/O trigger, and save points
11	Command list	Provide programming commands. You can right-click a command to copy, paste, or delete it

Procedure

Step 1 Click on DobotLab main page to enter Teaching and Playback Lab.

Step 2 Click the drop-down list of device connection panel, as shown below. Select **Magician** and click **Connect.**

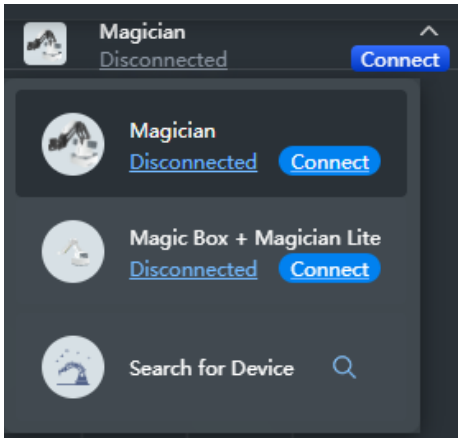

Figure 5.68 Connect device

Now DobotLab is connected to Magician successfully.

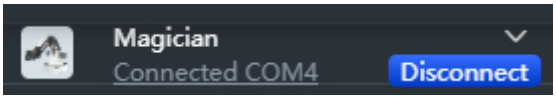

Figure 5.69 Device connected

Step 3 Set commands in Command panel.

1. Motion mode

- MovJ: Point-to-point movement in the Cartesian coordinate system.

- MovL: Linear movement in the Cartesian coordinate system.
- Jump: Move from the current position to a target position in a door-shaped mode
- Arc: Move from the current position to a target position in an arc interpolated mode.

2. Save points

- Method 1: Press and hold the unlock button on the forearm and then release it to automatically save the point.
- Method 2: Open the arm control panel, adjust the coordinates by jogging the axis icon, and click **Save point** in the Command panel.

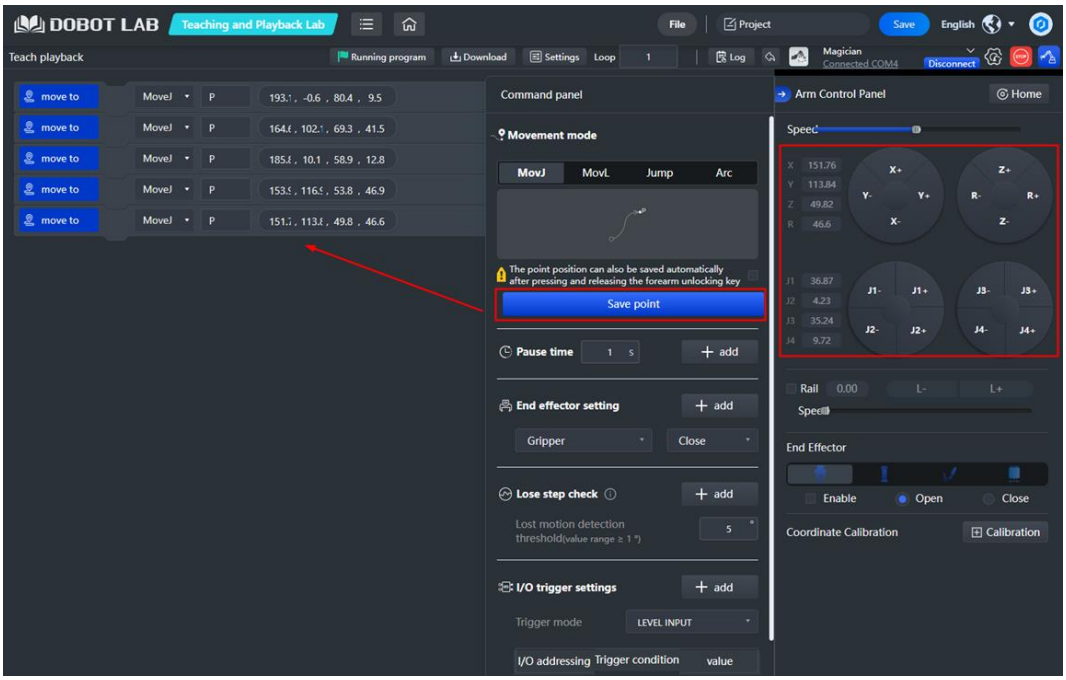

Figure 5.70 Save points

For Jump movement, you need to click Jump parameter setting to set the lifting height and maximum lifting height, as shown below.

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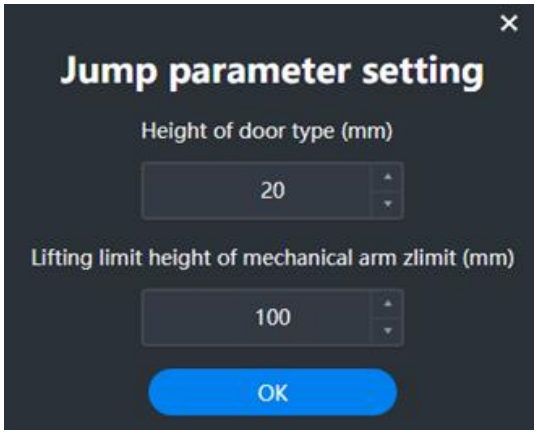

Figure 5.71 Jump parameter setting

For Arc movement, you need to set the coordinates of the start, intermediate and end points. When setting the start point, you should select the mode of moving to the start point at the same time, and then save the point, as shown in the following figure.

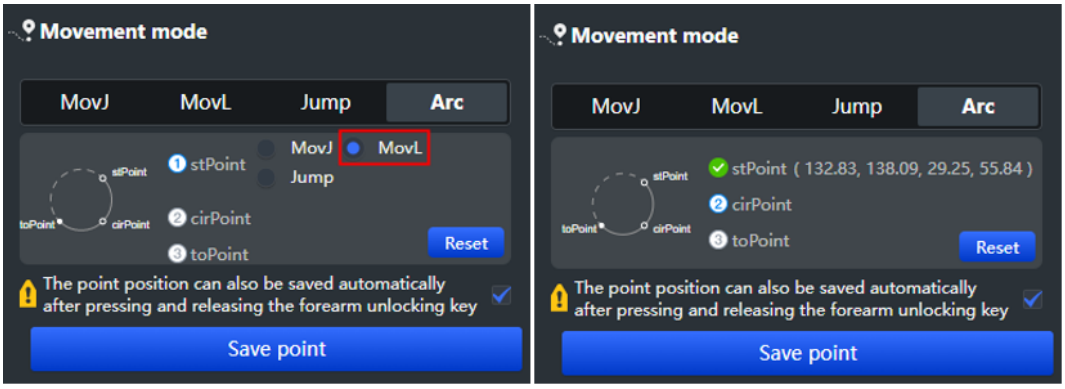

Figure 5.72 Arc point setting

After saving the intermediate and end points in sequence, you can see the following commands.

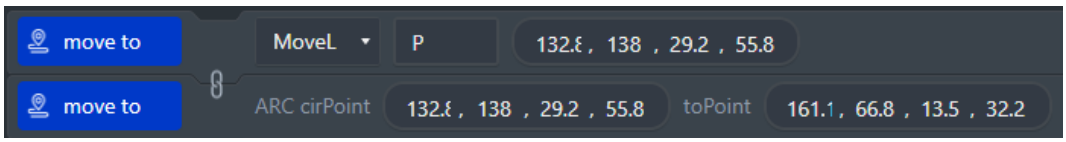

Figure 5.73 Arc point saving command

⚠NOTICE

Note the following rules when saving points to prevent the robot arm from working outside its normal workspace.

- Any two points cannot coincide.
- The three points cannot be in the same straight line.
- The arc trajectory cannot exceed the Dobot Magician's normal workspace.

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3. Pause time

You can set the pause time after executing a command as required, and click + add.

4. End-effector

You can select the end tool to gripper or suction cup as required, and set its state: gripper (Close, Open or Stop), suction cup (On or Off).

5. Lost step check

Lost step detection is used to detect whether a robotic arm loses step during operation. When lost step is detected, the robot arm will stop moving and the indicator light will turn red. The robot arm can run normally only after the lost step alarm is cleared and the robot arm returns to home point again. You can set the lost-step detection threshold as required and click + add.

6. I/O trigger setting

You can set the triggering mode to execute a command. For details, refer to *5.12 Multiplexed I/O Demo*. For I/O definition, see *Dobot Magician Interface Description V2*.

7. Loop

Click **Loop** to set the number of times the commands run.

Step 4 Click Running program to run the commands.

Step 5 (Optional) Click Save. Enter the project name and save the project to My Works.

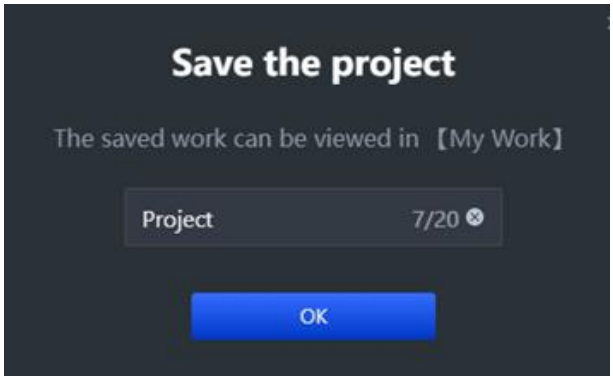

Figure 5.74 Save the project

Step 6 (Optional) Click Download to download the script to the device. Before

downloading, determine whether the robot arm returns to the home point before running offline. For detailed description on offline running, see *5.10 Working in Offline Mode* for details.

5.8 3D Printing

After installing an 3D printing kit, you can import 3D module into the 3D printing software to perform 3D printing. Figure 5.75 shows the 3D printing process.

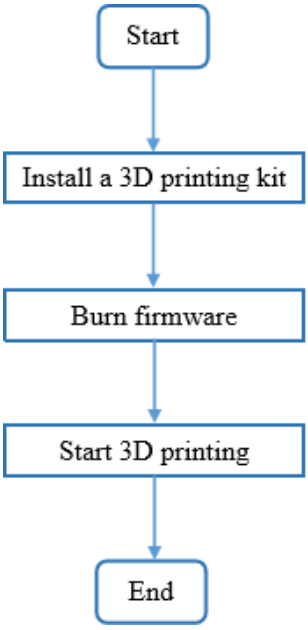

Figure 5.75 3D printing process

During 3D printing, the 3D printing control software is required. You can use **Repetier Host** or **Cura** software for 3D printing.

- **Reptier-Host**: Reptier-Host can slice with the third party slicing (such as CuraEngine, Slic3r, etc), check and modify G-Code, control 3D printing manually. More parameter settings make Reptier-Host very flexible.
- **Cure**: The slicing of Cura is fast and stable. It has strong inclusiveness to 3D model structure and less parameter settings.

⚠NOTICE

This section uses Windows as an example to describe how to perform 3D printing with **Repetier Host** and **Cura**. For Mac OS, only **Cura** is supported.

5.8.1 Installing 3D Printing Kit

3D printing kit contains extruder, hot end, motor cable, filament, and filament holder as shown in Figure 5.76.

Figure 5.76 3D printing kit

Procedure

Step 1 Press down the lever on the extruder, and push down the filament to the bottom of the hole via the pulley, as shown in Figure 5.77.

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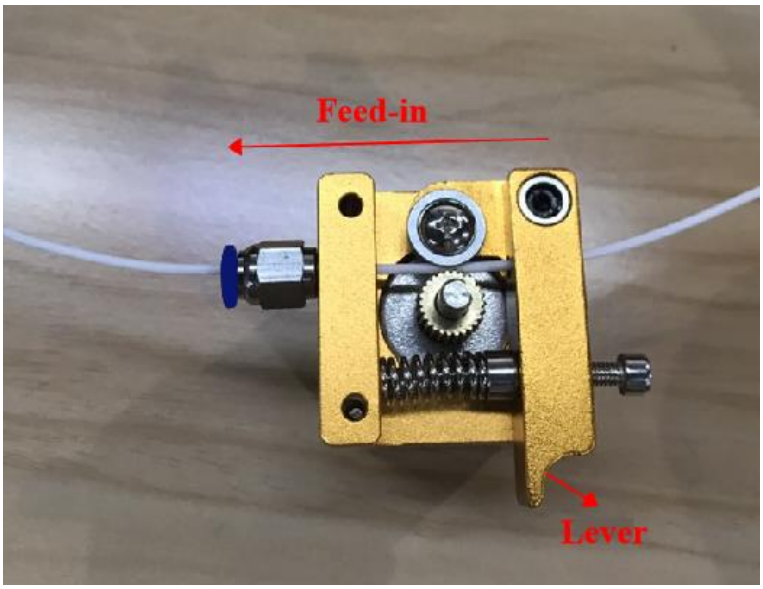

Figure 5.77 Push down the filament

Step 2 Connect the end of the PTFE tube to the hot end and push it down to the bottom of the hot end, and connect the other end to the extruder, as shown in Figure 5.78.

Figure 5.78 Connect extruder and hot end

Step 3 Insert the filament into the PTFE tube and push it down to the bottom of the hot end.

⚠NOTICE

Please make sure that the PTFE tube has been pushed down to the bottom of the hot end. Otherwise, it will cause abnormal discharge.

Step 4 Fix the hot end on the Dobot Magician with clamp fixing screw, as shown in Figure

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5.79.

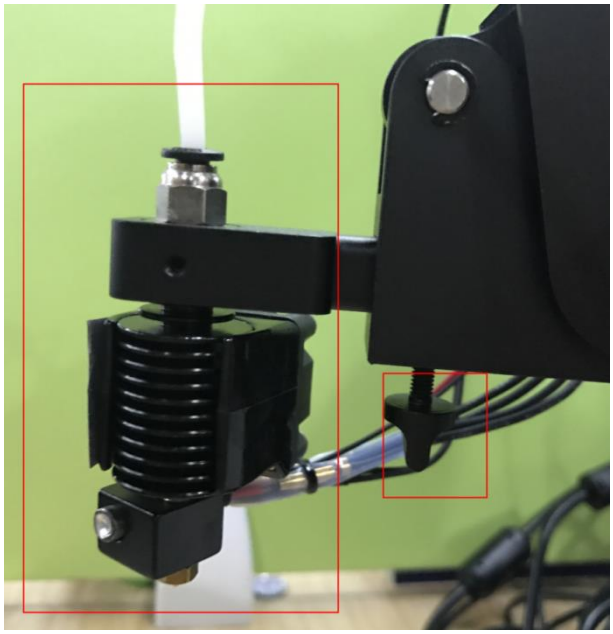

Figure 5.79 Fix hot end

Step 5 Insert the heating cable to the interface **4** on the Forearm, the fan cable to the interface **5** and the thermistor cable to the interface **6**, as shown in Figure 5.80.

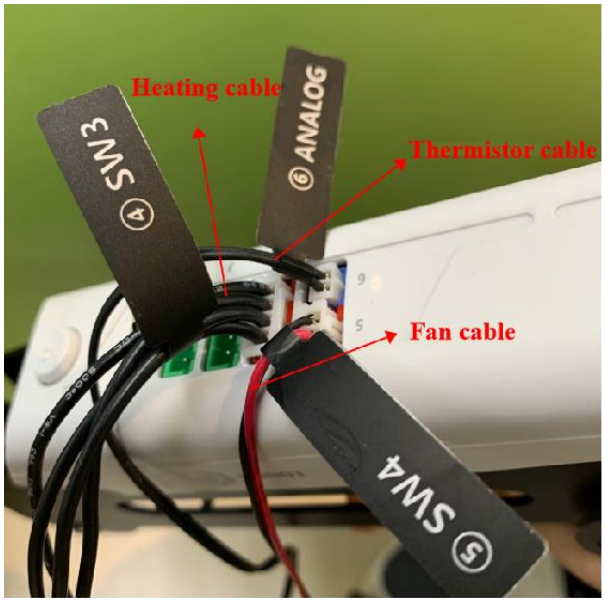

Figure 5.80 Connect hot end to the Forearm

Step 6 Connect the extruder to the **Stepper1** interface on the back of the base with motor cable, as shown in Figure 5.81.

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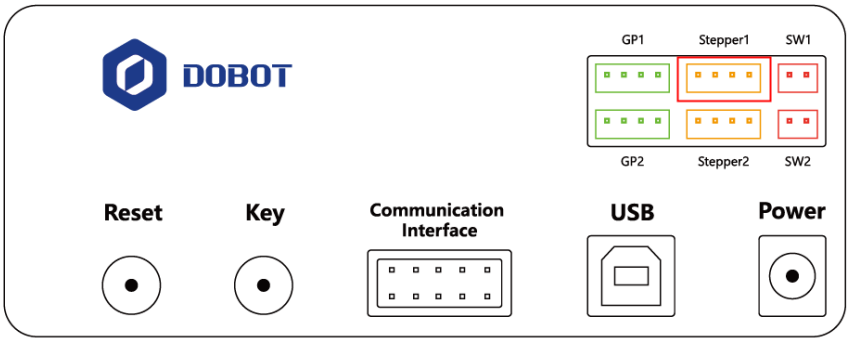

Figure 5.81 Connect with extruder

Step 7 Place the filament and the extruder to the filament holder, as shown in Figure 5.82.

Figure 5.82 Place filament and extruder to the Filament holder

5.8.2 Burning Firmware

Click on DobotLab main page, and you will see the following pop-up window.

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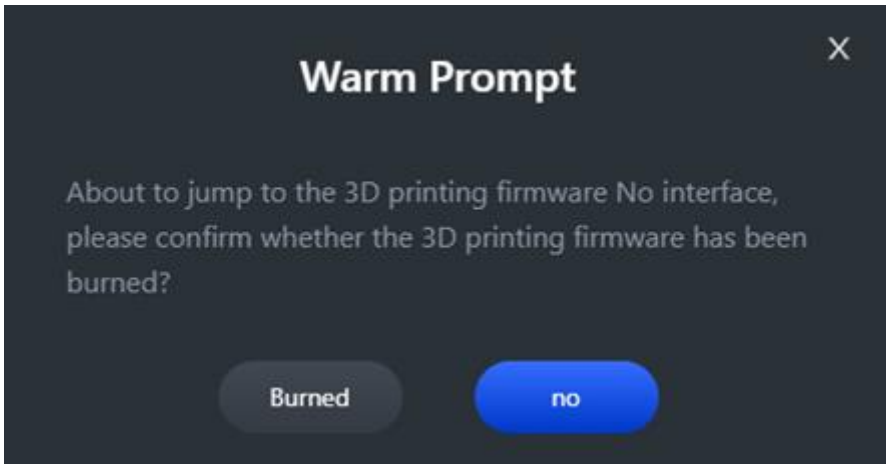

Figure 5.83 Confirm whether 3D printing firmware installed

If the 3D printing firmware has been burned, you need to confirm whether you have installed a 3D printing software. If not, click the link in the figure below to download and install the software.

Figure 5.84 Confirm whether burn firmware

If the firmware is not burned, click **no**, and the “Firmware Update” window will be displayed. Select **Magician** and the connected port will be automatically selected. Click

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Connect, as shown below.

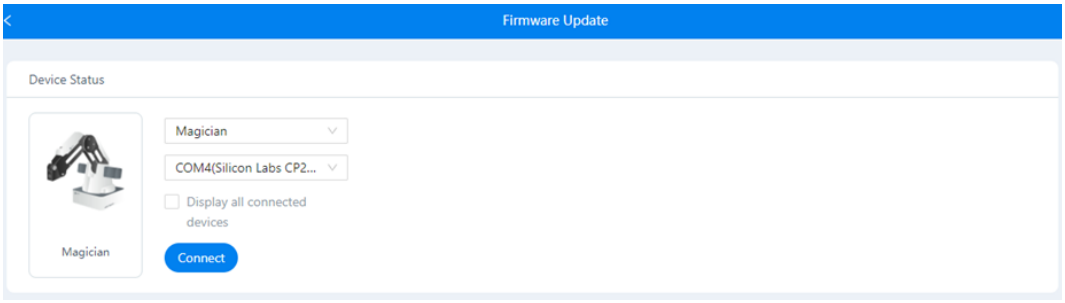

Figure 5.85 Connect device

Set the **Firmware Type** to **3D Print Firmware**. Click **Select Firmware** to select a firmware to be burned. Then click **Start Upgrading**.

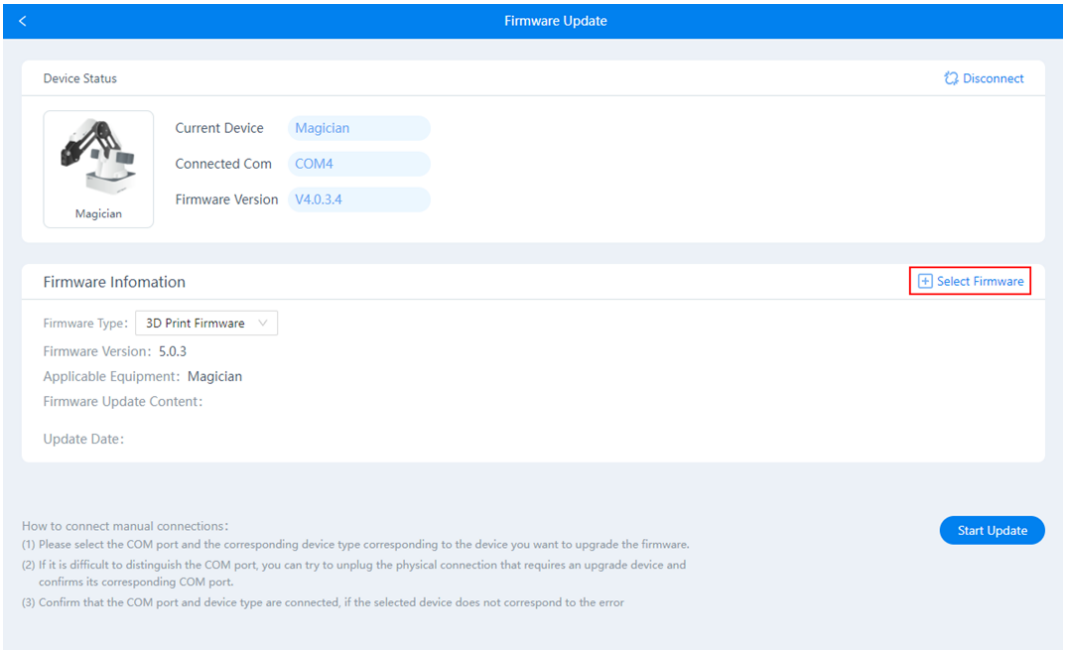

Figure 5.86 Burn firmware

⚠WARNING

- Please DO NOT operate or turn off Dobot Magician when burning firmware, to avoid machine damage.
- If the coordinates are abnormal after burning firmware, please reboot Dobot Magician.

After burning successfully, please download and install a 3D printing software.

5.8.3 Operating Repetier Host

Prerequisites

- The 3D printing model has been prepared.
- The printing platform has been prepared and please place it in the workspace of the Dobot Magician.
- Dobot Magician has been powered on and connected to DobotLab successfully (Only USB connection is supported).
- The 3D printing kit has been installed.

Procedure

Step 1 Open Repetier Host.

Step 2 Set printing parameters.

Printing parameters only need to be set for the first time.

1. Click **Printer Settings** on the top right corner of the Repetier Host page.

   Now the “Printer Settings” page is displayed.

2. Set the corresponding parameters on the Connection tab as shown in the red box of Figure 5.87. The other parameters are set by default. Click **Apply**.

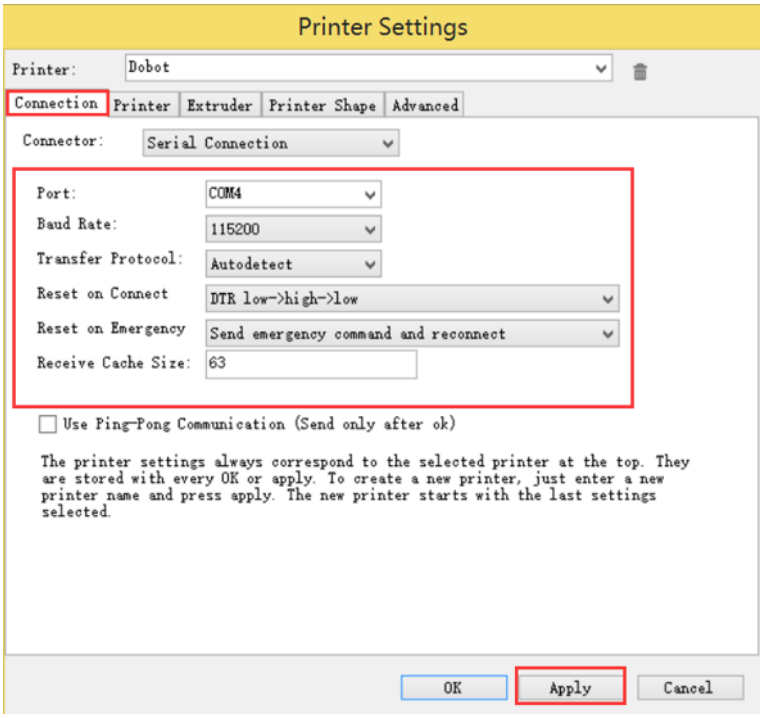

Figure 5.87 Connection setting

3. Unselect the corresponding options on the Printer tab as shown in the red box of Figure 5.88 and the other parameters are set by default. Then click **Apply**.

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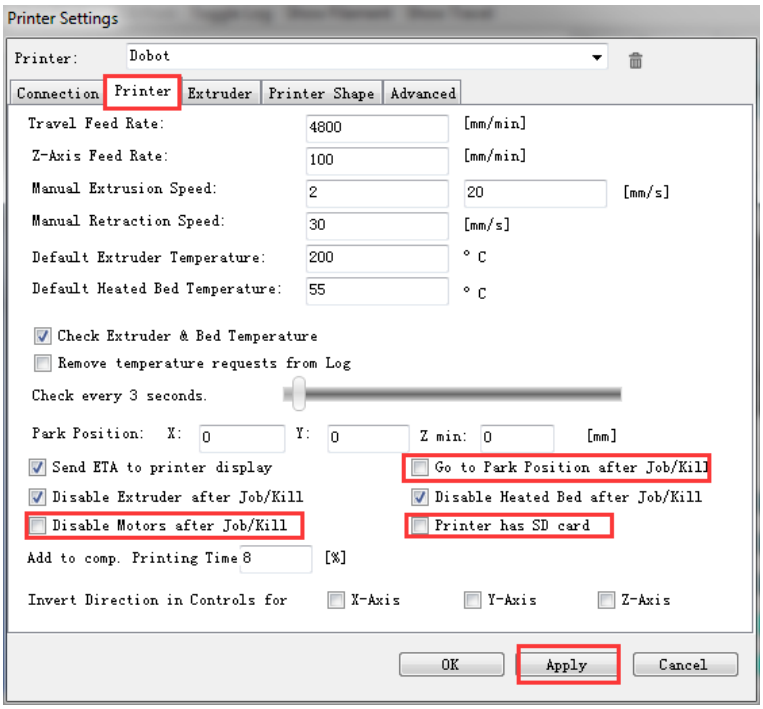

Figure 5.88 Unselect options

4. Set the corresponding parameters on the Extruder tab as shown in the red box of Figure 5.89, and the other parameters are set by default. Then click **Apply**.

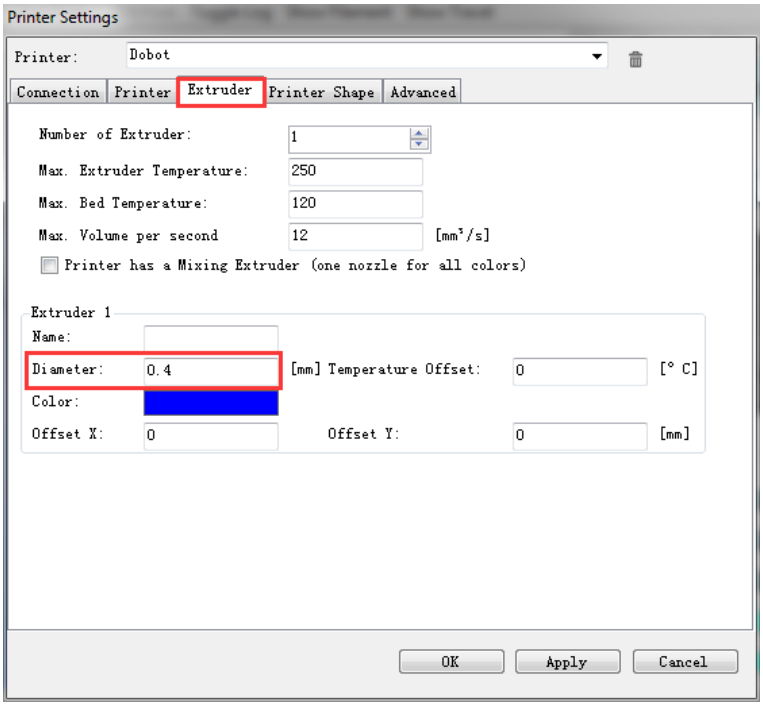

Figure 5.89 Extruder settings

5. Set the corresponding parameters on the Printer Shape tab as shown in the red box of Figure 5.90, and the other parameters are set by default. Then click **Apply**.

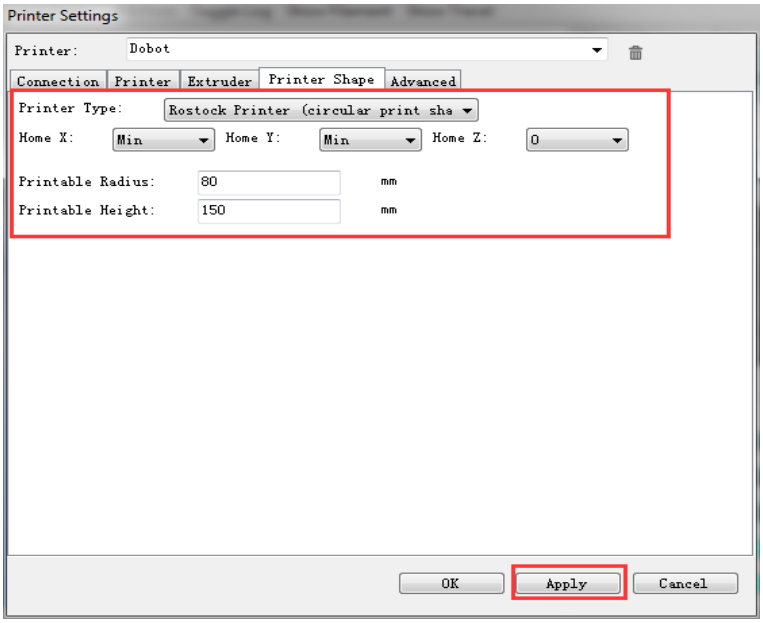

Figure 5.90 Printer shape settings

6. Click **OK**

Step 3 Click **Connect** on the Repetier Host page to connect Dobot Magician.

After the connection is successful, the current heating temperature will be shown on the below of the **Repetier Host** page, as shown in Figure 5.91.

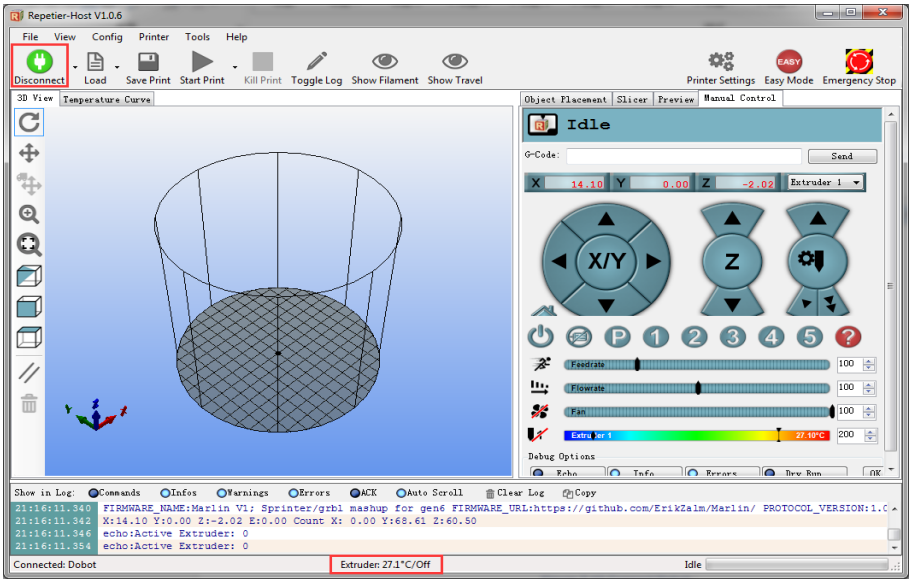

Figure 5.91 Connect to Dobot Magician

Step 4 Text extruder.

Before printing, you need to test the extruder to check whether the melted filament flows from the nozzle of the extruder.

The temperature of the extruder should be above 170℃. Dobot Magician will not start 3D printing until the filament is in the melting state. So you need to heat the extruder first.

1. Set the heating temperature to 200℃ on the **Manual Control** tab of the **Repetier Host** page and click , as shown in Figure 5.92.

⚠DANGER

The heating rod will produce high temperature up to 250℃, please be careful. Do not let children play with it alone. The process needs to be monitored when it is running. After the process is completed, please turn off the equipment promptly.

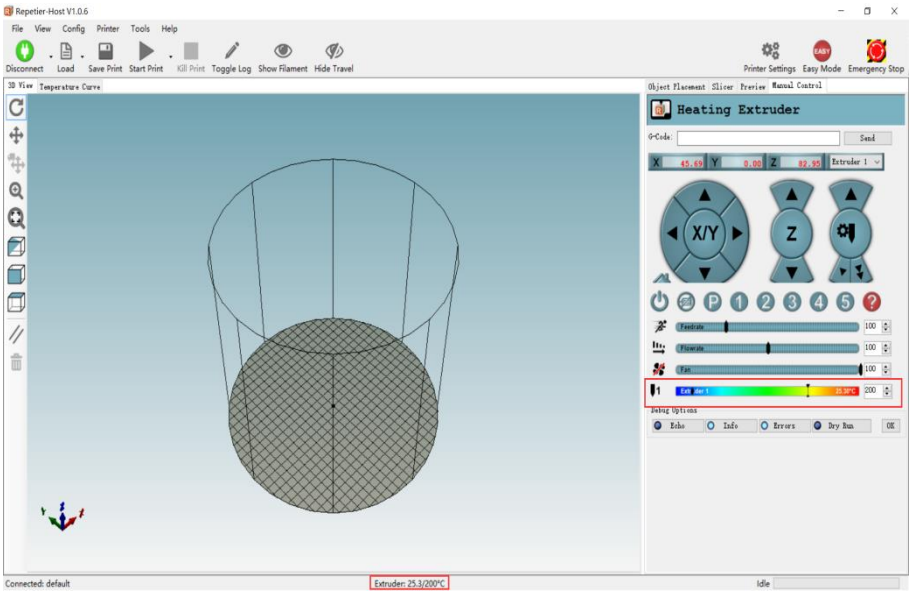

Figure 5.92 Heat the extruder

2. Click the extruder feeder when the heating temperature is up to 200℃ and feed up to10mm-30mm, as shown in Figure 5.93.

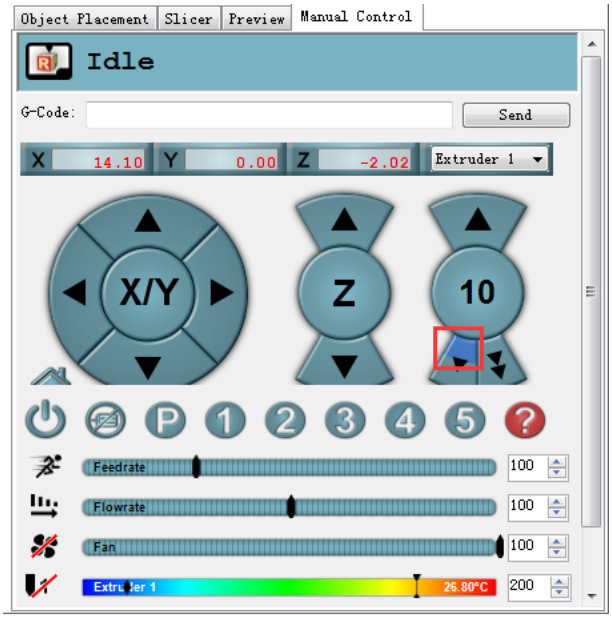

Figure 5.93 Extrude filament

If the melted filament flows from the nozzle of the extruder, the extruder is working properly.

⚠NOTICE

If the filament extrusion is in the opposite direction. Please remove the filament, and turn the extruder around, then re-push down the filament.

Step 5 Adjust the printing space and get the printing coordinates.

🕮NOTE

During printing, if the distance from Dobot Magician to the printing platform is too large or too small to paste the first layer, it can lead to the nozzle blockage. For increasing the stickiness of the first layer, placing a masking paper on the platform is recommended.

1. Press the **Unlock** key on the Forearm and drag Dobot Magician to make the printing head contact the surface of the masking paper (The distance between the printing head and the surface of the masking paper is the thickness of a sheet of A4 paper), then release the **Unlock** key.
2. Input command M415 on the G-Code command window and press Enter to get the current coordinates, as shown in Figure 5.94.

   You can also press the **Key** button on the back of the base to get the current coordinates.

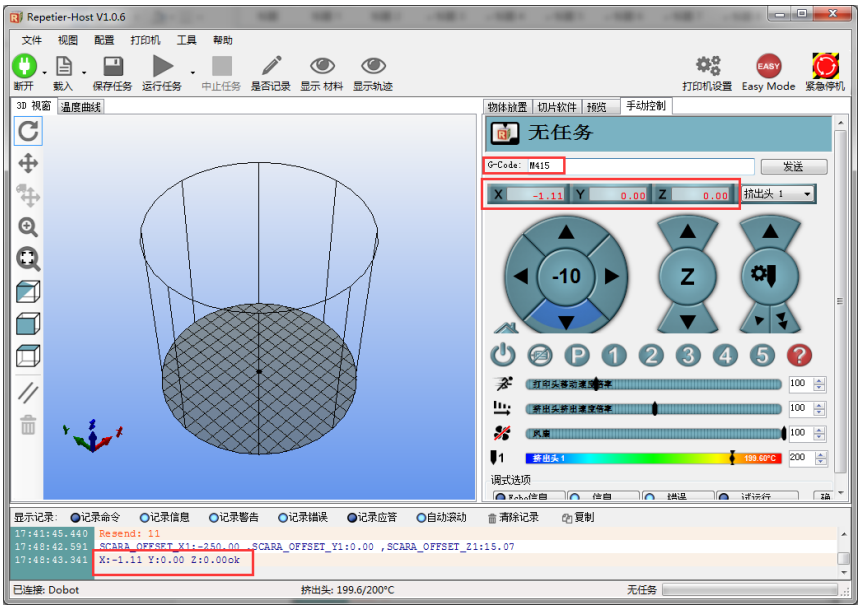

Figure 5.94 Input M415

NOTE

If you cannot find the **G-Code** command window, please click **EASY** to close **Easy Mode**, as shown in Figure 5.95.

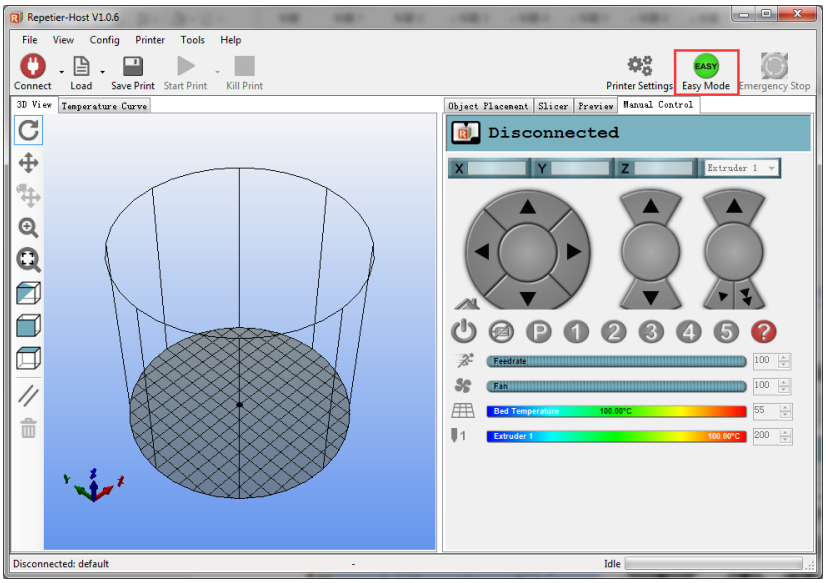

Figure 5.95 Easy mode

Step 6 Click **Load** to import the prepared 3D printing model, as shown in Figure 5.96.

The format of 3D model is **STL**. You can design 3D model and transform it into STL format.

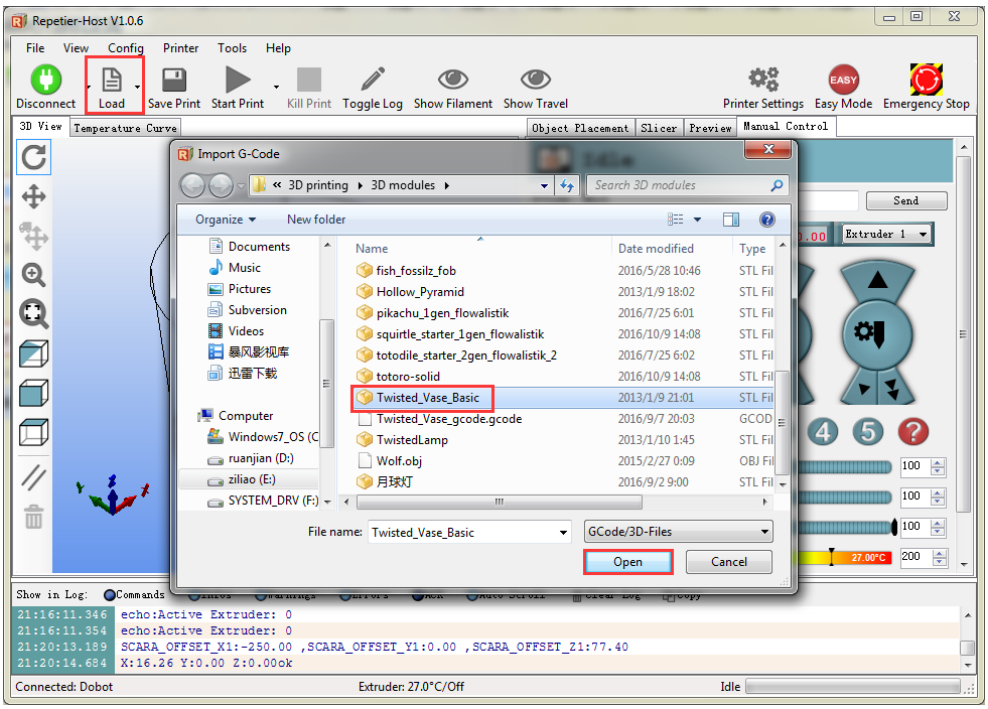

Figure 5.96 Import 3D printing model

After importing the model, you can center, zoom, or rotate the model on the **Object Placement** page, as shown in Figure 5.97.

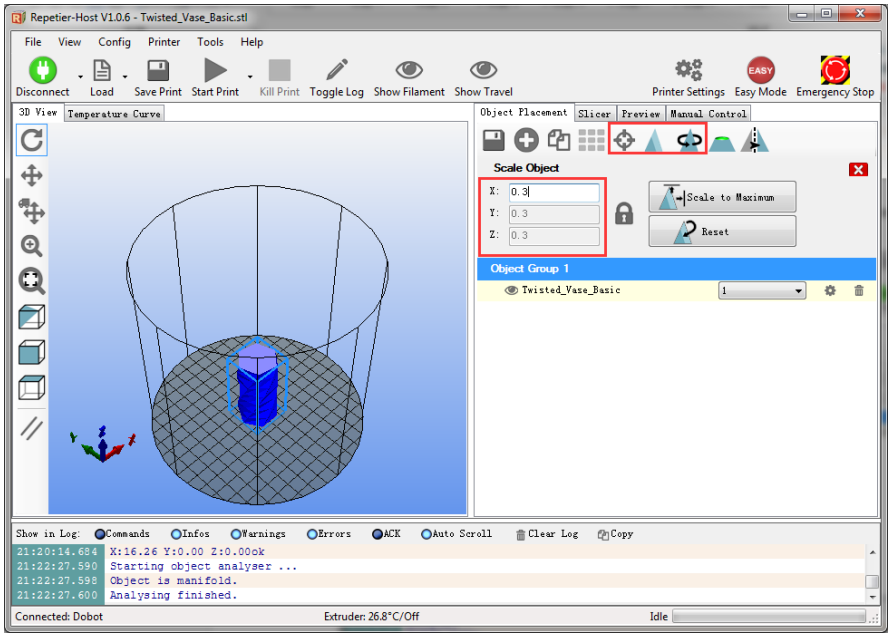

Figure 5.97 Model operation

Step 7 Set slicing parameters and slice up.

You need to set the slicing parameters before first printing.

1. Select **Slic3r** from **Slicer** on the **Slicer** tab of the **Repetier Host** page, and click **Configuration**, as shown in Figure 5.98.

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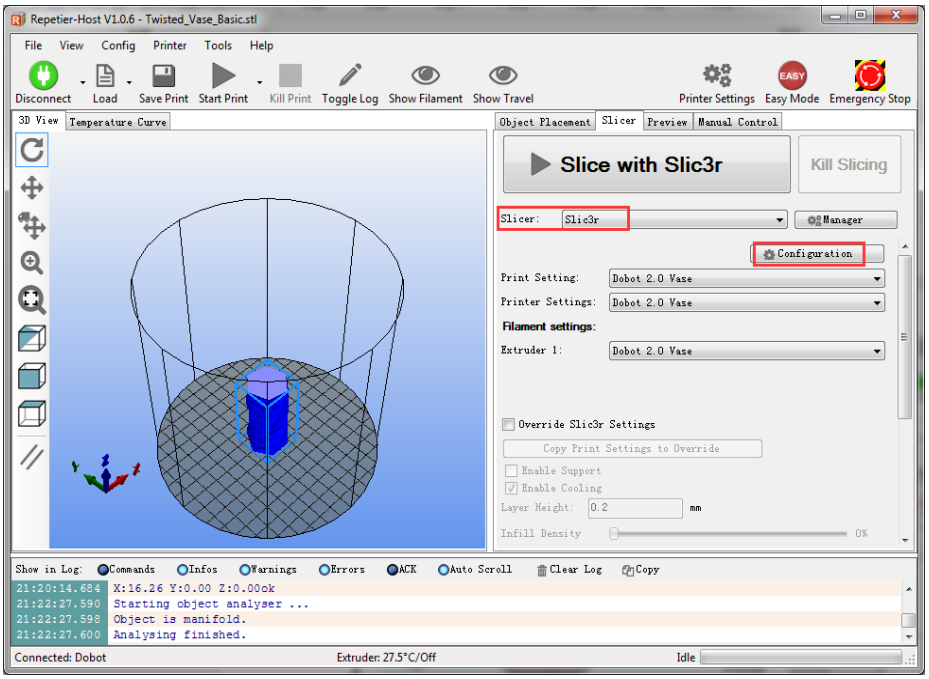

Figure 5.98 Select slicer

The Slic3r page is displayed, as shown in Figure 5.99.

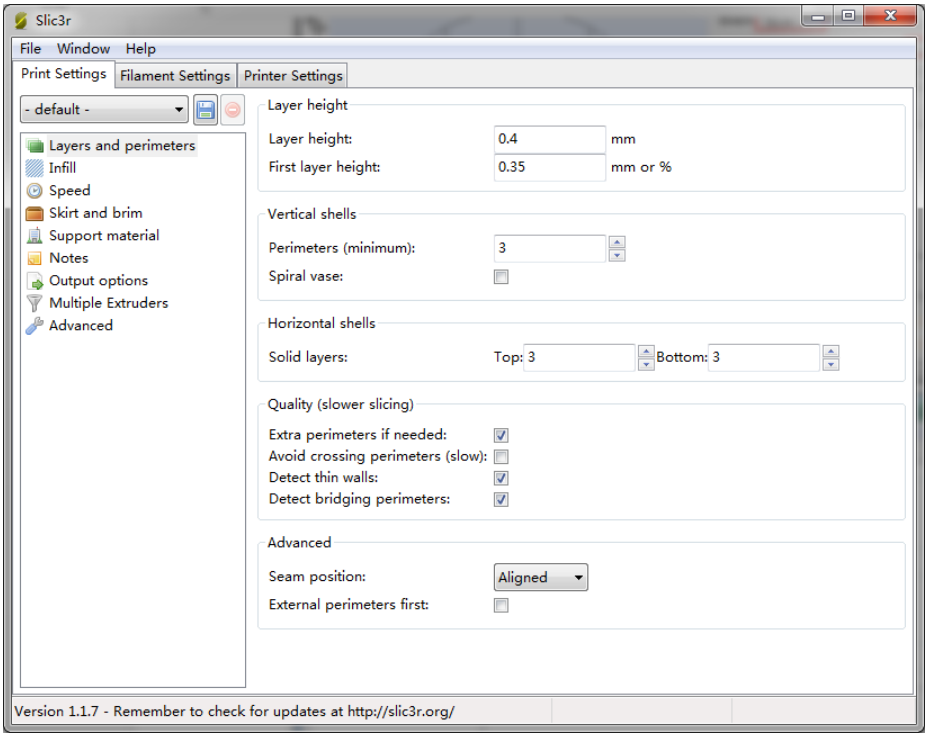

Figure 5.99 Slic3r page

2. Set the slicing parameters on the Slic3r page.

   The 3D printing effect depends on the slice parameters. This topic provides a

configuration sample, you can select File > Load Config on the Slic3r page to import it directly for printing.

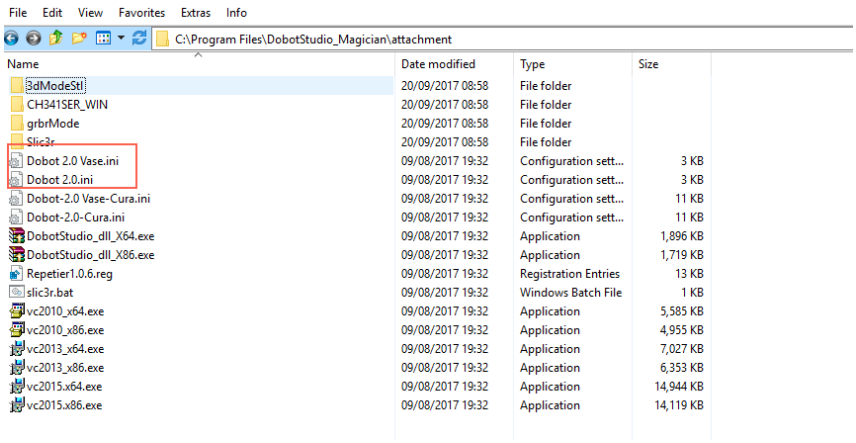

Figure 5.100 Configuration sample

Dobot-2.0-Vase.ini is used for printing a thin-walled vase, while Dobot-2.0-ini is used for the filling, the filling rate is 20%.

3. Save the Printing Settings, Filament Settings and Printer Settings tabs respectively after importing configuration sample, as shown in Figure 5.101.

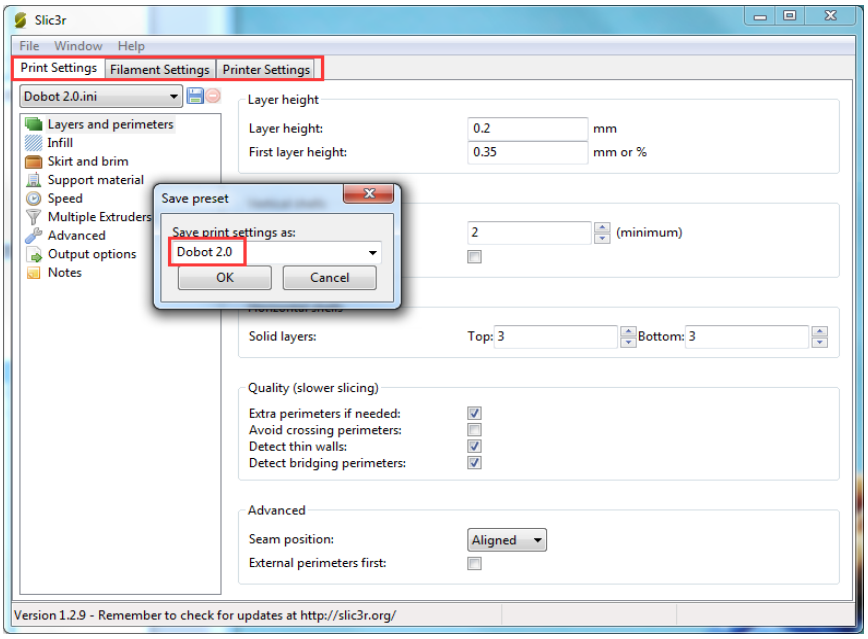

Figure 5.101 Save configuration file

4. Click Slici with Slic3r on the Slicer tab of the Repetier Host page, as shown in Figure 5.102.

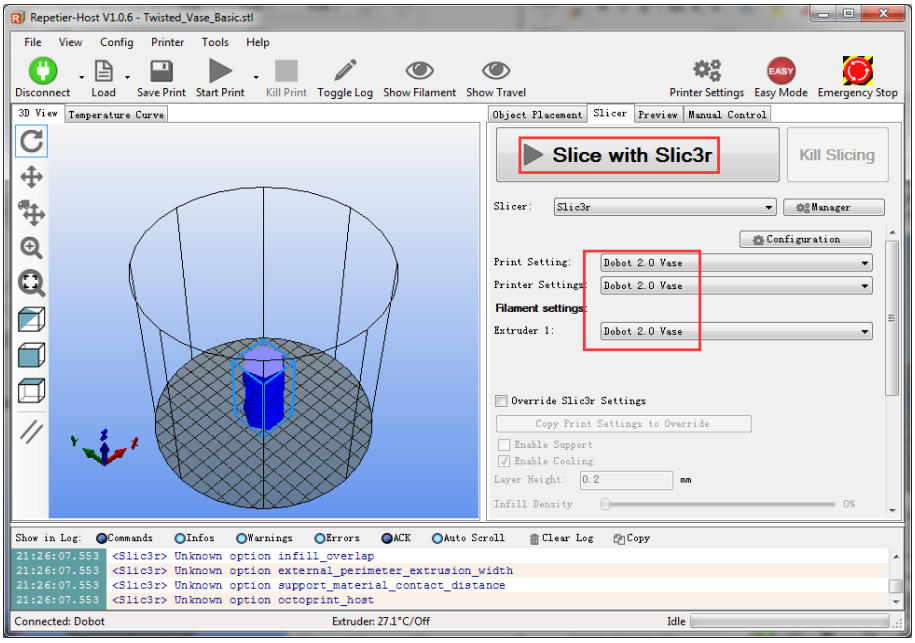

Figure 5.102 Start to slice

5. Click on the top left corner of the Repetier Host page to print.

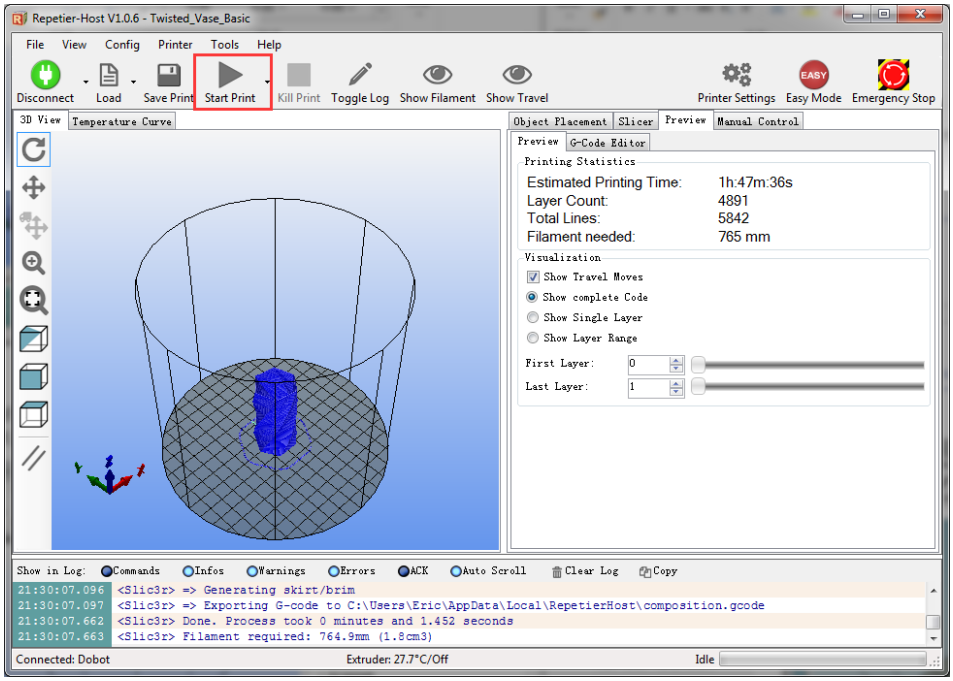

Figure 5.103 Start printing

Here the vase mode is adopted to print, and the product after printing is shown in Figure 5.104.

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Figure 5.104 Product of printing

5.8.4 Operating Cura

If you need to use Cura software for 3D printing, please launch the Cura software after burning firmware.

Prerequisites

- Slice software Cura has been installed.

  Download path: https://ultimaker.com/en/products/ultimaker-cura-software/list.

  Please download the recommended version V14.07. The way how to install and use is not described in this topic.
- The 3D printing model has been prepared.
- The printing platform has been prepared and placed within the workspace of Dobot Magician.
- Dobot Magician has been powered on, and connected to DobotLab successfully (Only USB connection is supported).
- The 3D printing kit has been installed.

Procedure

Step 1 Launch **Cura** software.

Step 2 Set slicing parameters.

1. Select **Machine > settings** on the Cura page.

   Now the **Machine settings** page is displayed.
2. Set the corresponding parameters on the Machine settings and click OK, as shown in Figure 5.105. Table 5.4 lists the values of the parameters that need to be set. The other parameters are set by default.

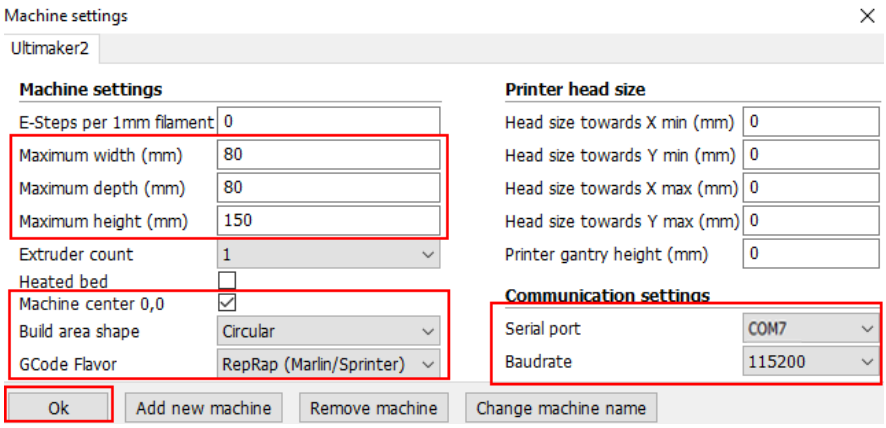

Figure 5.105 Parameters setting

Table 5.4 3D printing parameters description

Parameter	Description
Maximum width	Set to 80mm
Maximum depth	Set to 80mm
Maximum height	Set to 150mm
Machine center 0,0	Select it
GCode Flavor	Style of GCode: select **RepRap Marlin/Sprinter**
Build area shape	Select **Circular**
Serial port	Select the corresponding serial port
Baudrate	Set to 115200

3. Set slice parameters, and select File > Open Profile to import these parameters, as shown in Figure 5.106.

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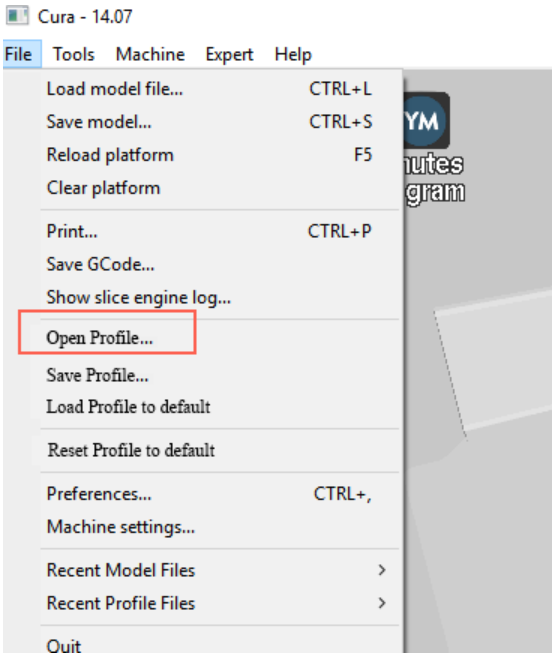

Figure 5.106 Import slice parameters

The 3D printing effect depends on the slice parameters. This section provides a configuration sample, you can import it directly for printing.

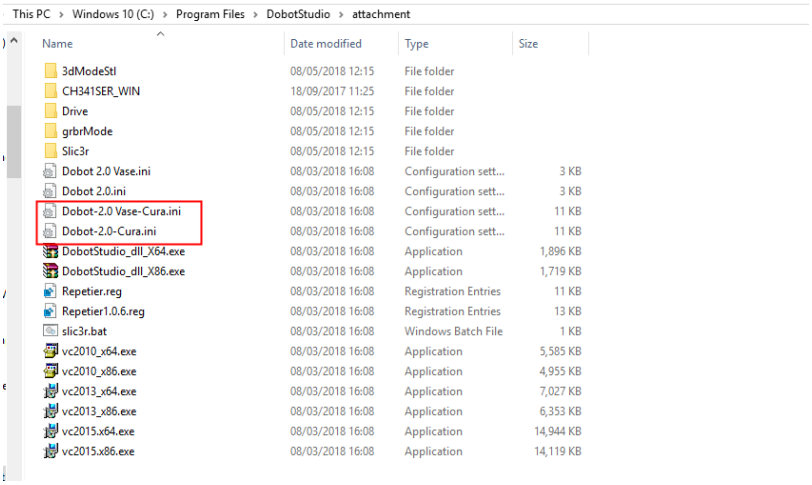

Figure 5.107 Configuration sample

Dobot-2.0-Vase-Cura.ini is used for printing a thin-walled vase, while Dobot-2.0-Cura.ini is used for the filling, the filling rate is 20%.

4. Click , the Open 3D model page is displayed, and select the 3D printing model prepared.

   The format of 3D model is STL. You can design 3D model and transform it into STL format.

   After importing the model, click the model itself, you can center, zoom or rotate,

and so on, as shown in Figure 5.108.

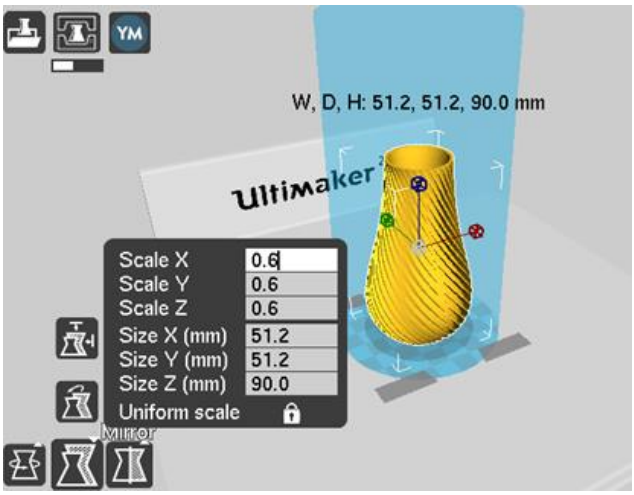

Figure 5.108 Zoom and rotate

5. Click to connect with Dobot Magician.

   The printing window is displayed and the current printing temperature is shown on the top corner of the window, as shown in Figure 5.109.

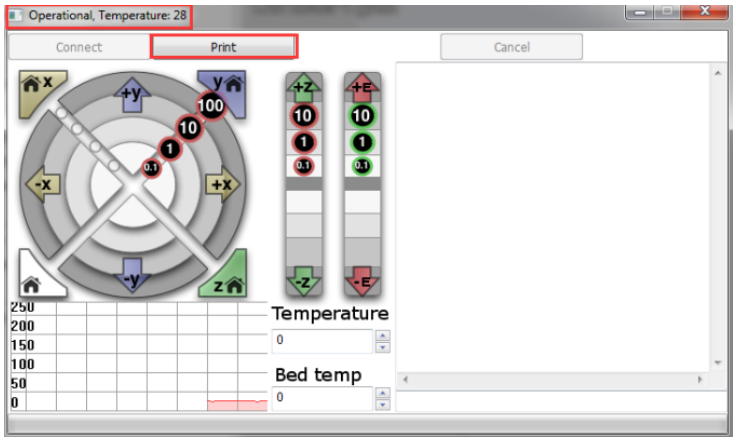

Figure 5.109 Printing window

6. Set **Temperature** to 200 and press down **Enter** to heat the extruder.

   The temperature of the extruder should be above 170℃. Dobot Maigicain will not start 3D printing until the filament is in the melting state. So you need to heat the extruder first.

⚠DANGER

The heating rod will produce high temperature up to 250℃, please be careful. Do not let children play with it alone. The process needs to be monitored when it is running. After the process is completed, please turn off the equipment promptly.

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Step 3 Test the extruder.

Before printing, you need to test the extruder to check whether the melted filament flows from the nozzle of the extruder.

Click the feedstock extruder or click the given stepper, such as **10**, **1**, **0.1** (**10** is recommended) on the **Operational** page and feed up to 10mm-30mm, as shown in Figure 5.110.

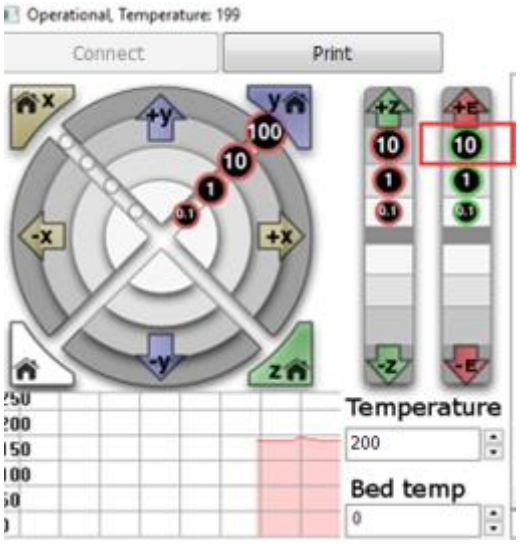

Figure 5.110 Click feedstock extruder

If the melted filament flows from the nozzle of the extruder, the extruder is working properly.

⚠NOTICE

If the filament extrusion is in the opposite direction, please remove the filament, and turn the extruder around, then re-push down the filament.

Step 4 Adjust the printing space and get printing coordinates.

🕮NOTE

During printing, if the distance from Dobot Magician to the printing platform is too large or too small to paste the first layer, it can lead to the nozzle blockage. For increasing the stickiness of the first layer, placing a masking paper on the platform is recommended.

1. Press the **Unlock** key on the Forearm and drag Dobot Magician to make the printing head contact the surface of the masking paper (The distance between the printing head and the surface of the masking paper is the thickness of a sheet of A4 paper), then release the **Unlock** key.
2. Input command M415 on the lower right of the Operational page to get the

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current coordinates, as shown in Figure 5.111.

You can also press the **Key** button on the back of the base to get the current coordinates.

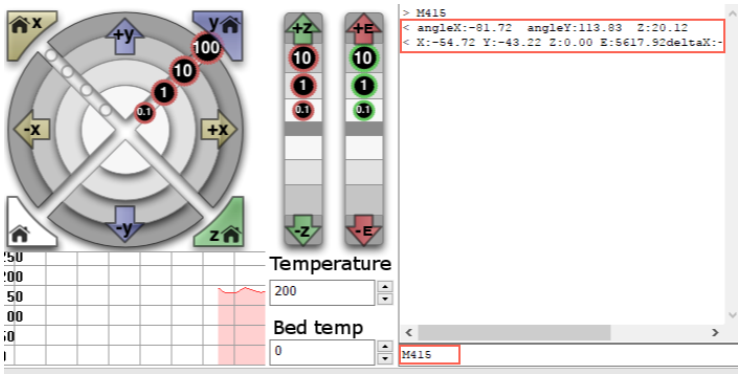

Figure 5.111 Input command M415

Step 5 Click **Print**, Dobot Magician moves to the printing origin (System setting) and starts printing.

5.9 Calibration

5.9.1 Base Calibration

The base encoder has been calibrated before being shipped out. Generally, the J1-coordinate is 0° after homing, where the homing point is the system default. Namely, the Forearm is located at the middle in front of the base.

If the J1-coordinate is not 0° (error range: 1° ~3°) after homing, you need to re-calibrate the base encoder.

Prerequisites

- The writing and drawing kit has been installed. For details, see *5.5.1 Installing a Writing and Drawing Kit*.
- Dobot Magician has been powered on, and connected to DobotLab.
- DobotLink has been started.
- The sensor calibration board has been prepared.

Procedure

Step 1 Place the Dobot Magician at the right position on the sensor calibration board, as shown in Figure 5.112.

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Figure 5.112 Location of Dobot Magician

Step 2 (Optional) Set the home point and make the nib contact the surface of the calibration board.

This step is used for observing the nib position on the calibration board when moving J1-axis in **Step 7**, to improve calibration accuracy.

1. Click on the DobotLab main page to enter Teaching and Playback Lab.
2. Click the drop-down list of device connection panel, as shown below. Select **Magician** and click **Connect**.
3. Press the Unlock key on the Forearm and drag Dobot Magician to make the nib contact the surface of the calibration board, then release the Unlock key. The coordinates of this point will be displayed on the command area.
4. Right-click the command, and select **Set Home.**

Step 3 Open DobotLink. Click **Enter** in Machine Calibration module.

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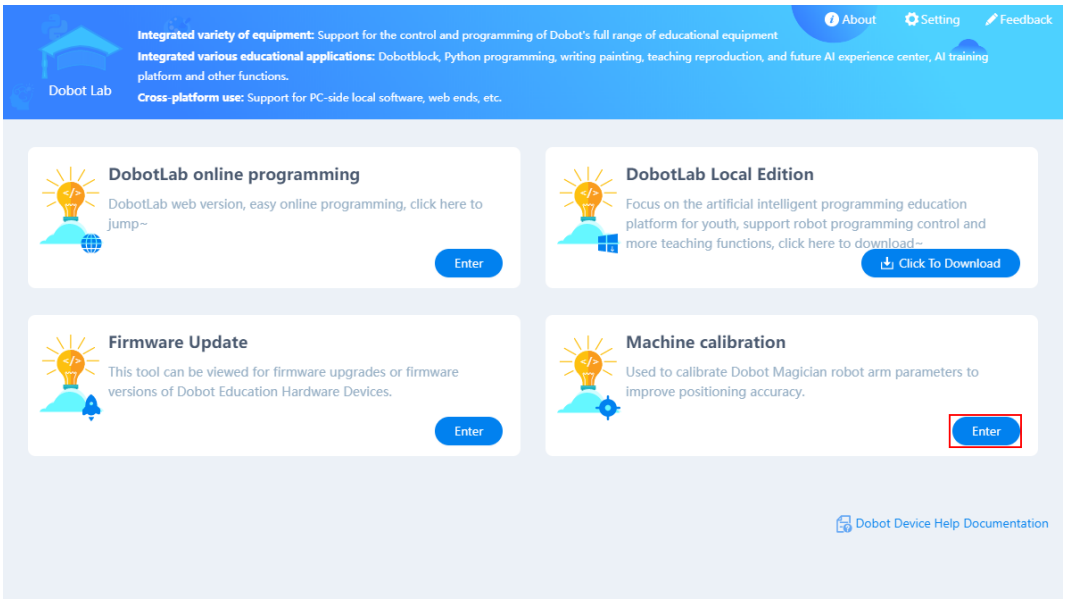

Figure 5.113 Enter machine calibration

Step 4 Click **Connect** on the pop-up window, as shown below.

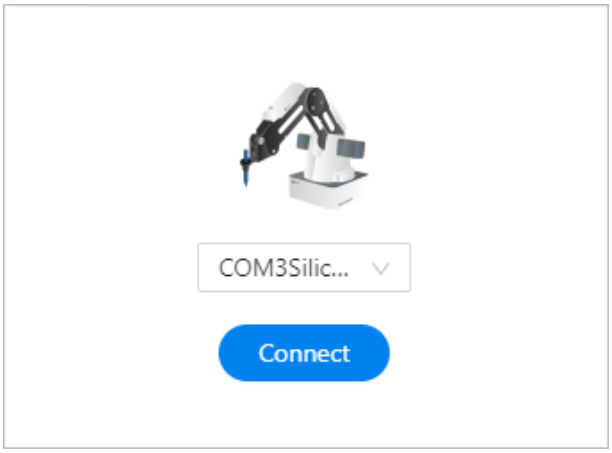

Figure 5.114 Connect device

Step 5 Click **Start calibration** in Base calibration module. The **Base Calibration** page is displayed as below.

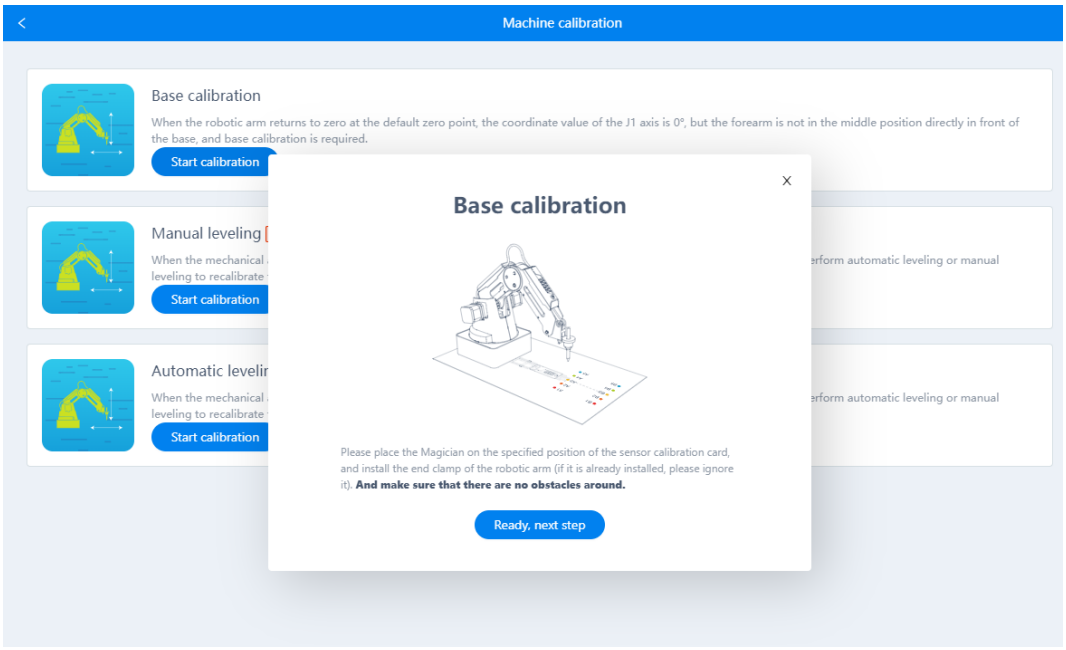

Figure 5.115 Base calibration

Step 6 Click **Ready, next step** on the **Base Calibration** page.

Dobot will start homing. Please ensure that there are no obstacles within the workspace during homing.

Step 7 After homing is finished, click **+J1** or **-J1** to make the nib at a point on the line between **A3** and **B3** on the calibration board, as shown in Figure 5.116 and Figure 5.117.

If the speed is too fast when moving J1-axis, you can drag **speed** slider to adjust speed.

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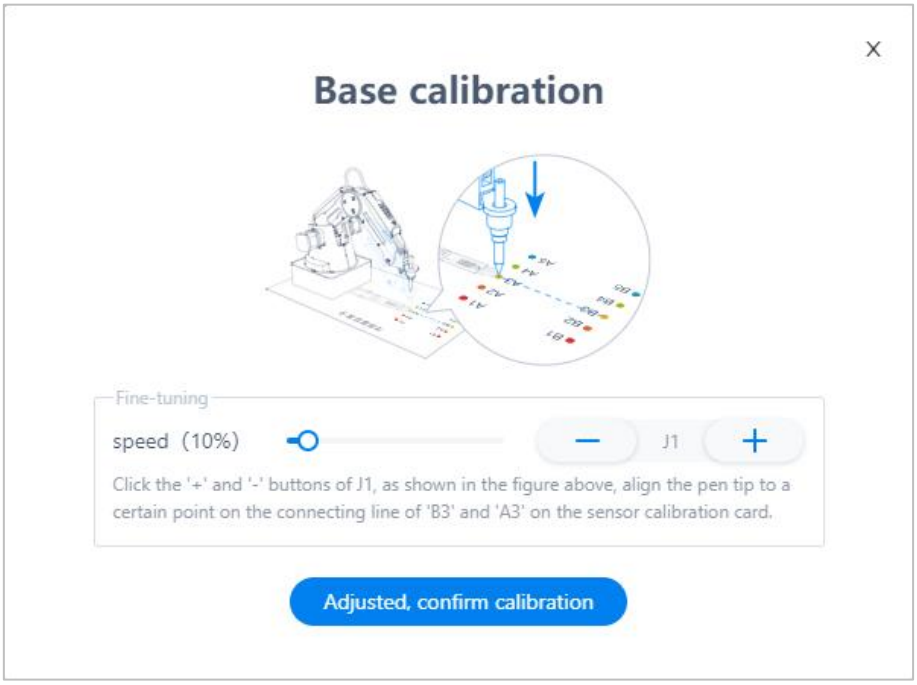

Figure 5.116 Adjust J1 axis

Figure 5.117 Nib position

Step 8 Click **Adjusted, confirm Calibration** to start calibrating the base encoder.

You can check the J1-coordinate on the **Arm Control Panel** page, as shown in Figure 5.118.

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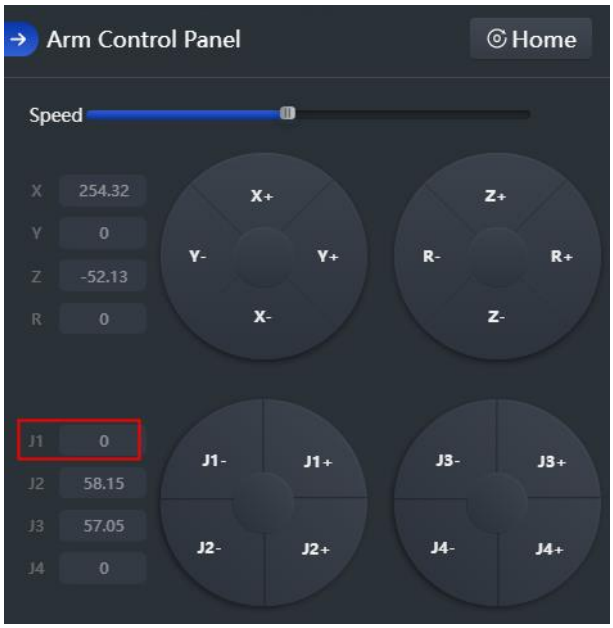

Figure 5.118 J1 coordinates

5.9.2 Sensor Calibration

The angle sensors of the forearm and rear arm have been calibrated before being shipped out. Generally, the Z-coordinate will remain the same when moving Dobot Magician in the same horizontal plane. If changed, you need to recalibrate the angle sensors by manual levelling or auto levelling to improve the positioning accuracy.

- **Manual Levelling**: It is more accurate to calibrate manually with DobotLink, sensor calibration board, and writing and drawing kit, which is suitable for the application scenarios with high requirements for absolute positioning accuracy.
- **Auto Levelling**: It is simple and quick to calibrate automatically with DobotLink and auto-levelling tool, which is suitable for the application scenarios without high requirements for absolute positioning accuracy, such as writing and drawing, 3D printing.

5.9.2.1 Manual Levelling

Prerequisites

- Dobot Magician has been powered on and connected to DobotLab.
- DobotLink has been enabled.
- The sensor calibration board has been prepared.

Procedure

Step 1 Place the Dobot Magician at the right position on the sensor calibration board, as shown in Figure 5.119.

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Figure 5.119 Location of Dobot Magician

Step 2 Open DobotLink. Click **Enter** in Machine Calibration module.

Step 3 Click **Connect** in the pop-up window, as shown below.

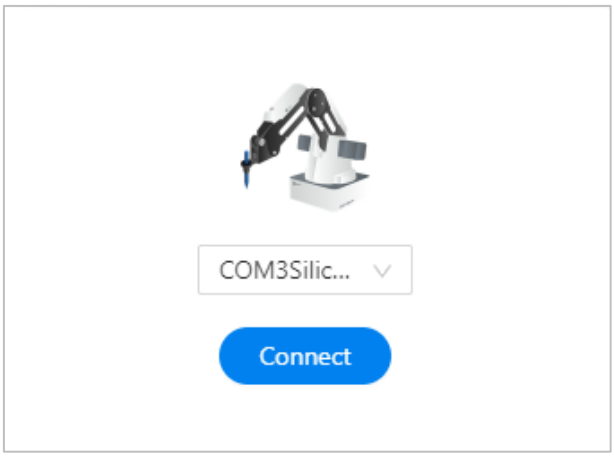

Figure 5.120 Connect device

Step 4 Click **Start calibration** in Manual Levelling module.

The **Manual Levelling** page is displayed.

Step 5 Click **Ready, next step** on the Manual Levelling page.

Dobot Magician will move according to the system settings and finish the auto-compensation of the angle senor coefficients of the forearm and rear arm.

⚠NOTICE

Please remove all end-effectors from Dobot Magician before calibrating

Step 6 Place the pen to the end of the Dobot Magician. See *5.5.1 Installing a Writing and*

Drawing Kit for details. Click **Ready, next step** after installation.

Step 7 Adjust "X" "Y" "Z" coordinates to move Dobot Magician to the first calibrated point (take **A3** as an example). Click **Ready, next step.**

If the speed is too fast when moving J1-axis, you can drag **speed** slider to adjust the speed.

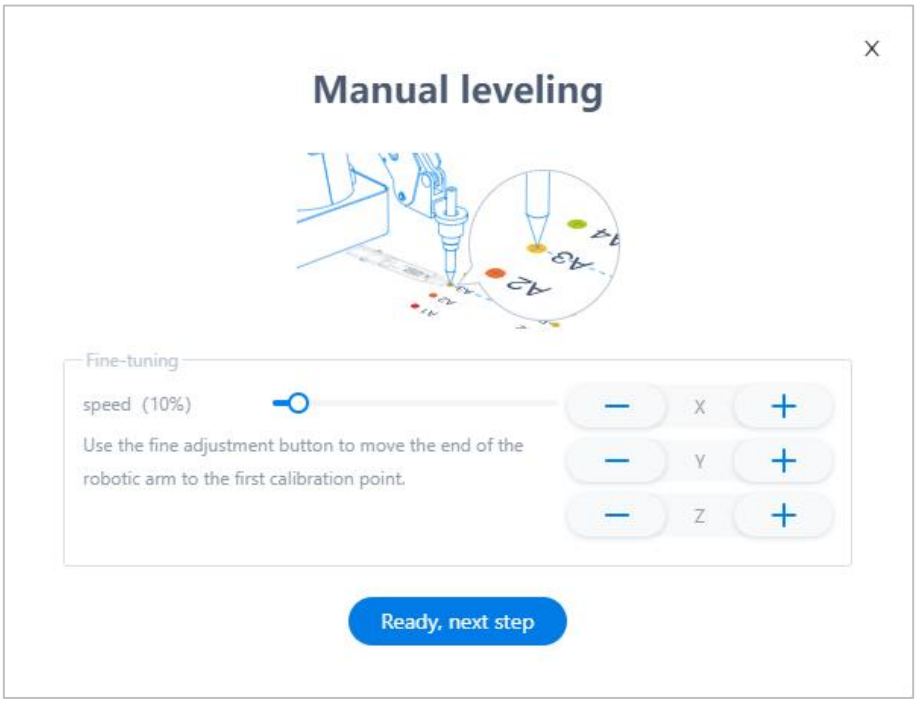

Figure 5.121 Adjust the first calibrated point

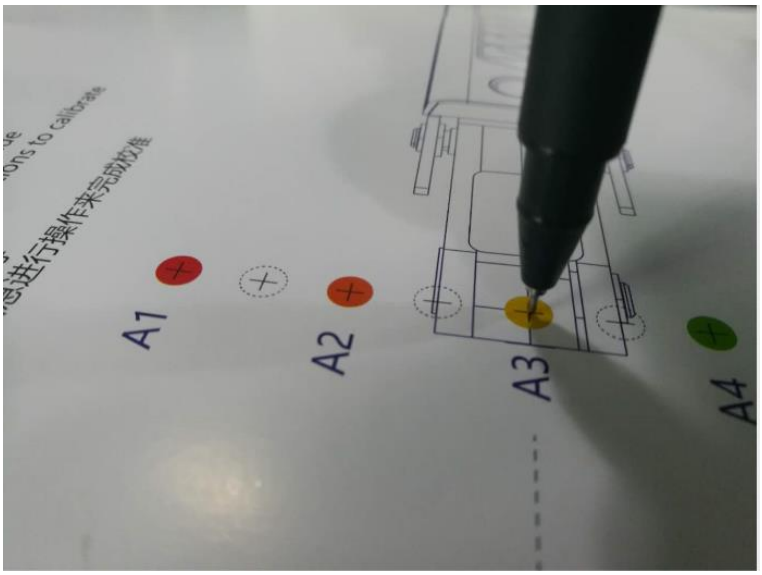

Figure 5.122 Move to the first calibrated point

Step 8 Adjust the "X" "Y" and "Z" coordinates to move Dobot Magician to the second calibrated point (take B3 as an example). Click **Ready, next step.**

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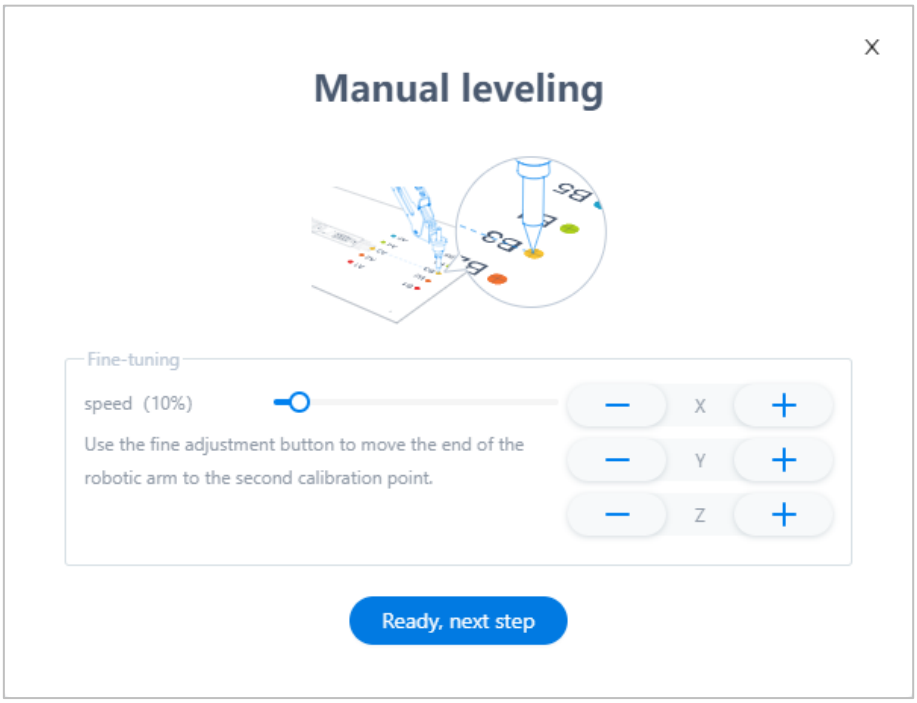

Figure 5.123 Adjust the second calibrated point

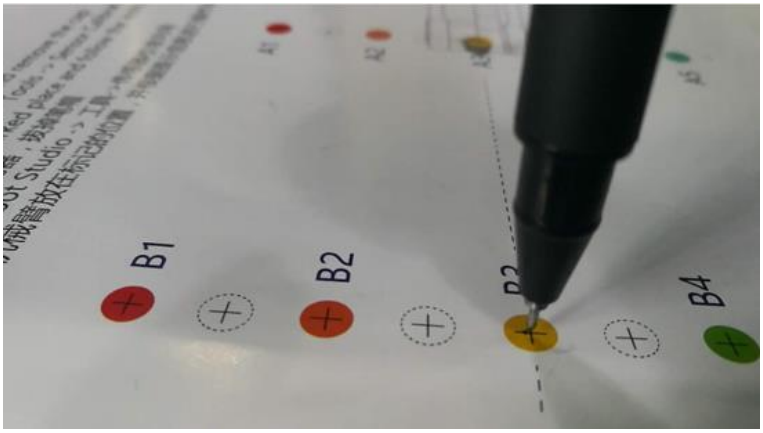

Figure 5.124 Move to the second calibrated point

Step 9 Set the distance between the two calibrated points, as shown in Figure 5.125. As the distance between the two calibrated points on the calibration board is 80mm, please keep the default value in this step.

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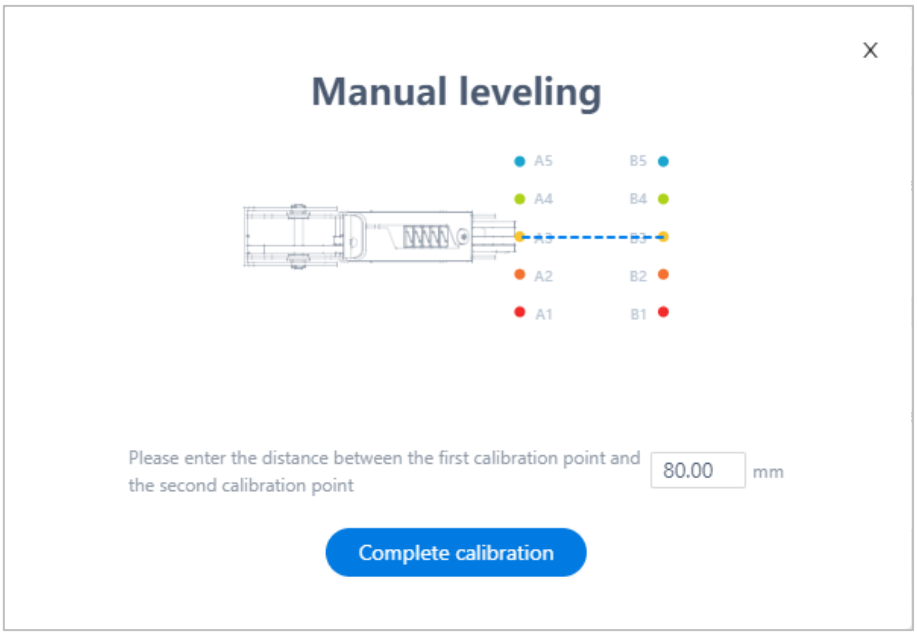

Figure 5.125 Set the distance between two calibrated points

⚠NOTICE

Please DO NOT drag Dobot Magician in this step, to avoid manual levelling failure. If the speed is too fast when clicking coordinate buttons, you can drag the **speed** slider to adjust the speed.

Step 10 Click **Complete calibration.**

5.9.2.2 Auto Levelling

Prerequisites

- Dobot Magician has been connected to a PC via USB cable.
- Dobot Magician has been connected to the power adapter.
- DobotLink has been started.
- The auto-levelling tool has been obtained, as shown in Figure 5.126.

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Figure 5.126 Auto-levelling tool

Procedure

Step 1 Place the Dobot Magician on the flat platform.

⚠NOTICE

Please ensure that the platform is flat. Otherwise, the auto levelling will be failed.

Step 2 Fix the auto-levelling tool on the Dobot Magician with a clamp fixing screw, as shown in Figure 5.127.

Figure 5.127 Fix auto-levelling tool

Step 3 Insert the cable of the auto-levelling tool to the **GP4** interface in the forearm, as

shown in Figure 5.128.

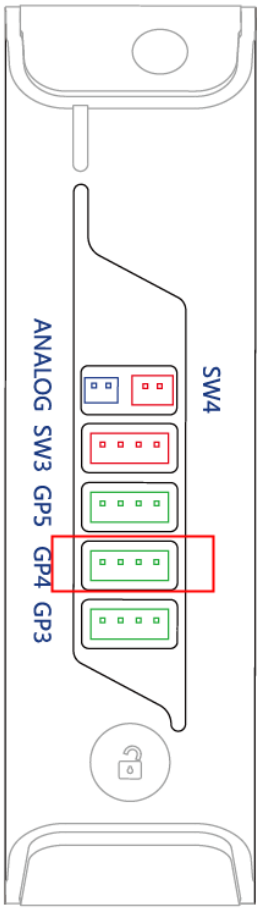

Figure 5.128 Insert the cable of the auto-levelling

Step 4 Power on the Dobot Magician.

Step 5 Open DobotLink. Click **Enter** in Machine Calibration module.

Step 6 Click **Start calibration** in **Auto Levelling** module.

The Auto Levelling page is displayed, as shown in Figure 5.129.

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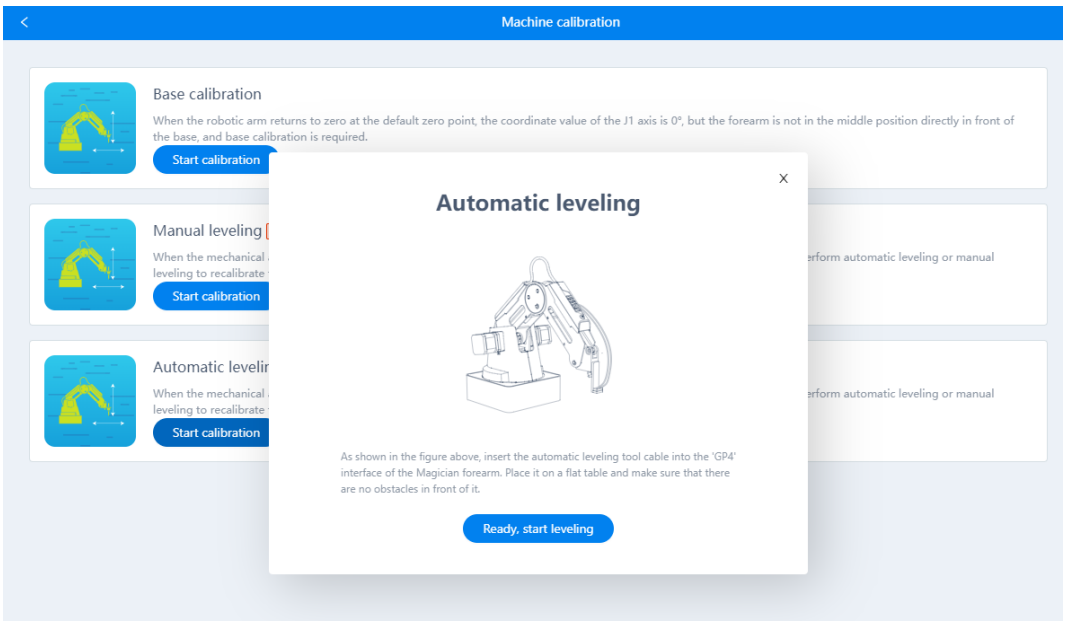

Figure 5.129 Automatic leveling

NOTICE

Please ensure that there are no obstacles in the workspace during auto levelling.

Step 7 Click **Ready, next step** on the "Auto Levelling" page.

Dobot Magician starts auto levelling. The levelling process will take about 2 minutes.

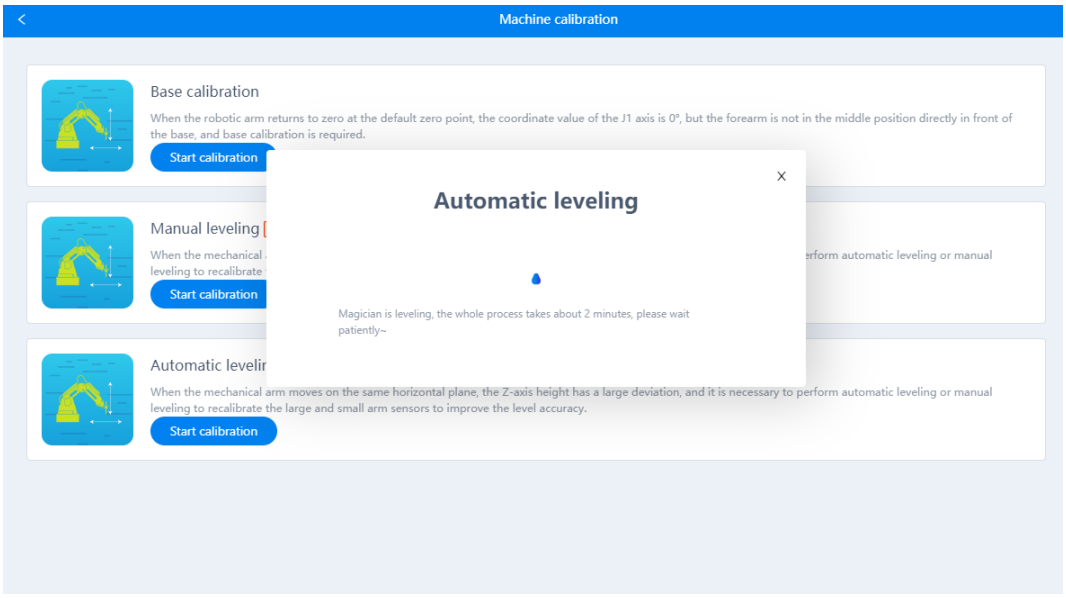

Figure 5.130 Start automatic leveling

5.9.3 Homing

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Dobot Magician has been calibrated before being shipped out. If the Dobot Magician has been hit or the motor has lost step, you need to operate homing to improve the positioning accuracy.

Prerequisites

Dobot Magician has been powered on, and connected to DobotLab.

Procedure

Click **Home** on the arm control panel of DobotLab, as shown in Figure 5.131.

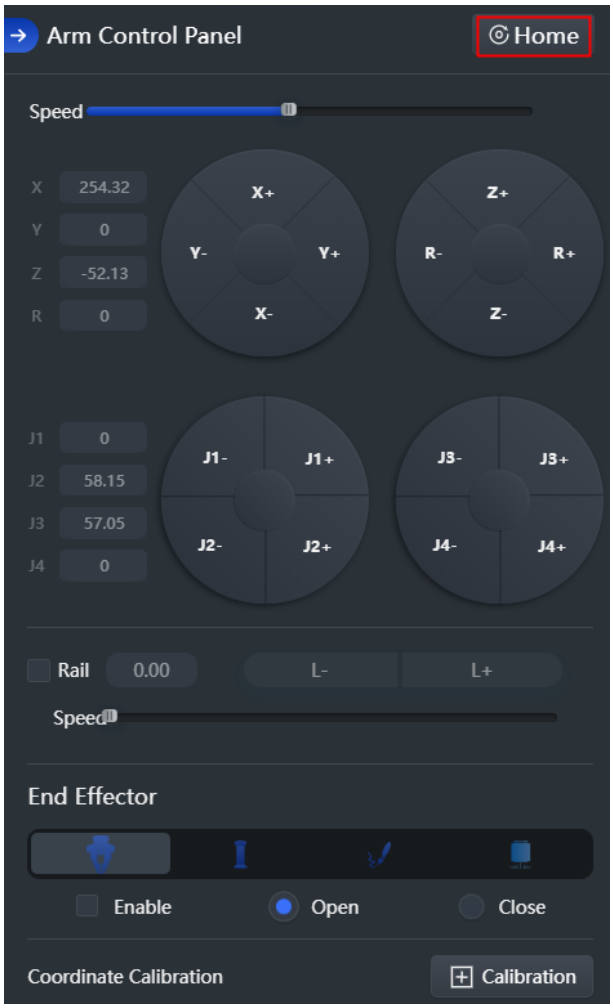

Figure 5.131 Set home

NOTICE

- Please remove the end-effector from the Dobot Magician before homing.
- Please ensure that there are no obstacles within the workspace during homing.

Dobot Magician will rotate clockwise to the limited position and then return to the default homing point automatically and the LED indicator on the base flashes blue. After the homing is successful, there is a beep sound and the LED indicator turns green.

The homing point can also be use-defined. You can right-click a saved point in the command

area of Teaching and Playback Lab and click **Set Home** to set it as the homing point, as shown in Figure 5.132.

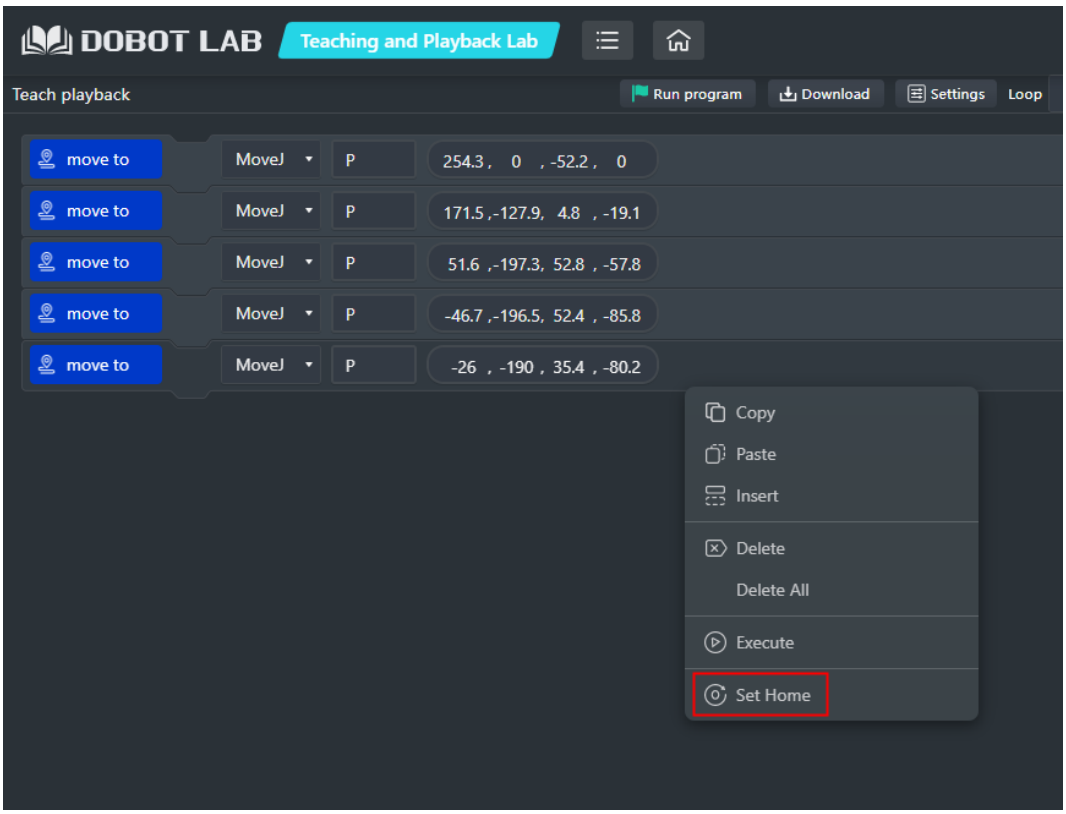

Figure 5.132 Set home position

5.10 Working in Offline Mode

Offline mode allows the Dobot Magician to perform the points in the point list previously downloaded from DobotLab, without keeping the USB connection established.

Prerequisites

- The Dobot Magician has been powered on.
- The Dobot Magician has been connected to DobotLab.
- The points have been saved.

Procedure

Step 1 After saving points in Teaching and Playback Lab, click **Download**. A prompt window on whether to return to the home point will pop up, as shown below.

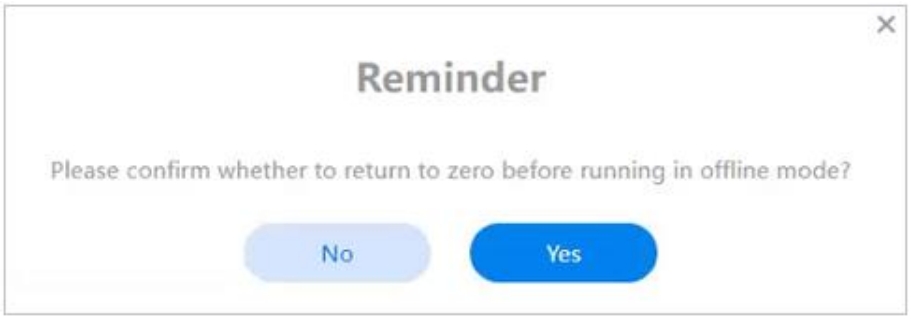

Figure 5.133 Confirm whether returning to the home point

Step 2 Click **Yes** to download the point list.

You will see "The script has been downloaded to Magician successfully" on the screen when the downloading is completed.

Step 3 Disconnect the Dobot Magician from Dobotlab, or the USB cable between the robot arm and your computer.

Step 4 Short press the **Key** button on the rear panel of the base.

Step 5 The Dobot Magician returns to its home point and performs the downloaded points. To stop the movement of the robot arm, short press the **Key** button.

⚠NOTICE

Before using offline mode, setting the Dobot Magician to the home point can make the Dobot Magician more accurate.

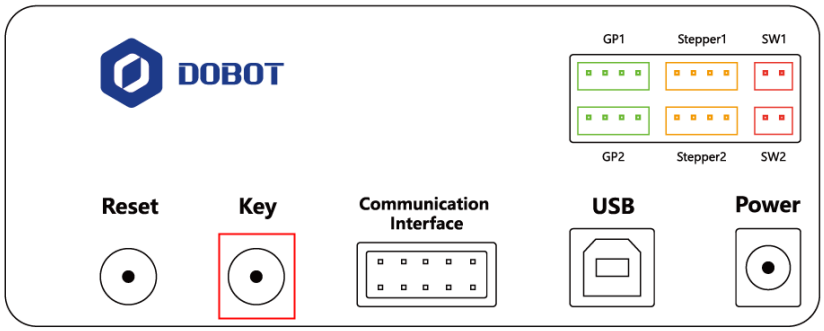

Figure 5.134 Base panel

If there are some points saved in Dobot Magician before, you need to directly start the Magician, wait about 20 seconds after the light turns green, and short press the **Key** button to start homing operation. Then short press the **Key** button again to start offline playback.

5.11 Operating Stick Controller Kit

Dobot Magician can be controlled by stick controller kit. As shown in Figure 5.135, the stick controller kit includes (from left to right) a stick controller, a USB Host module, a USB cable (used

for charging stick controller), and a transceiver.

Figure 5.135 Stick controller kit

⚠NOTICE

- Please do not connect Dobot Magician to DobotLab when operating the stick controller.
- Please turn off the Dobot Magician completely first before connecting or disconnecting external equipment. Otherwise, it causes serious damage to your device.

Prerequisites

Dobot Magician has been connected to the power adapter.

Procedure

Step 1 Connect the transceiver to the USB module.

Step 2 Connect the USB Host module to the UART interface on the base, as shown in Figure 5.136. Please note that one end of the 10pin communication cable should be inserted into the communication interface of the robot arm with the slot side upwards, and the other end should be inserted into the USB host interface with the slot side naturally downwards, as shown in Figure 5.137.

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Figure 5.136 Connect with USB Host module

Figure 5.137 Connect Magician to USB host

Step 3 Press down the **Power** button to turn on the Dobot Magician.

The blue LED indicator on the USB Host module is on. After Magician is turned on, there are four short beep sounds and the green one is on.

Step 4 Press down the power button on the stick controller, as shown in Figure 5.138.

The red LED indicator on the middle of the stick controller is on, indicating that the Dobot Magician can be controlled by the stick controller.

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Figure 5.138 Power button of the stick controller

Table 5.5 lists the functions of buttons on the stick controller.

Table 5.5 Button function

Button	Function
Power button	Turn on stick controller The stick controller will turn off automatically
LT	Turn on the peripheral motor
RT	Turn off the peripheral motor off
RB	Switch to Cartesian coordinate system mode
LB	Switch to Joint coordinate system mode
X	Control the outtake of the air pump
Y	Control the intake of the air pump
B	Turn off the air pump
Left stick: Front/back	• Cartesian coordinate system mode: Dobot Magician moves along X-axis in the positive/negative direction • Joint coordinate system mode: Dobot Magician rotates along J1-axis in the positive/negative direction
Left stick: Left/right	• Cartesian coordinate system mode: Dobot Magician moves along Y-axis in the positive/negative direction • Joint coordinate system mode: Dobot Magician rotates along J2-axis in the positive/negative direction
Right stick: Front/back	• Cartesian coordinate system mode: Dobot Magician moves along Z-axis in the positive/negative direction

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Button	Function
	• Joint coordinate system mode: Dobot Magician rotates along J3-axis in the positive/negative direction
Right stick: Left/right	• Cartesian coordinate system mode: Dobot Magician rotates along R-axis in the positive/negative direction • Joint coordinate system mode: Dobot Magician rotates along J4-axis in the positive/negative direction

5.12 Multiplexed I/O Demo

The addresses of the I/O interfaces in Dobot Magician are unified. Most of I/O interfaces have multiple functions. For details, see *4.3 Multiplexed I/O Interface*.

You can set I/O interfaces in the command panel of Teaching and Playback Lab, as shown in Figure 5.139; or select I/O block in DobotBlock Lab, as shown in Figure 5.140; or call corresponding APIs in the command list of Python Lab, as shown in Figure 5.141.

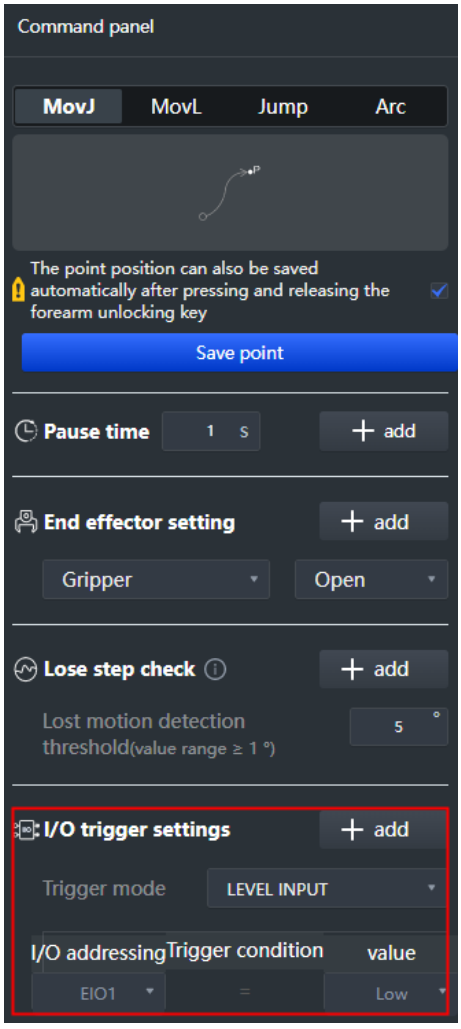

Figure 5.139 IO settings in Teaching and Playback Lab

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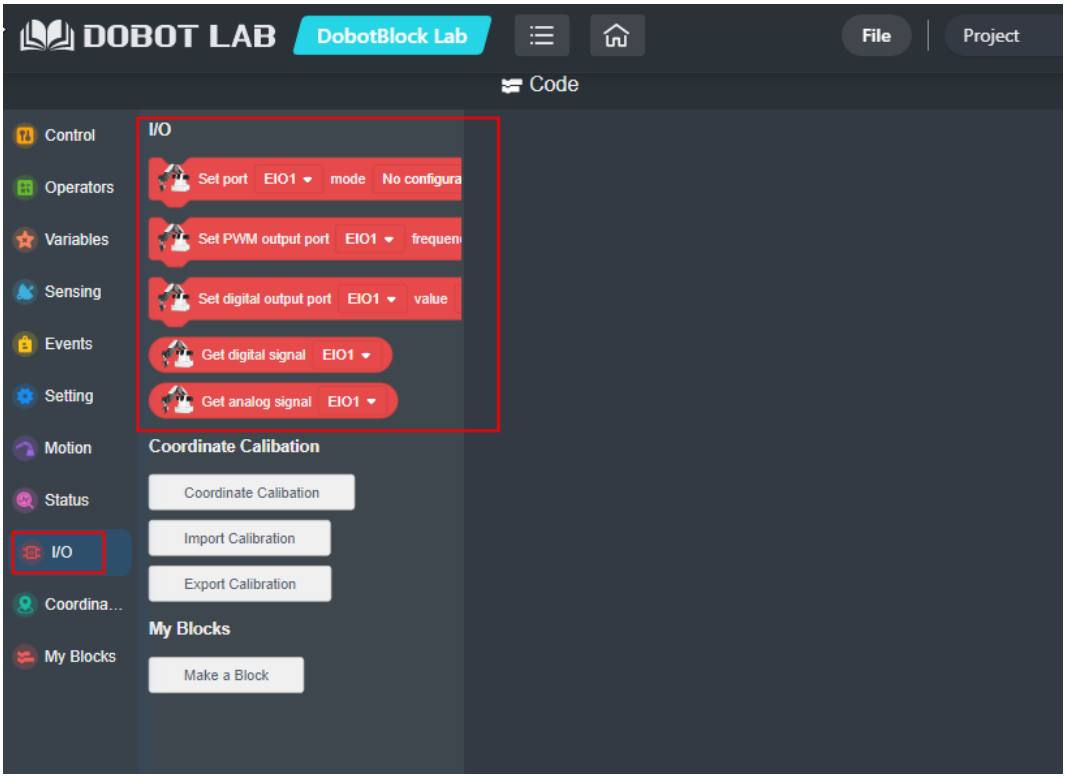

Figure 5.140 IO settings in DobotBlock Lab

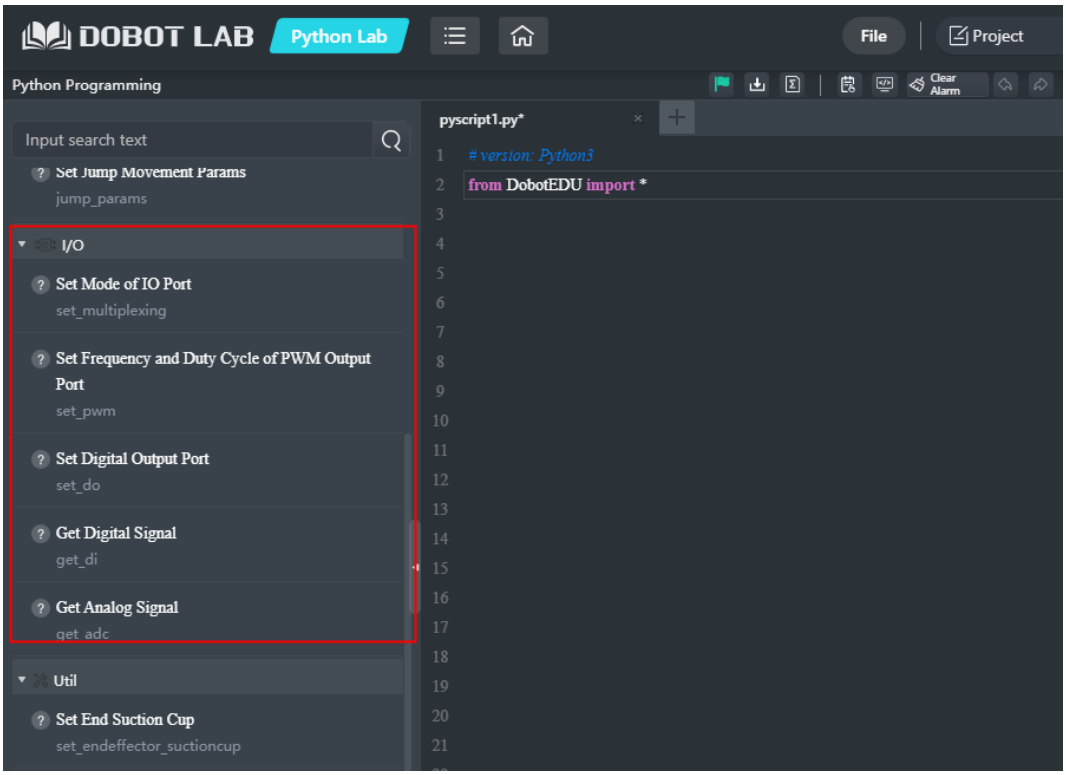

Figure 5.141 IO settings in Python Lab

This section takes Teaching and Playback Lab as an example to illustrate level output, level

input, and PWM output.

5.12.1 Level Output

Normally, an air pump can be controlled by the I/O interfaces. The I/O **11** controls its intake (High level) and outtake (Low level) and the I/O **16** controls its start-stop. Table 5.6 lists the multiplexed descriptions of I/O **11** and I/O **16**.

Table 5.6 Multiplexed I/O description

I/O addressing	Voltage	Level Output	PWM	Level Input	ADC
11	3.3V	√	√	-	-
16	12V	√	-	-	-

The I/O **11** and I/O **16** are located at the peripheral interface of the base, as shown in Figure 5.142.

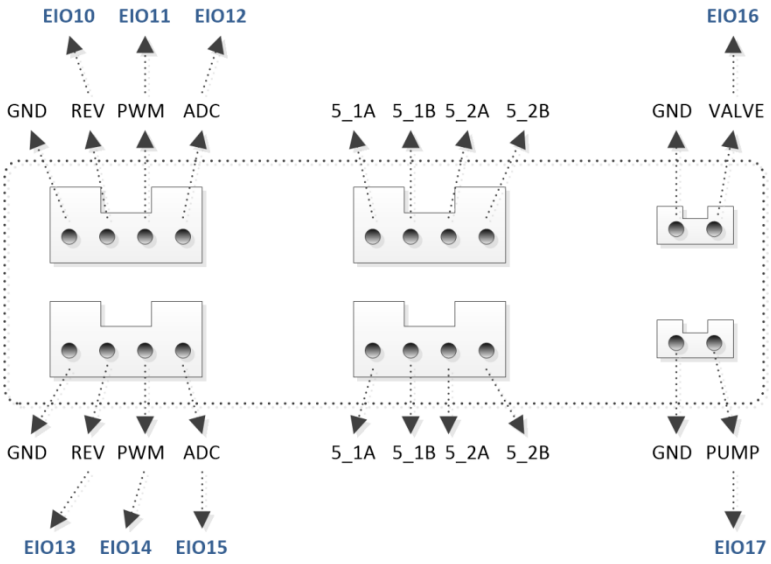

Figure 5.142 Peripheral Interface on the base

Prerequisites

- The air pump has been connected to Dobot Magician. For details, see *5.7.1 Installing a Suction Cup Kit*.
- Dobot Magician has been powered on, and connected to DobotLab successfully.

Procedure

Step 1 Enter Teaching and Playback Lab. Select **Pen** from the end-effector module on the arm control panel, as shown in Figure 5.143.

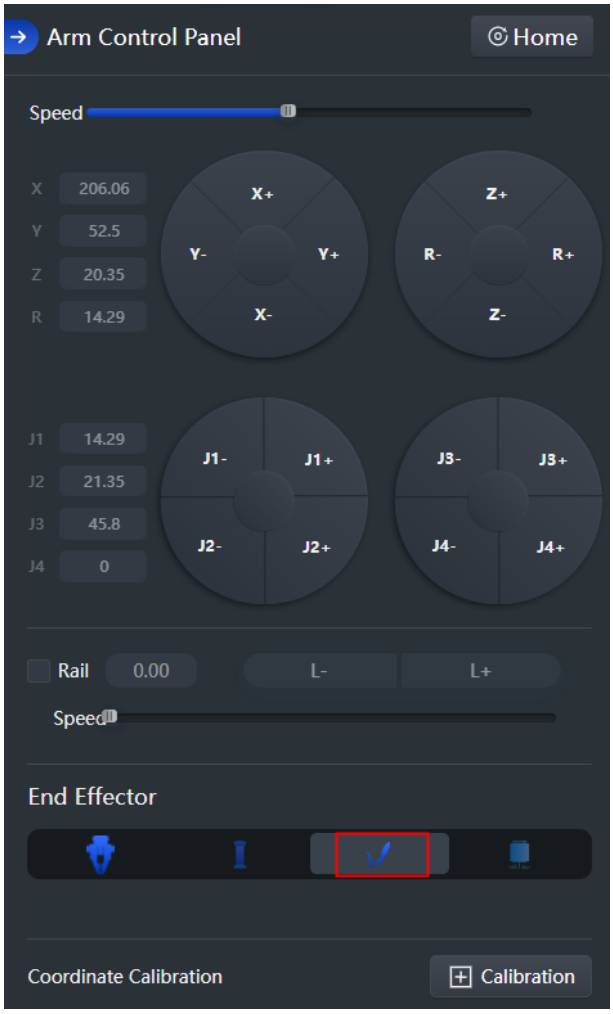

Figure 5.143 Set end-effector

Step 2 Set **Trigger Mode** in I/O trigger settings to **LEVEL OUTPUT**, and EIO11 and EIO 16 value to **High**. Click **Add**, and the corresponding trigger commands are displayed in the command area.

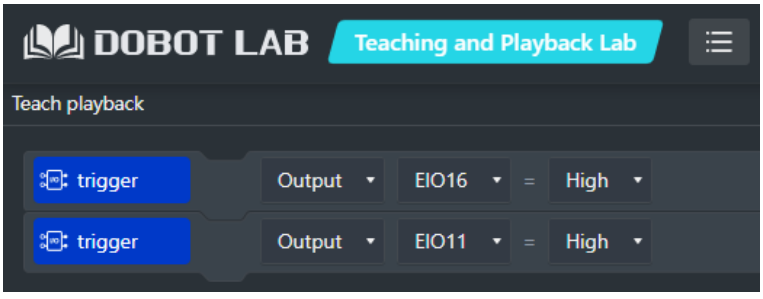

Figure 5.144 Trigger commands

Step 3 Click Running program.

The air pump is humming with intake.

Step 4 Modify EIO11 value to **Low**, as shown below.

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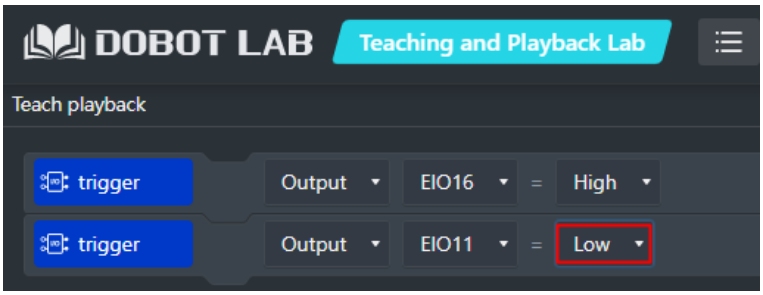

Figure 5.145 Modify EIO11 value

Step 5 Click Running program.

The air pump is humming with outtake.

5.12.2 Level Input

This section takes EIO 12 as an example.

Table 5.7 Multiplexed I/O description

I/O addressing	Voltage	Level Output	PWM	Level Input	ADC
12	3.3V	-	-	√	-

Prerequisites

- Dobot Magician has been powered on, and connected to DoboLab successfully.
- The saved points list has been existed in the Teaching and Playback Lab.

Procedure

Step 1 Enter Teaching and Playback Lab. Set **Trigger Mode** in I/O trigger settings to **LEVEL INPUT,** and EIO12 value to **High**. Click **Add**, and the corresponding trigger commands are displayed in the command area.

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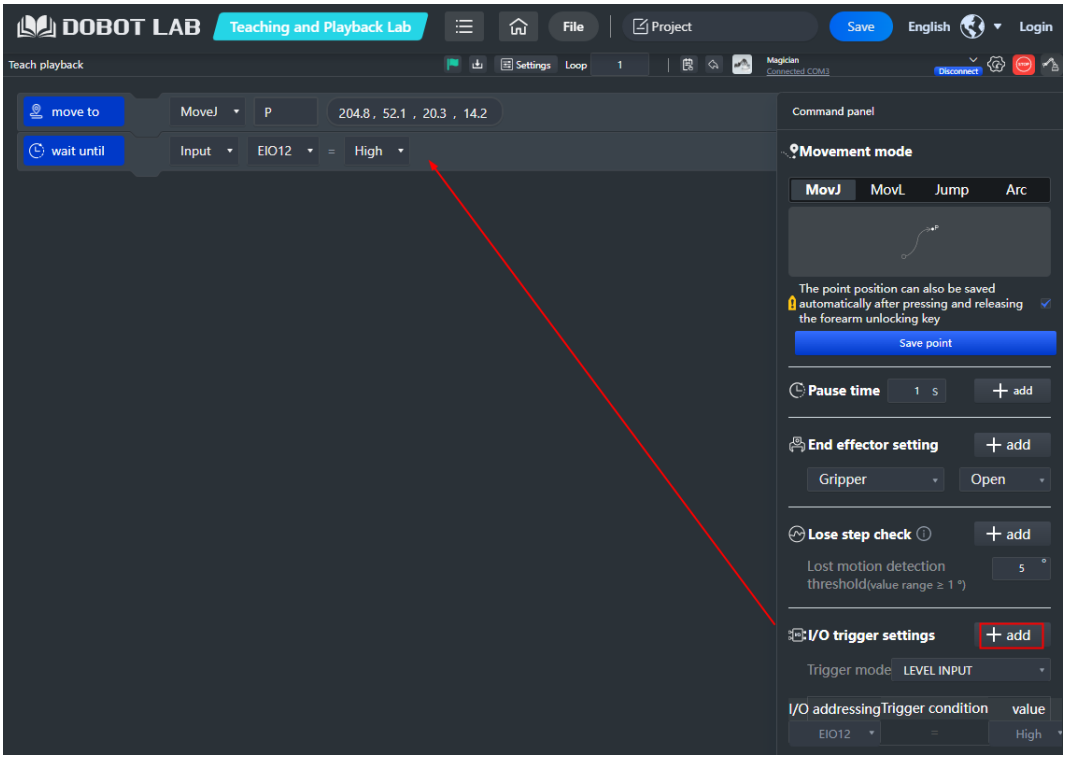

Figure 5.146 Add IO trigger command

Step 2 Move the trigger command above the saved point command.

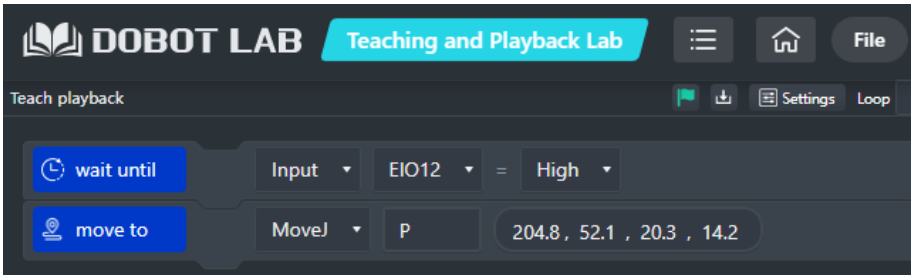

Figure 5.147 Move the trigger command

Step 3 Click Running program.

5.12.3 PWM Output

This section also takes I/O 11 as an example.

Table 5.8 Multiplexed I/O description

I/O addressing	Voltage	Level Output	PWM	Level Input	ADC
11	3.3V	√	√	-	-

Prerequisites

Dobot Magician has been powered on, and connected to DobotLab successfully.

Procedure

Step 1 Enter Teaching and Playback Lab. Set **Trigger Mode** in I/O trigger settings to **PWM**, **I/O addressing** to EIO11, and set the period and duty cycle. Click **Add**, and the corresponding trigger commands are displayed on the command area.

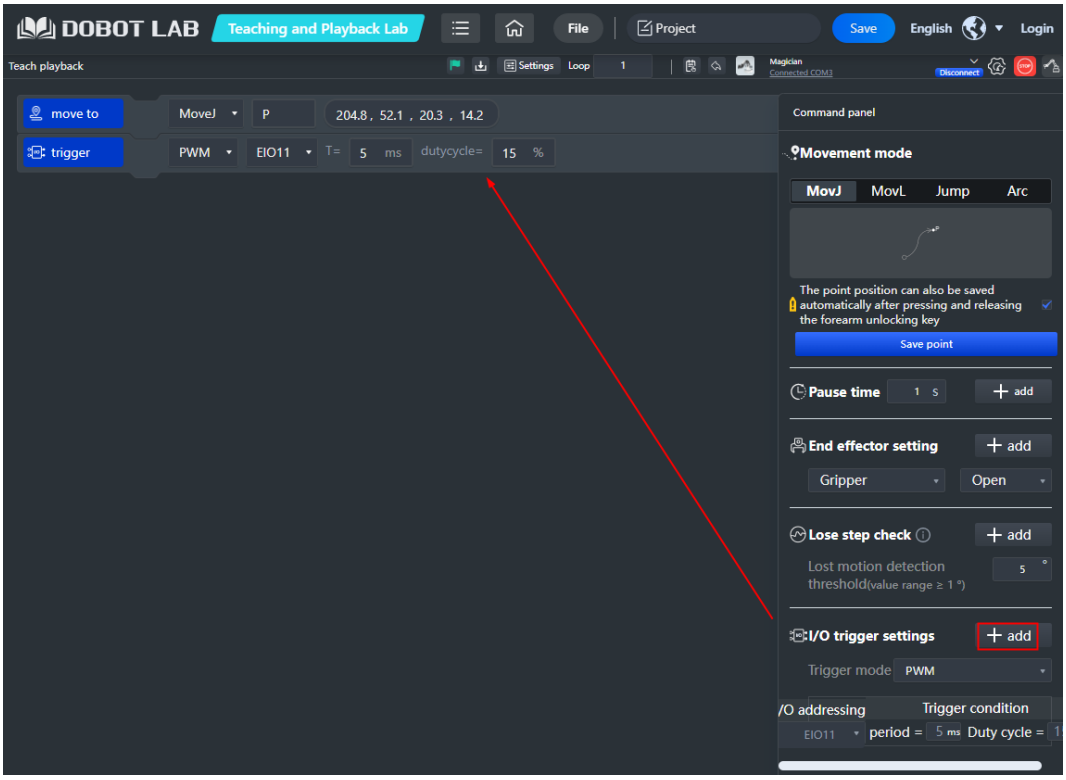

Figure 5.148 Add IO trigger command

Step 2 Move the trigger command above the saved point command.

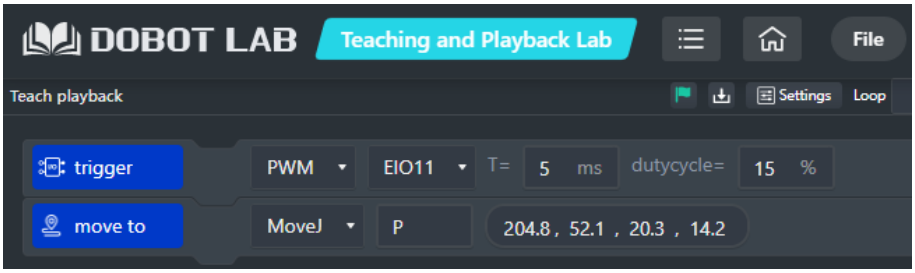

Figure 5.149 Move the trigger command

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