Application Instructions

Dobot

version: 1.0.1_en date: 14th Feb. 2016

support@dobot.cc

Contents

Chapter 1 Install Arduino Driver

1. Install **Arduino1.0.6**, you can download from here:
   http://www.arduino.cc/en/Main/OldSoftwareReleases#previous
2. Run the install package and choose a path to install the software. There is a driver to be installed which is important for the controller box to be connected to the computer.

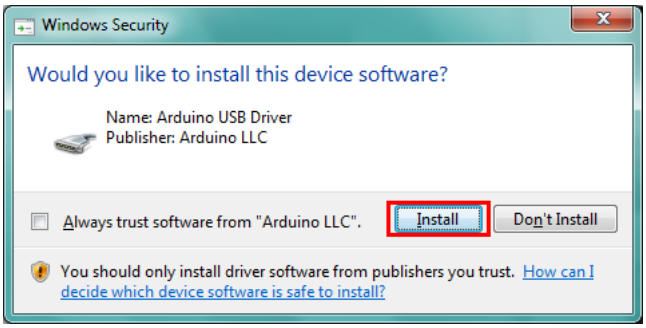


Figure 1.1 Install the driver

3. You can check device manger to see if the driver was installed properly. You will notice the device name of [**Arduino Mega 2560]** appear in the Device Manager under Ports (COM & LPT).

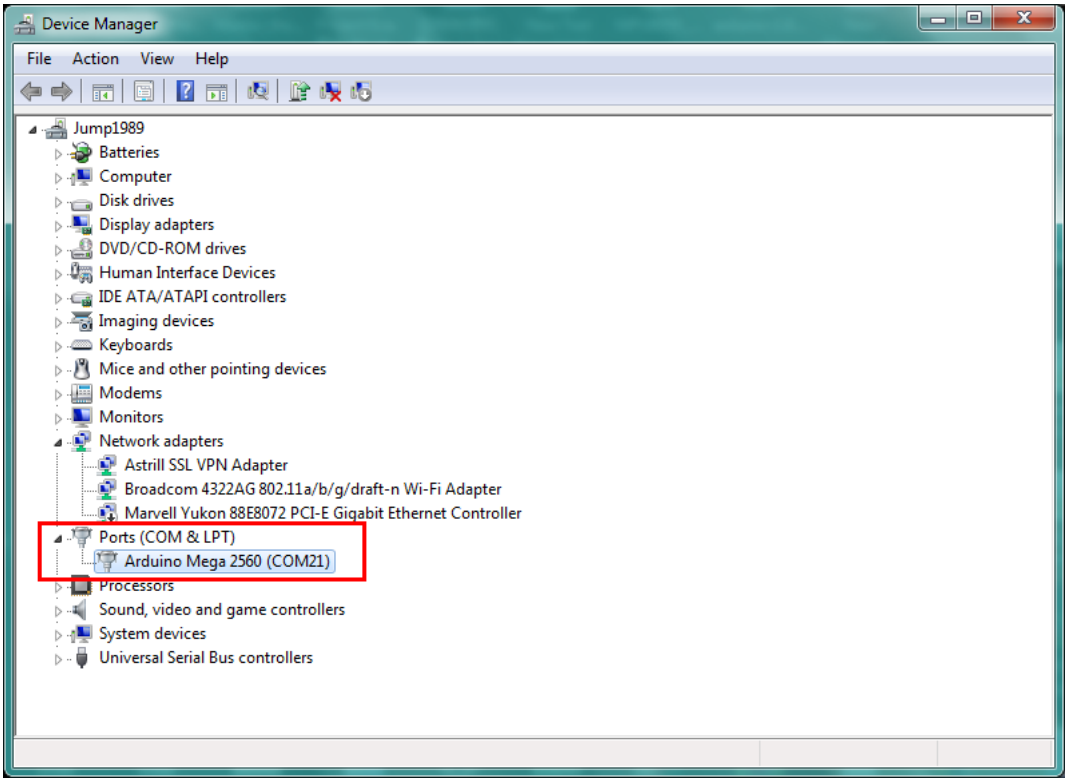


Figure 1.2 Device manager

4. In case it was not installed properly, you can manually update the driver.
   1) Right click on the device and choose **Update Driver Software**

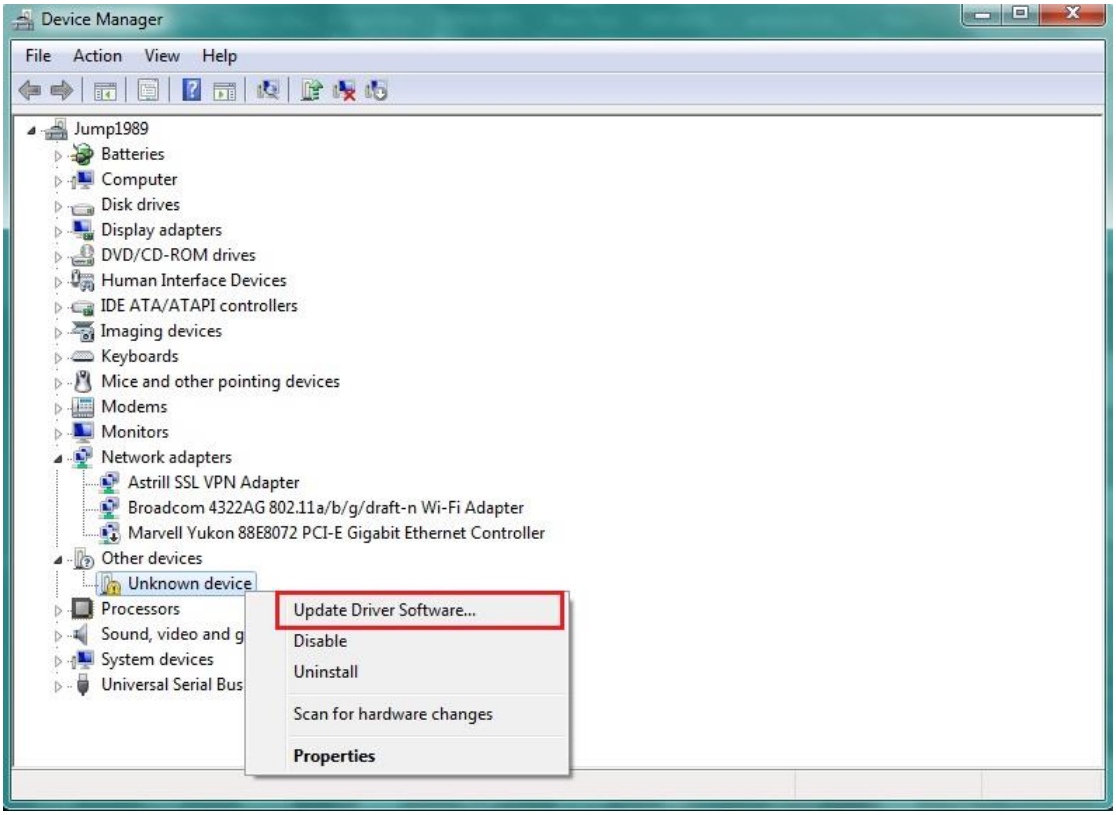


Figure 1.3 Update driver software

Explore the computer to locate the folder where the Arduino Driver was previously installed.

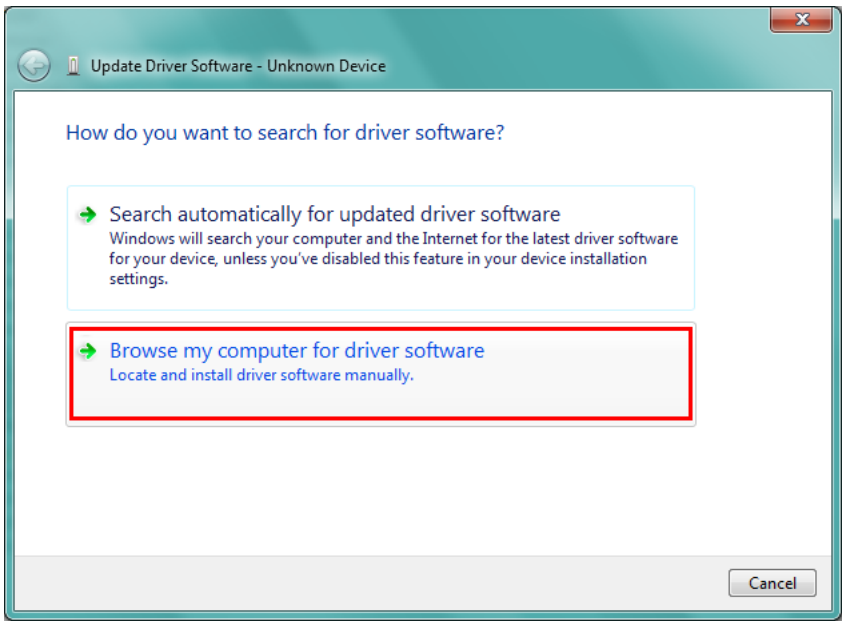


Figure 1.4 Manually install the driver

5. Find the path where you installed **Arduino**, and there is a 'drivers' folder. And check the option '**Include subfolders**'. Click next then the driver will be installed.

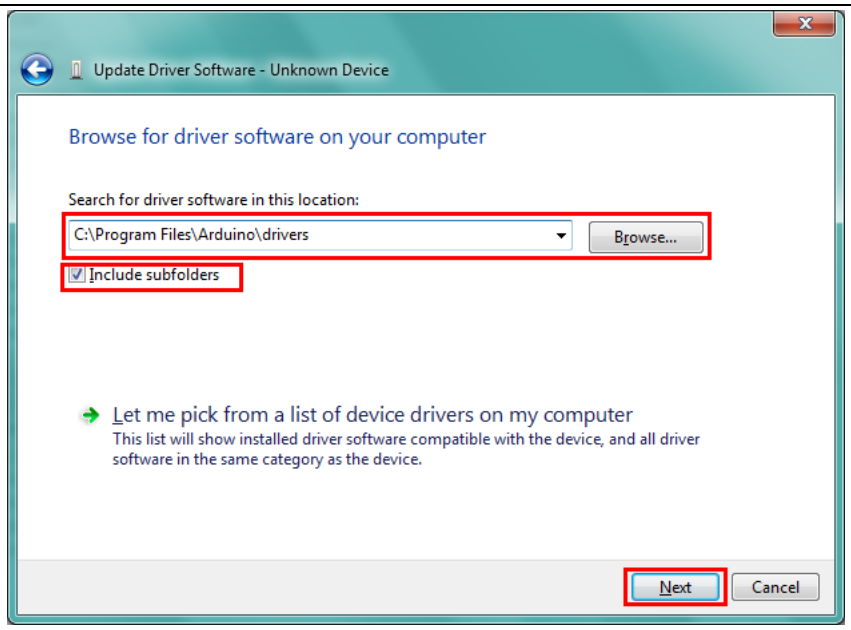


Figure 1.5 Locate the driver and install it manually

Chapter 2 Preparation

2.1 End effector introduction

2.1.1 Pump and suction cup

1. A suction cup was installed as factory default configuration shown in Figure 2.1

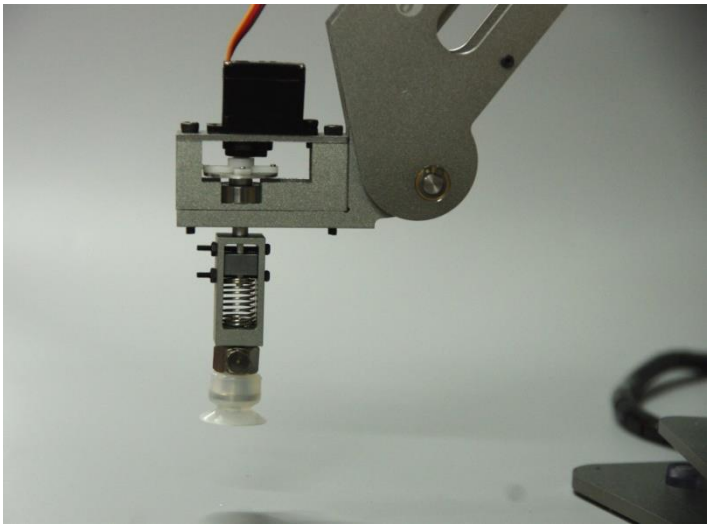


Figure 2.1 Sucker installation

2. To disassemble the suction cup, hold down the M2 nut and loosen the socket head cap screw using the M2 Allen Wrench provided in the package. Once the nuts have taken out, carefully remove the spring from the housing (shown in Figure 2.2).

3. 

Figure 2.2 Sucker disassembled (1)

4. Pull out the two M2 by 20 bolts. The aluminum housing for the suction cup can now be removed and stored for future applications (Figure 2.3 & 2.4).

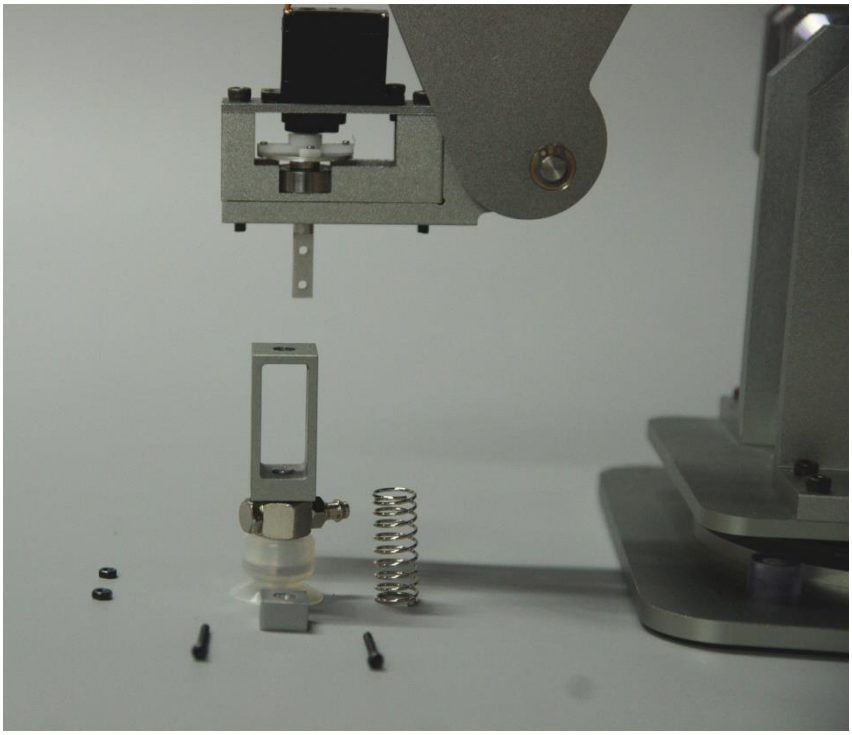


Figure 2.3 Sucker disassembled (2)

Figure 2.4 Sucker components

2.1.2 Gripper

1. Components for the gripper is shown in Figure 2.5: two **M2×8 bolt** and **M2 nut**, **Gripper**，**Servo Extension Cable**.

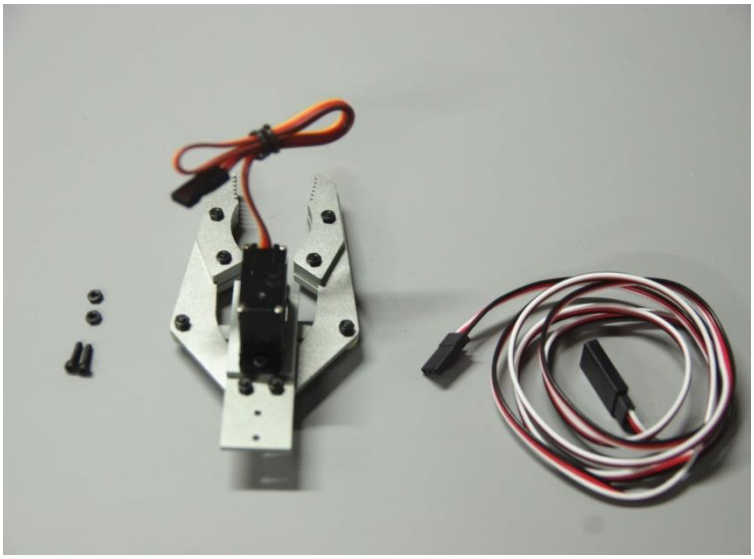


Figure 2.5 Gripper components

2. Mounted Gripper is shown in Figure 2.6.

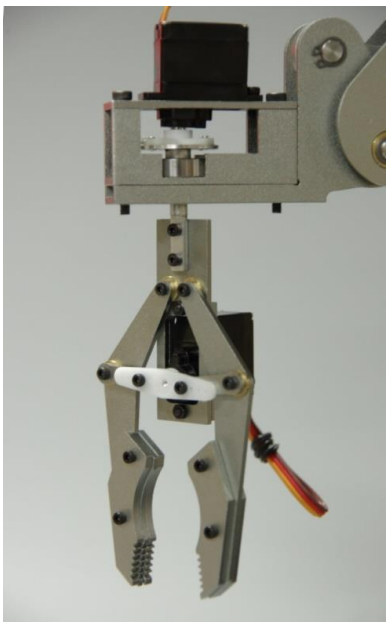
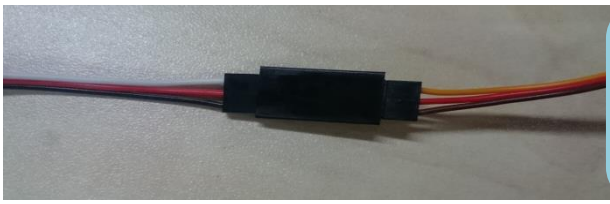


Figure 2.6 Gripper installation

3. The gripper wiring is shown in Figure 2.7：



Note: the black cable is connected with the brown one.

Figure 2.7 Servo cable connection

4. As shown in Figure 2.8，connect the female end of the **Servo Extension Cable** to the pins shown in dashed rectangle on the circuit board. Note the word **'Grab'** printed on the board.

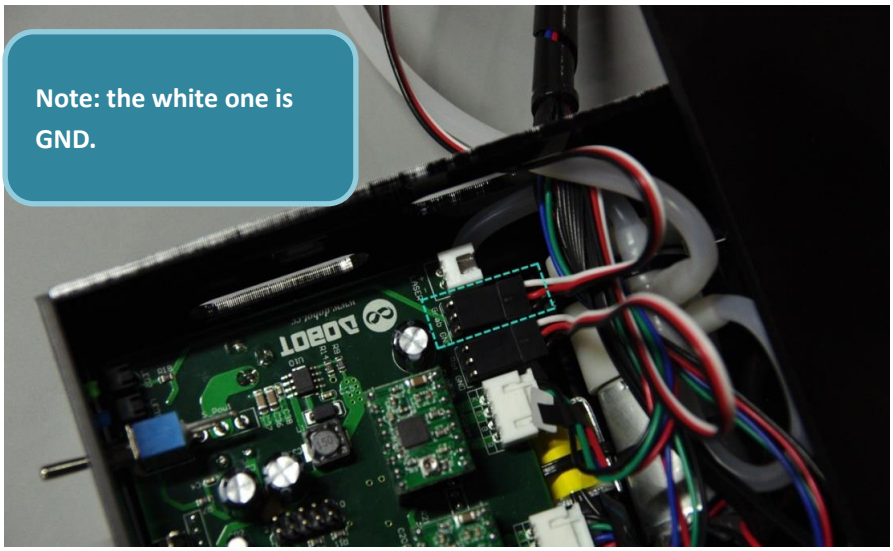


Figure 2.8 Servo extension cable connection to the board

5. Optionally, you can organize the cables with the provided **Cable Clips**. These can be attached to the arms with the backing paper removed (Figure 2.9).

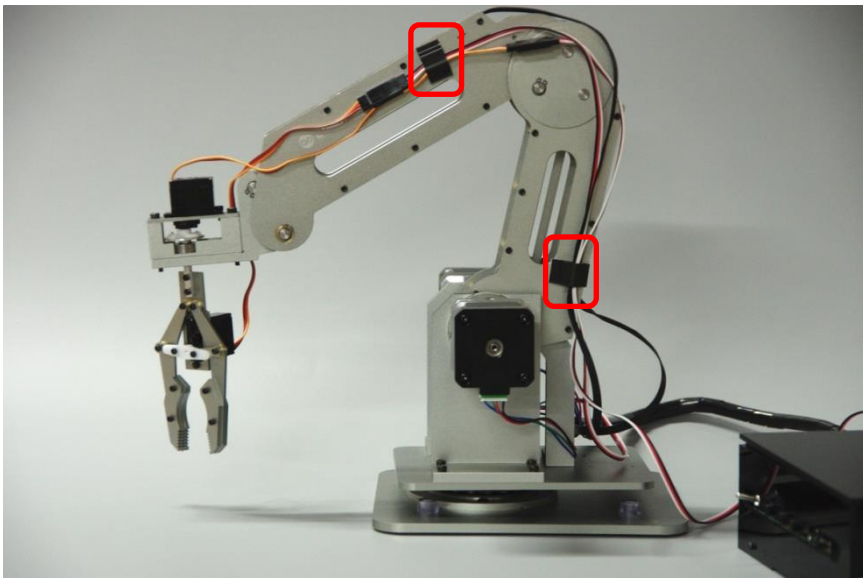


Figure 2.9 Cable clips

2.1.3 Gripper in horizontal position

1. Extra components includes an **Adapter Bracket** and two **M3×10 bolt**.

Figure 2.10 90° transformer components

2. As shown in Figure 2.11， disassemble the **Rotation Servo**, install the 90°transformer at the end of the robot arm.

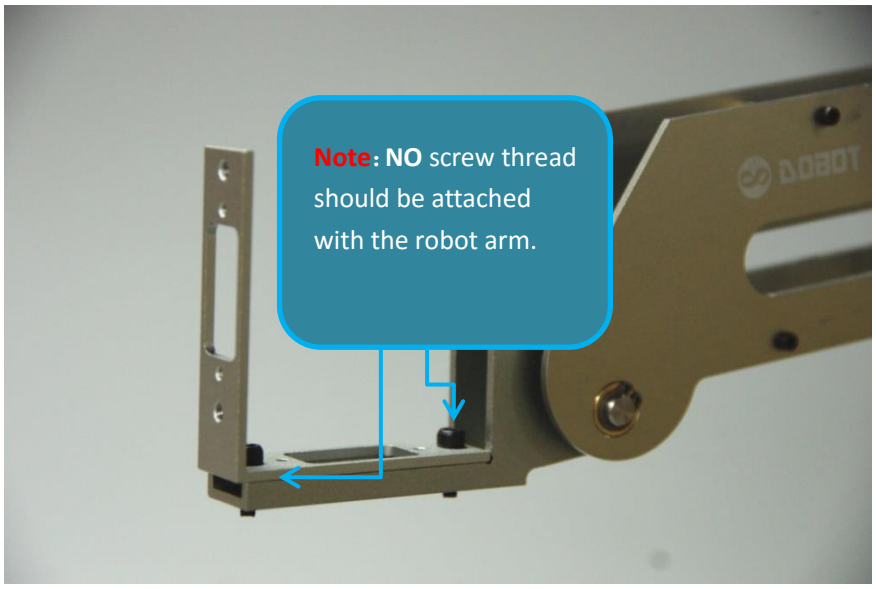


Figure 2.11 90°transformer installation

3. Install the servo.

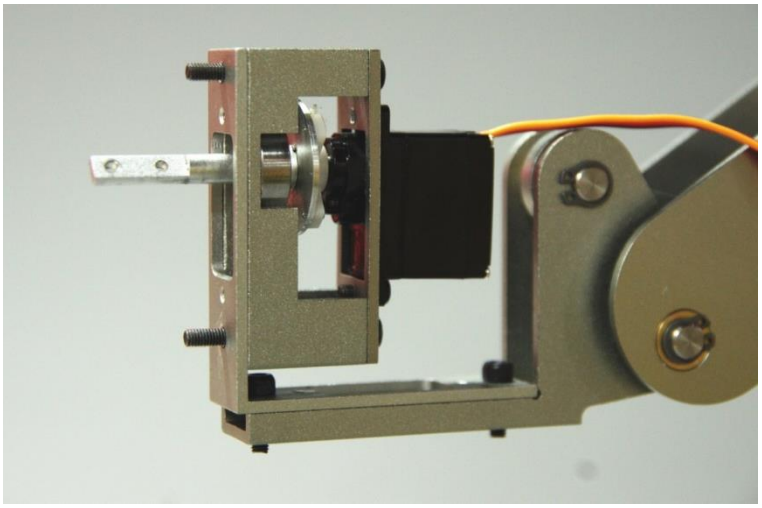


Figure 2.12 Horizontally installed servo

4. Install the gripper with two **M2×8 bolt** and **M2 nut.**

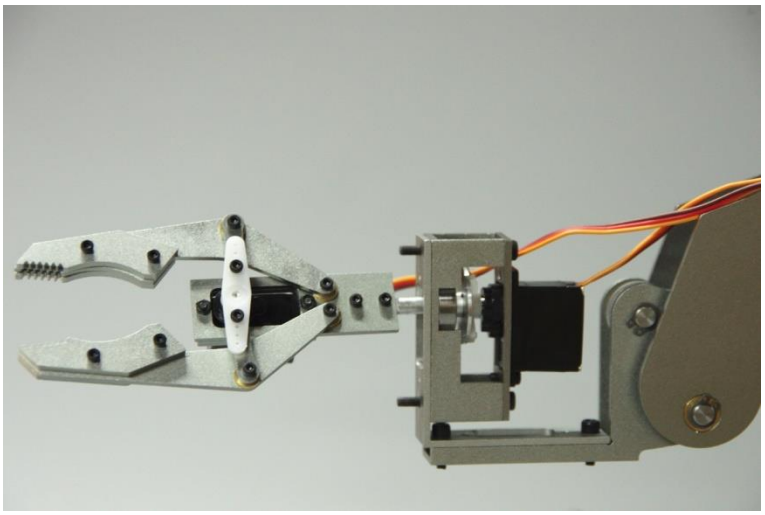


Figure 2.13 Horizontally mounted gripper

2.1.4 Laser installation

1. **Components**: laser, laser holder, two [M2×8 bolt & M2 nut], M3×10 bolt.

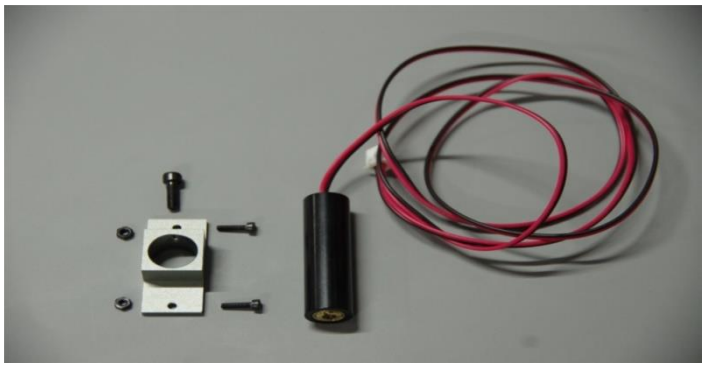


Figure 2.14 Laser components

2. Use the M2 bolt and nut to mount the laser holder under the end of the robot arm, then put the laser inside the holder from the bottom(cable go through the hole first, then the laser), as shown in Figure 2.15.

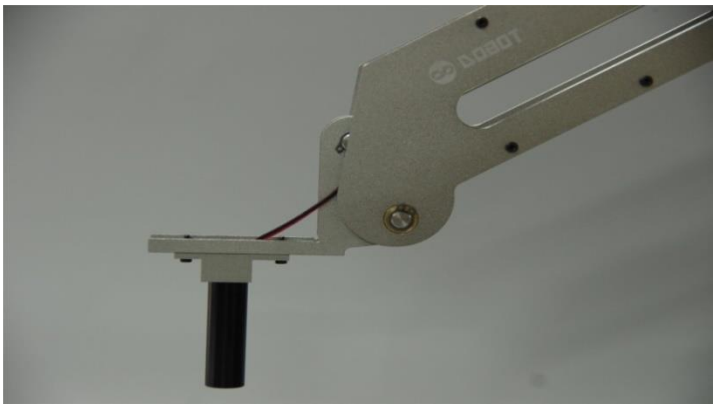


Figure 2.15 Laser installation (1)

3. Fasten the laser with the M3×10 bolt.

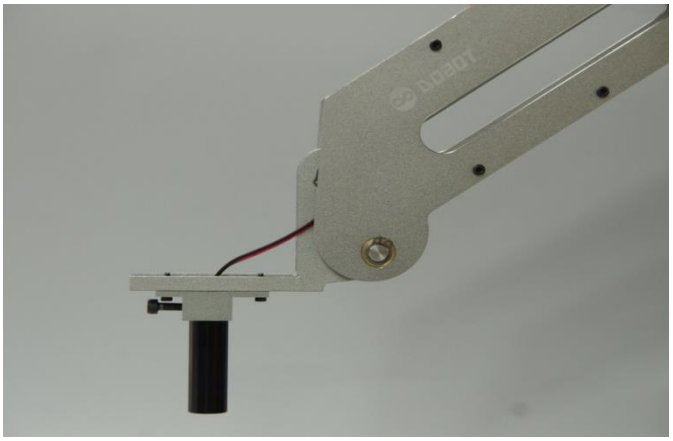


Figure 2.16 Laser installation (2)

4. Connect the laser cable to the board, the Pins are located at the edge of the board, labeled with ‘LASER’.

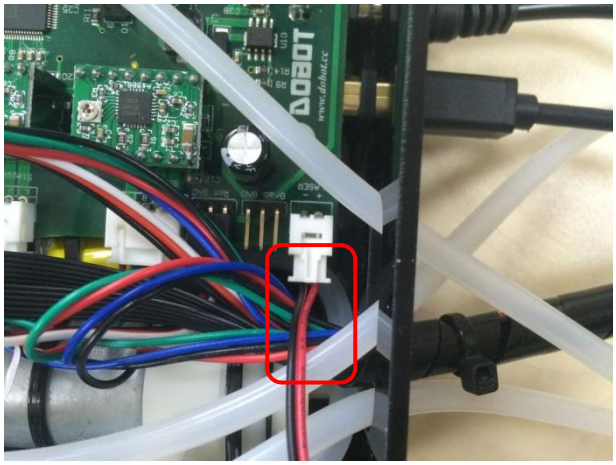


Figure 2.17 Laser cable connection

2.1.5 Pen installation

1. **Components**: pen, pen holder, two (M2×8 bolt & M2 nut), M3×10 bolt.

Figure 2.17 Writing components

2. The installation is similar with the laser. Pen holder is mounted on the top of the end of robot arm with two M2 bolt, and put the pen/brush inside the pen holder, then fasten it with the M3 bolt from one side, shown in Figure 2.18;

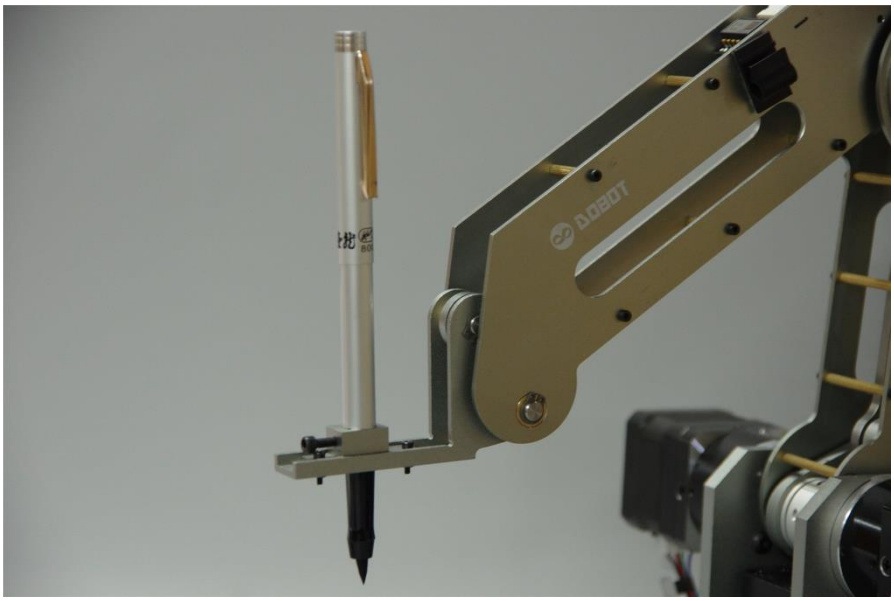


Figure 2.18 Pen installation

2.2 Start Dobot

[Important]

1. Turn the **Powere Switch** (located at the front of the control box) off (pointing down) if it is not.
2. Plug in the **12V DC Adaptor** to a wall plug and to the 12V socket located on the left side of the **Control Box**.
3. Adjust the robot arm to a comfortable position (around 45 degree for Joint 2 and Joint 3, avoiding either end of vertical and horizontal positions). Hold the arm in place and turn on the **Power Switch** which will power the stepper motors and lock the robot arm.
4. Press **Reset** (the first button to the right of the switch). Control board will refresh readings from both **angle sensors**, if all within limits, Dobot is ready for some actions!

Chapter 3 Teach & Playback

Teach & Playback is the most frequently used module of this software, you can use this function to manipulate your Dobot and teach it a series of movements and let it do the work for you. It is a good start point for you get familiar with your Dobot.

3.1 Chose the end effector

Click the radio button for **Pump**、**Gripper**、**Laser** and choose corresponding end effector that mounted at the end of the robot arm(refer to Error! Reference source not found.for different end effector installations).

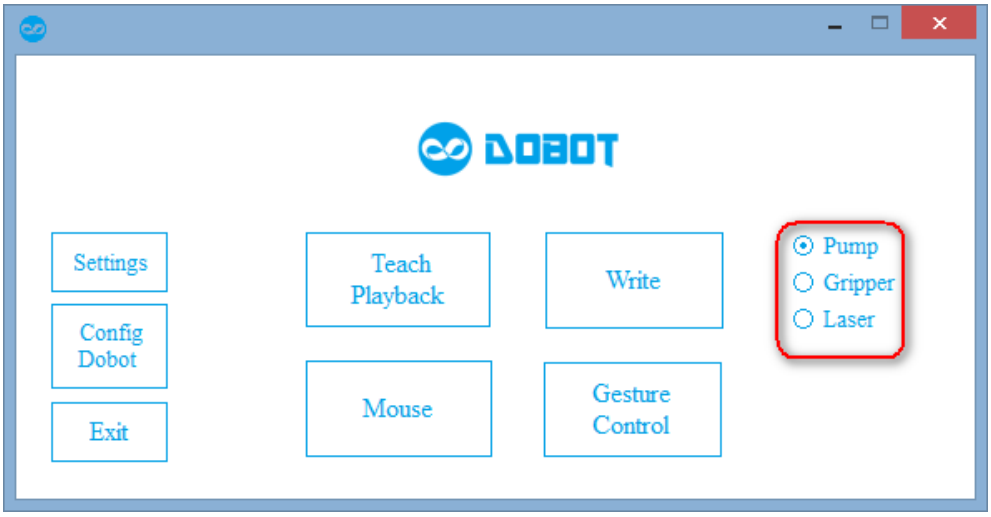


Figure 3.1 Chose end effector

3.2 Manipulation: manipulate the robot arm to perform certain task

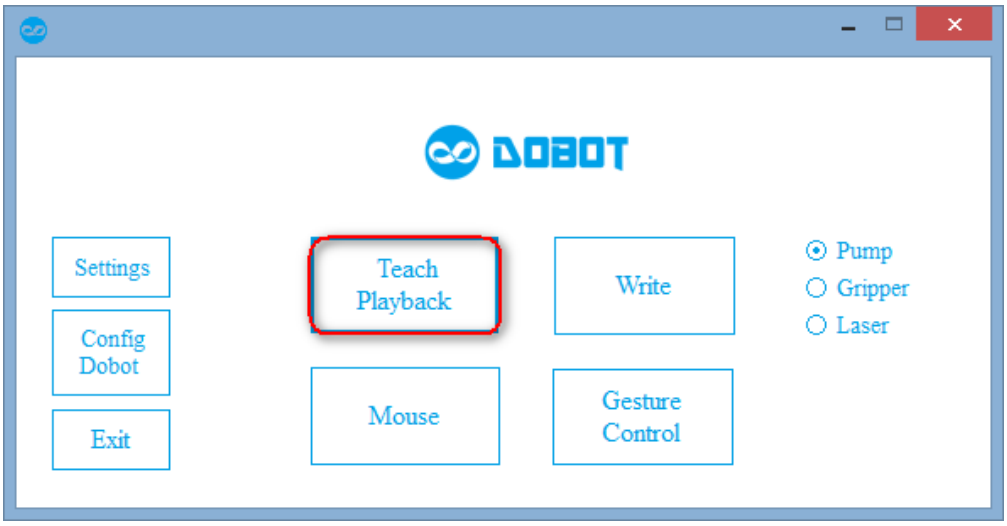


Figure 3.2 Teach & Playback

Click **Teach Playback** and enter this module:

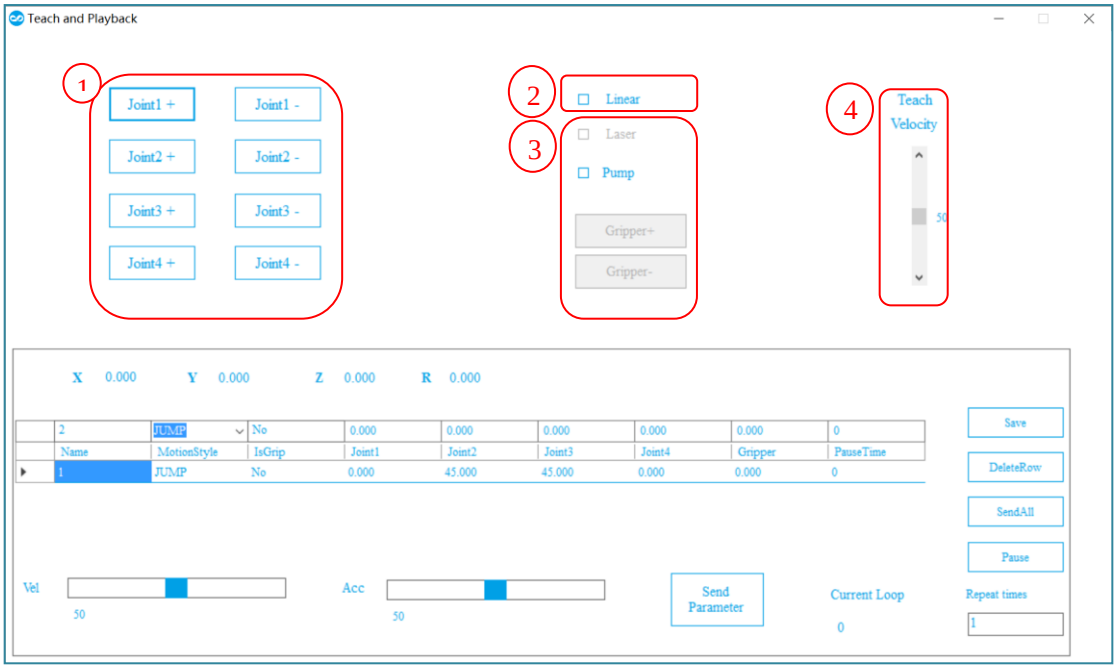


Figure 3.3 User Interface for robot manipulation and Teach

1. **Jog Operation**：press the button in region ① and operate the corresponding joint.
   The default operation mode is **Joint Jog**, the operation object is the target joint. When the button is pressed, the target joint will move independently to the corresponding direction. Counter-clockwise direction is the positive direction for each joint.

2. **Joint Jog/ Linear Jog mode switch**：click ②**Linear** to choose **Linear Jog Mode**. Now the center's coordinate of the end of robot arm is the target object. The three joints will run in cooperation to enable the robot arm move linearly in x, y, z direction.

3. **Linear Jog: the coordinate frame of the robot arm is shown in Figure 3.4 left, the original point locates at the cross point of the shafts of three stepper-motors.**

   R indicates the direction of the end effector relative to the coordinate frame.
   Check the ②**Linear** to enable Linear Jog Mode. **In Linear Jog**, the servo at the end of robot arm will rotate to maintain its relative direction to the coordinate frame.

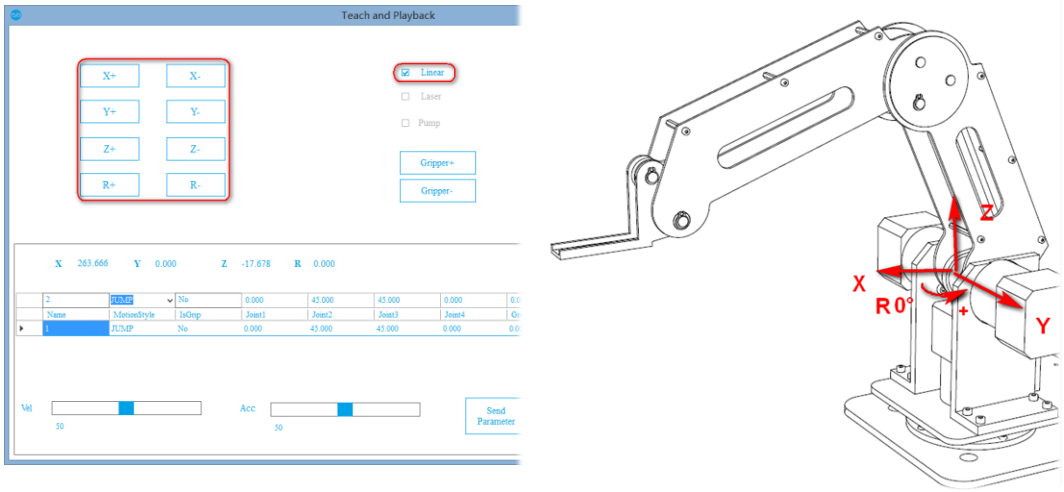


Figure 3.4 Coordinate frame

1. **End effector control: as mentioned in Chapter 3.1, we can choose different end effector for the robot arm, and then corresponding state can be controlled here.**

   （1） **Laser on/off**：you can light the laser here, then you can manually adjust the height of laser in order to make it focused on the target plan. One hand press the Laser Adjust button while the other hand hold the mounted laser in different height until you find a proper height that the laser can engrave the kraft board easily. **Note**: After using the laser adjust function and locking the robot arm again, you need to reset the controller board to measure the current angle of robot arm.

   （2） **Pump On/Off:** change the pump state so that the suction cap can take something up or drop it somewhere.

   （3） **Gripper +/-**：open or close the gripper.

2. **Velocity adjust**：the moving velocity can be adjust by dragging the sliding bar up and down.. **Max velocity** of the robot arm can be modified in the **Teach** tab of the **Config Dobot** module.

3.3 Teach and Playback

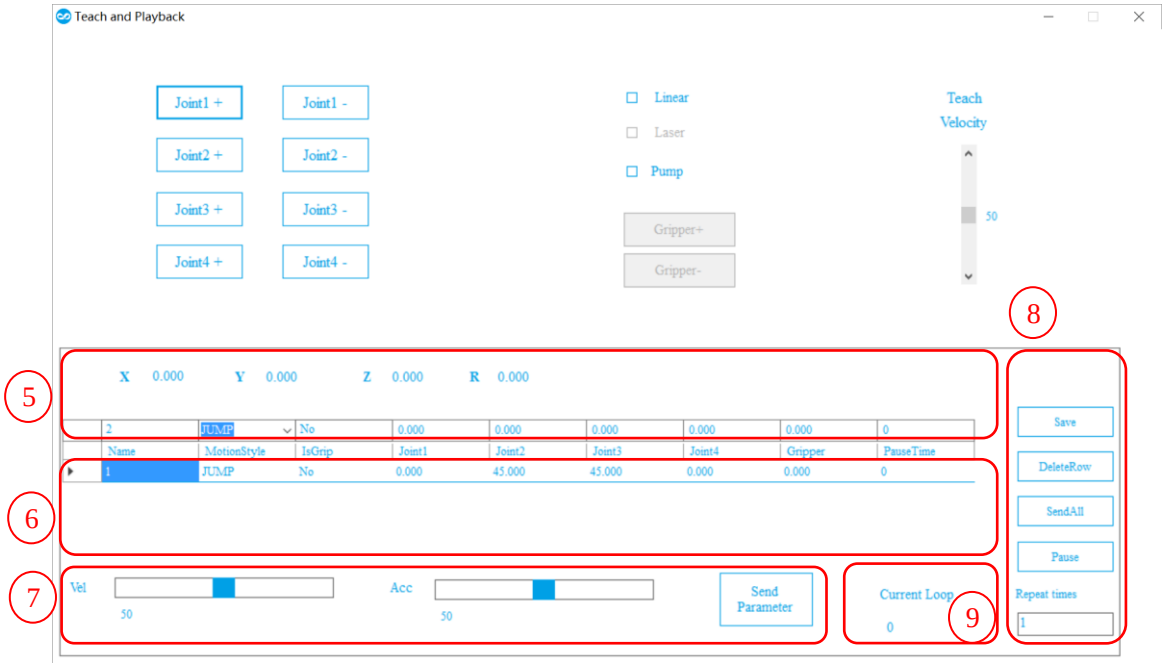


Figure 3.5 Teah & Playback

1. ⑤ display current state of the robot arm:：

（1）**X，Y, Z** is the coordinate of the center of the end platform。R indicates the rotation of the servo joint relative to the coordinate frame(counter-clockwise is the positive direction)；

（2）'2': indicates the default name of the current point；

（3）MotionStyle：approaching method to reach this point, there are three options: **JUMP**、**MOVJ**、**MOVL**.

JUMP: from point **A** to point **B**, the trajectory is shown below, the end effector will lift upwards by amount of Height (in mm) and move horizontally to a point that is above B by Height and then move down to Point B. Value of **Hight** can be configured in the **Playback** tab of the **Config Dobot** Module**,** the default value is 20 mm. Click send to configure Dobot after changing the value.

Figure 3.6 JUMP trajectory illustration

MOVJ：Joint movements. From point A to point B, each joint will run from initial angle to its target angle, regardless of the trajectory. The motion time for all joints are the same which means all joints will start and finish at the same time.

MOVL：The joints will cooperate in order to perform a line trajectory from point A to point B.

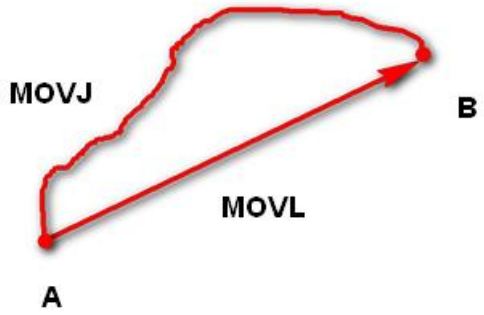


Figure 3.7 Illustration of MOVJ and MOVL

（1）**IsGrip**：the state of the pump. 1 indicates it is on while 0 indicates it is off.
（2）**Joint1**、**Joint2**、**Joint3**、**Joint4:** the corresponding angle value.
（3）**Gripper**: The servo angle of the gripper.
（4）**PauseTime**：the pause duration after moving to this target point.

2. **Trajectory Display**:

The table in ⑥ shows the saved points list. You can edit or delete the points.

Edit: double click the text that you want to modify and input the new value, e.g. changing the **MotionStyle**, adjusting the **PauseTime**.
Delete：Click the first blank space of the row you want to delete, then either press **Delete** key on the keyboard or the **DeleteRow** Button on the screen.

3. **Speed adjustment**：You can adjust the **speed(Vel)** and **acceleration(Acc)** by the

Sliding bar in region ⑦, after changing the value, press **SendParameter** to let the new value take effect.

4. Buttons in region ⑧:

- **Save**：Save current state as a point in the trajectory.
- **DeleteRow**：Delete the selected row.
- **SendAll**：**Playback**- execute all the points in the trajectory to the **Control Box**. This button will change to **Stop** after execution. Clicking **Stop** will then terminate the motion sequence. Note that the robot arm will continue to move for a few seconds before coming to a complete stop.
- **Pause**：pause the process(the process will pause after a few seconds)，This button will change to Resume after execution. Clicking **Resume** will then **resume** motion.
- **Repeat times**：The number of repetitions can be set here.

5. Current Loop indicates the current loop being executed.

Chapter 4 Writting and laser engraving

Note: the laser can heat object when it is in focused state, objects like paper board or wood can be engraved or burned.

- DO NOT focus the laser on people or animals.
- DO NOT let children play with it alone.
- The process needs to be monitored when it is running.
- After the process please turn off the laser promptly.

4.1 Laser Engraving

4.1.1 Adjusting focus of laser

Install the laser as introduced in Chapter **Error! Reference source not found.**, and djust the laser to proper height and focus on target object.

1. Chose laser as the end effector and open the **Teach & PlayBack** module and turn on the laser.

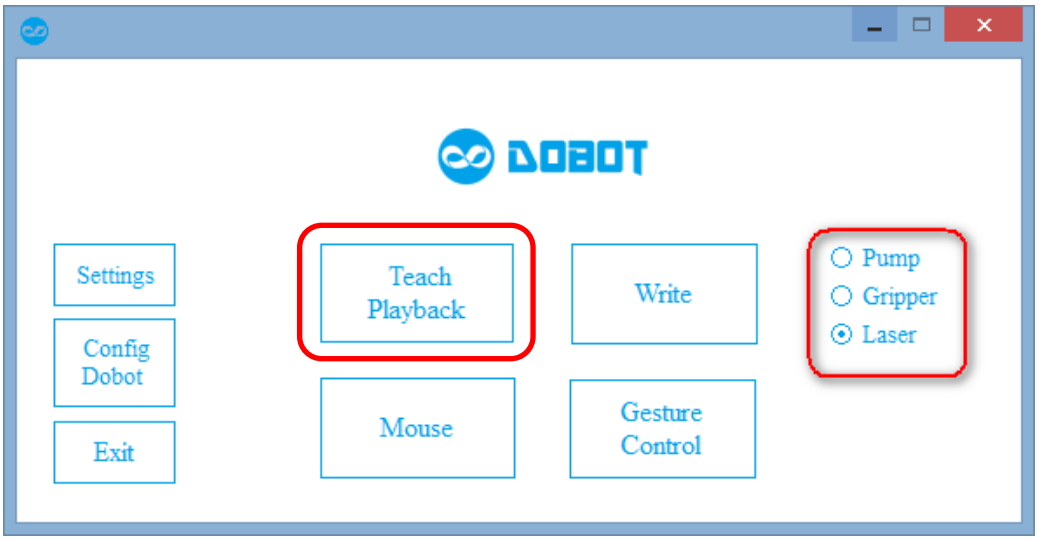


Figure 4.1 Chose laser as end effector

1. Put the engraving material under the laser, turn on the laser and press the Laser Adjustment button to slowly move the laser to a proper position(avoid positioning the arm in the maxed-out position, either vertically or horizontally) and height(laser should be focused on the material), then release the button to lock the robot arm. Now, reset the **Controller Box** so that the current joint angle can be measured by the angle sensor.

2. Set Laser Speed: in **Config Dobot** module there is a write tab where you can set

the acceleration of the writing process. For laser engraving on **Kraft Paper** provided, you can set Acc= 0.01. For different material or a laser with different power, a different value can be set.

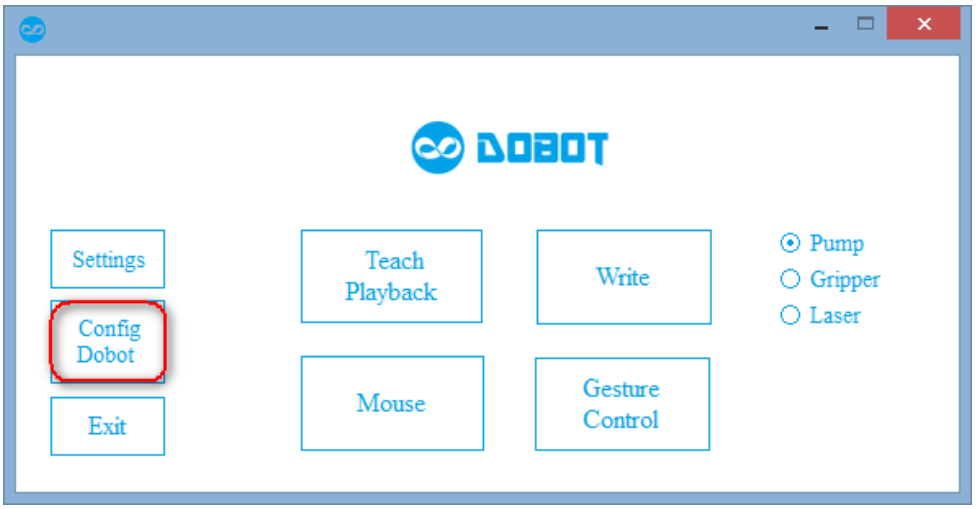


Figure 4.2 Config Dobot

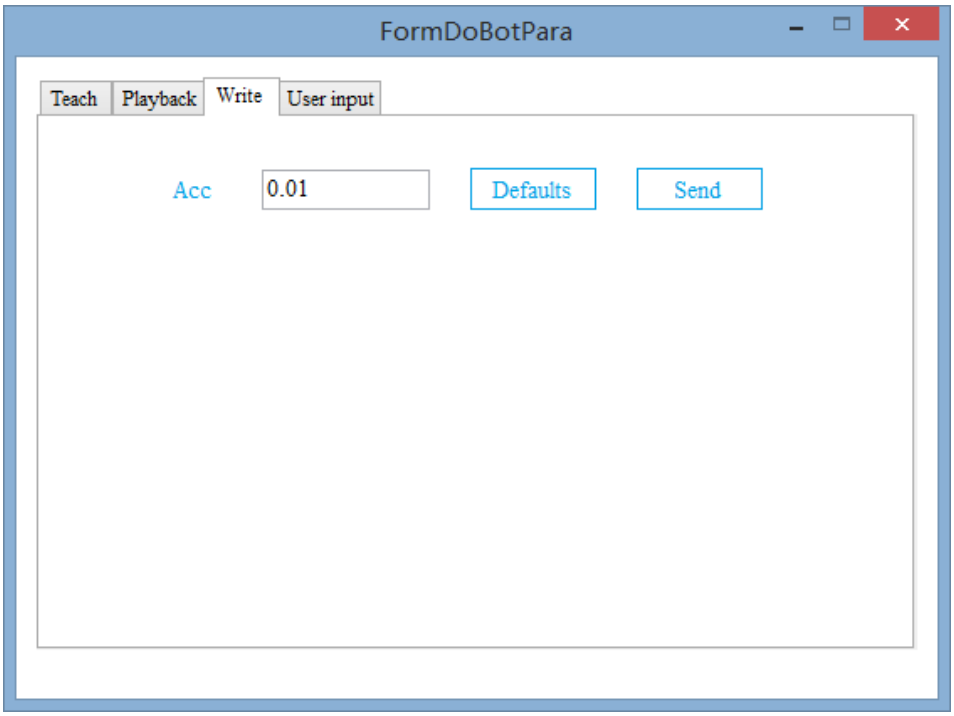


Figure 4.3 Set acceleration for laser engraving

3. Chose Laser option and click **TextDesign** to design a text for laser engraving；

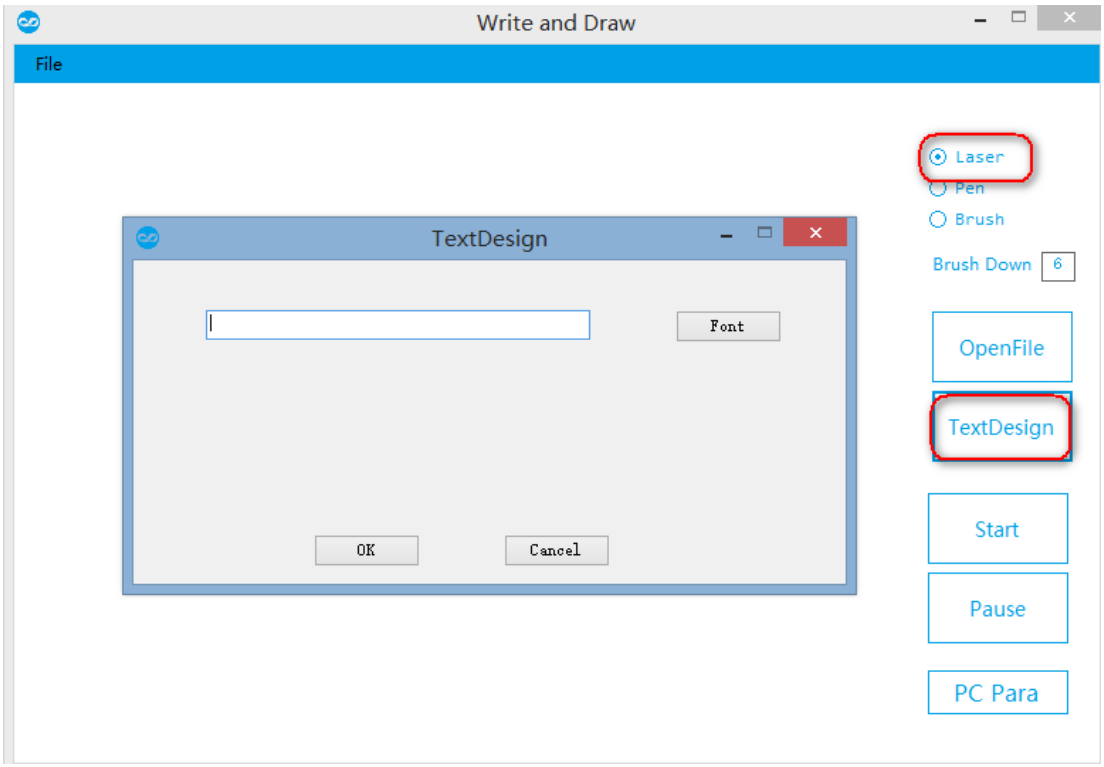


Figure 4.4 TextDesign

4. E.g. you can input Chinese character“龍”or other words as a test, font of the words can be set in **Font** option, click **OK** and return；

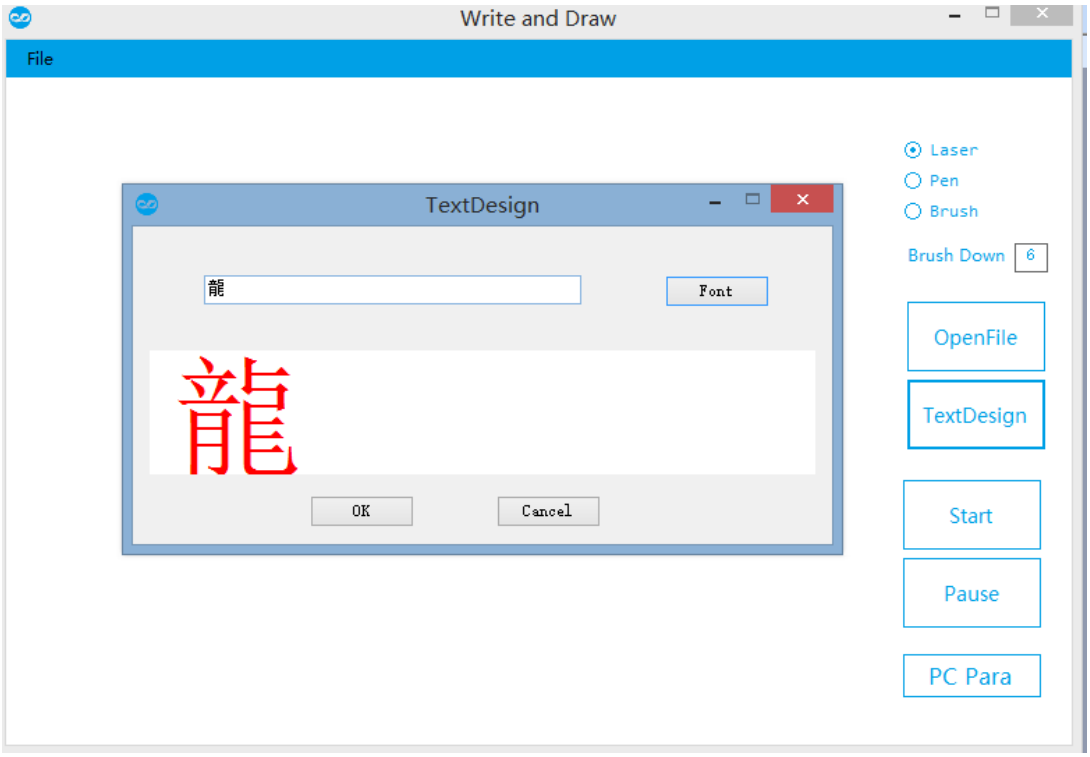


Figure 4.5 Design the text

5. Click **Start** and start the process.

6. Click **Stop** the laser engraving process will continue to run for a few seconds before coming to a complete stop. Click **Start** it will start the whole process again from current position.

7. Click **Pause** the laser engraving process will continue running for a few seconds before it is temporally paused; click Resume will resume the laser graving process.

4.2 Writing

Install the Pen as introduced in Chapter **Error! Reference source not found.**. We rovide two approaches for writing with Pen and brush. The difference is that we need put brush over the paper a few millimeters before it starts writing, since otherwise the ink will puddle up. But for pen, we can directly position it on the paper. Therefore, there is a textbox for brush which is the estimated height to drop before the writing process starts.

1. Put the robot arm to a proper position to ensure the writing can be performed within its limit. Turn on the power of the controller box to lock the robot arm, and press the reset button so that current joint angles are measured again.

2. Set writing parameters: In **Config Dobot** module there is a **Write** tab where the acceleration of the writing process can be set. Acc= 50 for **Writing** is recommended.

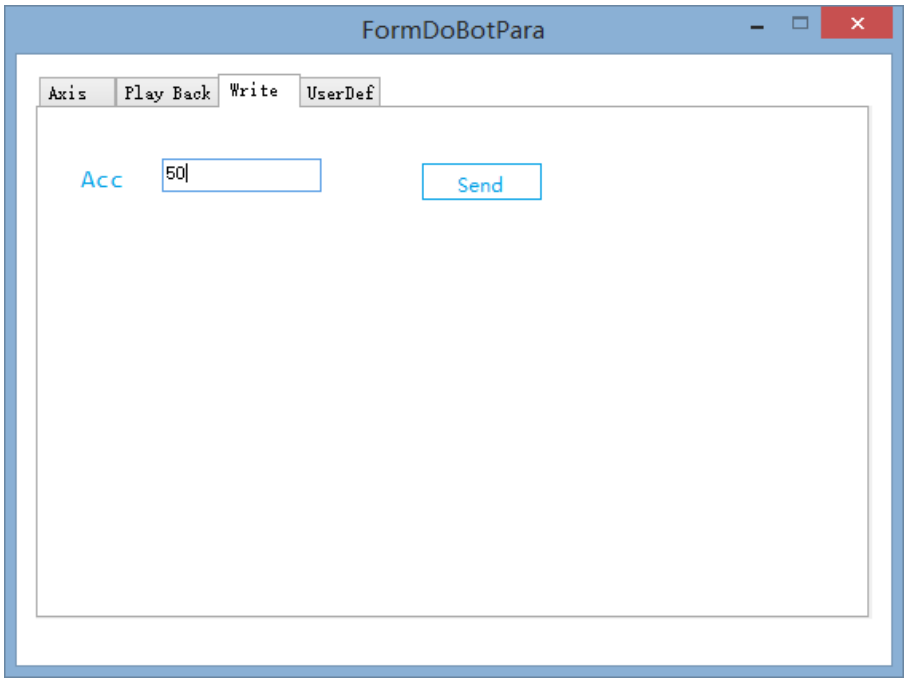


Figure 4.6 Writing paramter

3. Open **Write** module from the main window.

4. Choose Pen or Brush option; if it is brush, enter the estimated height of the brush so it will drop on the paper at the beginning of the writing process.

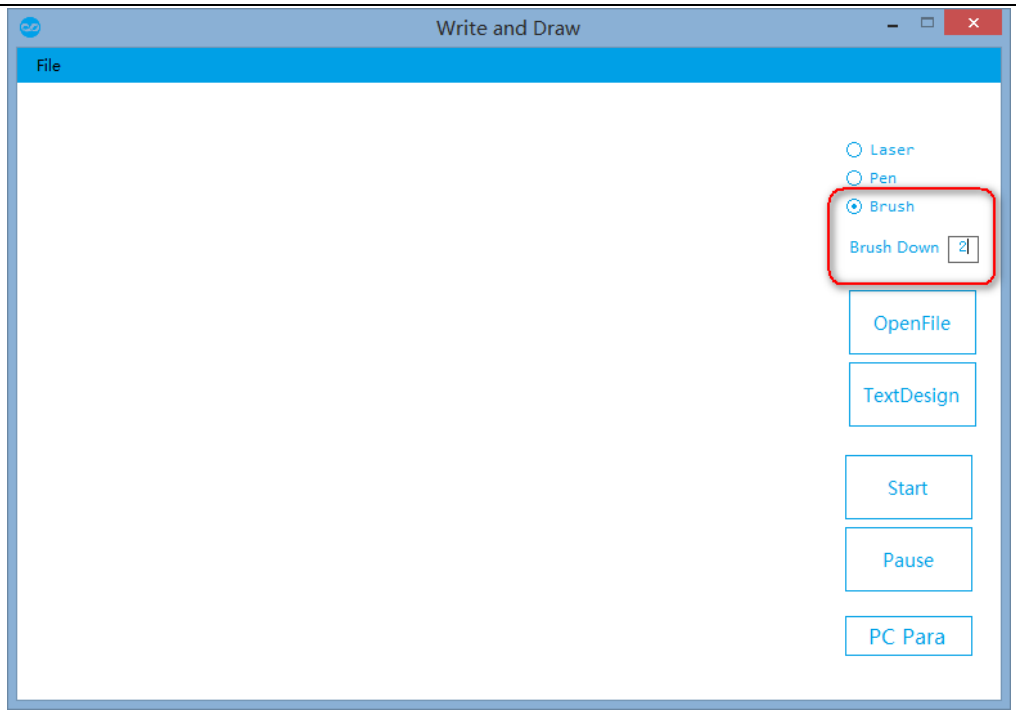


Figure 4.7 Set parameter for the brush to come down

5. Click **OpenFile** and select a *.plt file that you want to write, e.g. '***Love Letter.plt***'. Click **Start** to begin.

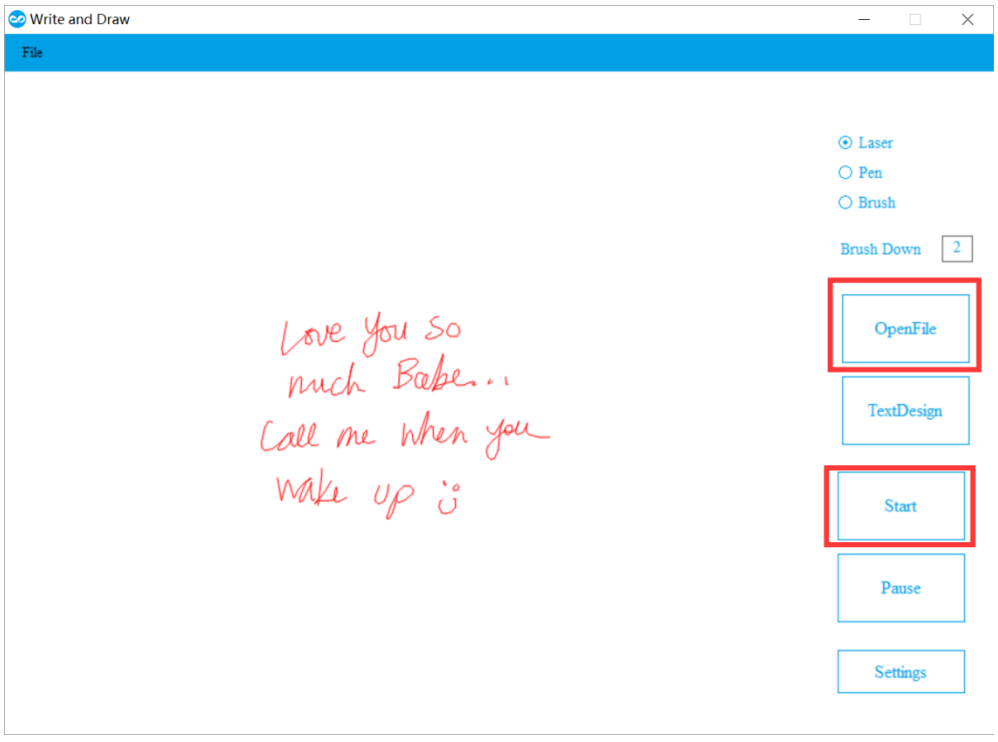


Figure 4.8 Writing user interface

Chapter 5 Mouse and keyboard control

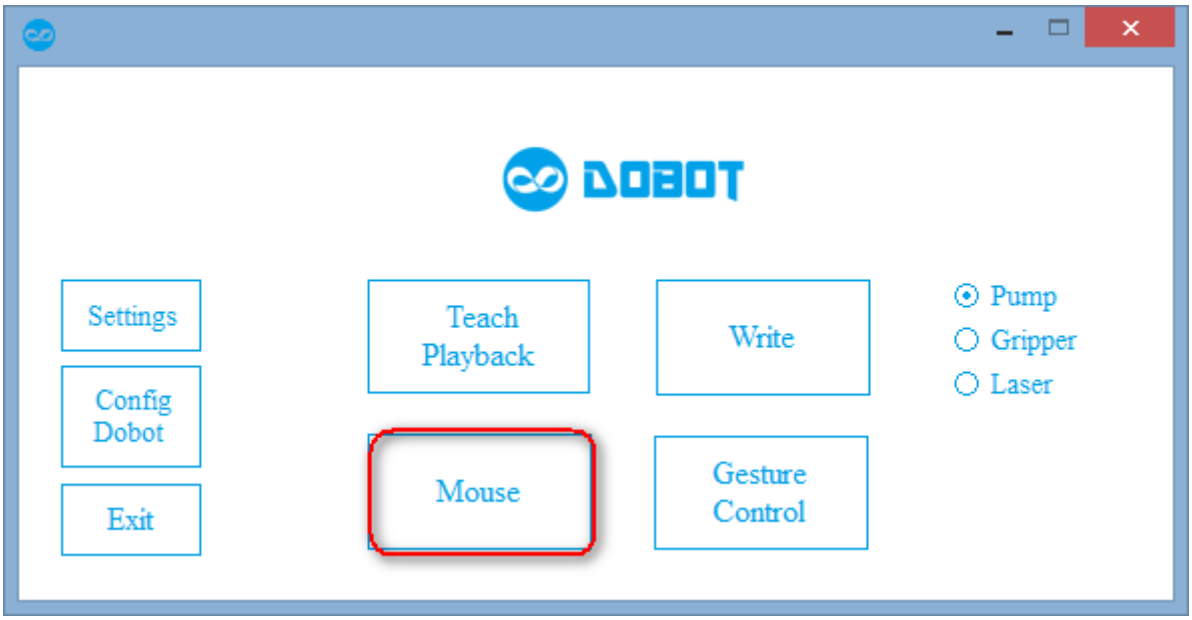


Figure 5.1 Mouse & Keyboard

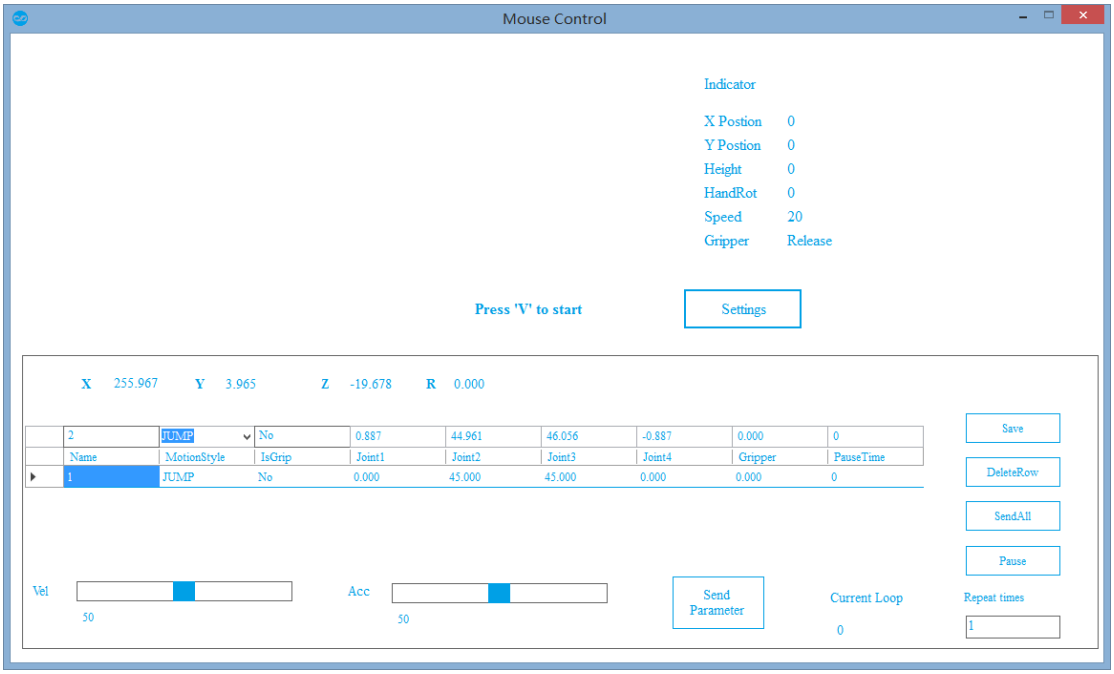


Figure 5.2 User Interface of the Mouse & Keyboard

1. Move mouse to the blank area where the curser will be tracked.

2. Click '**v**' on the keyboard to start the tracking process, the direction of the mouse movements will be tracked and translated into corresponding **x/y** movements of the robot arm. The scroll wheels controls the robot to move alone **z** axis.

3. Click '**h**' on the keyboard to exit the tracking process.

4. Starts the pump by a single click.

5. Turn off the pump by a double click.

6. You can save the point and playback them as introduced in Chapter 3.3.

Table 5.1 Mouse and keyboard function

Mouse	Key	function
	+	Increase speed
	-	Decrease speed
	V	Start mouse tracking
	H	Exit mouse tracking
Move up	W/↑	Move in **y+**
Move down	S/↓	Move in y-
Move right	D/→	Move in x+
Move left	A/←	Move in x-
Scroll up	E/PageUp	Move in z+
Scroll down	Q/PageDown	Move in z-
Hold right button and scroll up	X	Servo rotates to negative(clockwise) direction
Hold right button and scroll down	Z	Servo rotates to positive(counter-clockwise) direction
Left click	O	Start pump
Double left click	P	Release pump

Chapter 6 Gesture Control

1. Go to https://www.leapmotion.com/setup download **Leapmotion** driver and install it. Connect Leapmotion device with USB cable to your computer.

2. Starts the Gesture control module.

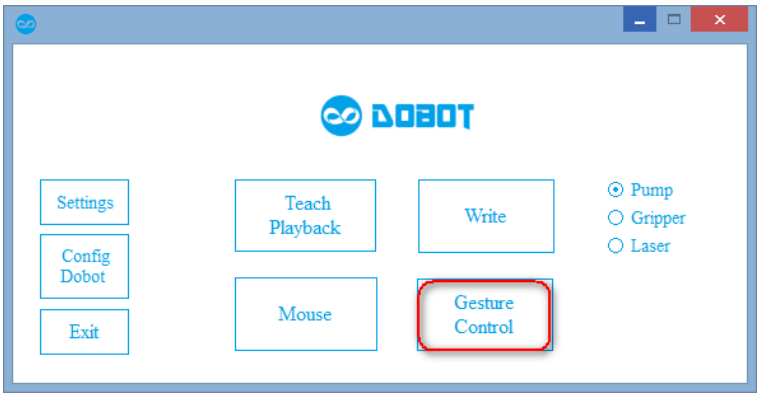


Figure 6.1 Gesture(Leapmotion) control

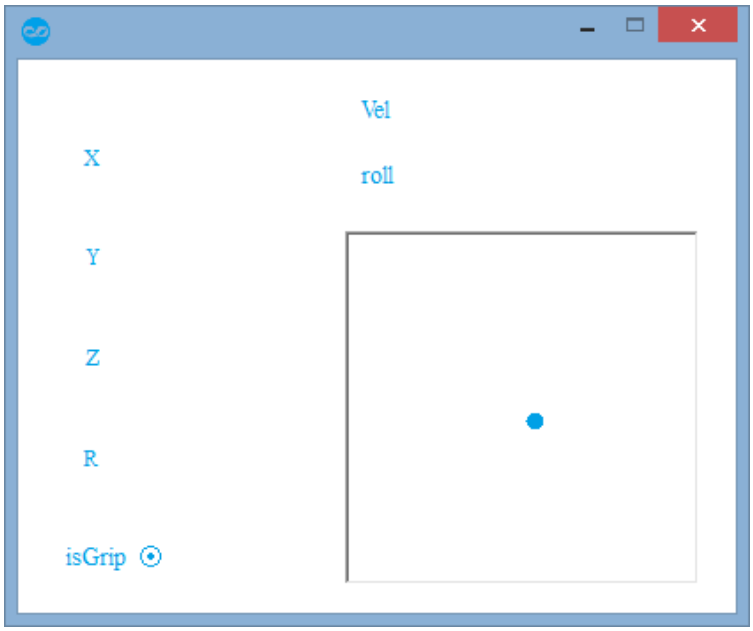


Figure 6.2 User interface for gesture control

3. Move your hand (palm down) to the top(valid detection area) of Leap motion. Once your hand is detected, the robot arm will follow your hand and move to corresponding area.

4. By closing and opening your hand, pump and gripper can be controlled.

5. Turn your palm upward will stop the tracking process, and the robot arm will stop follow your gesture.