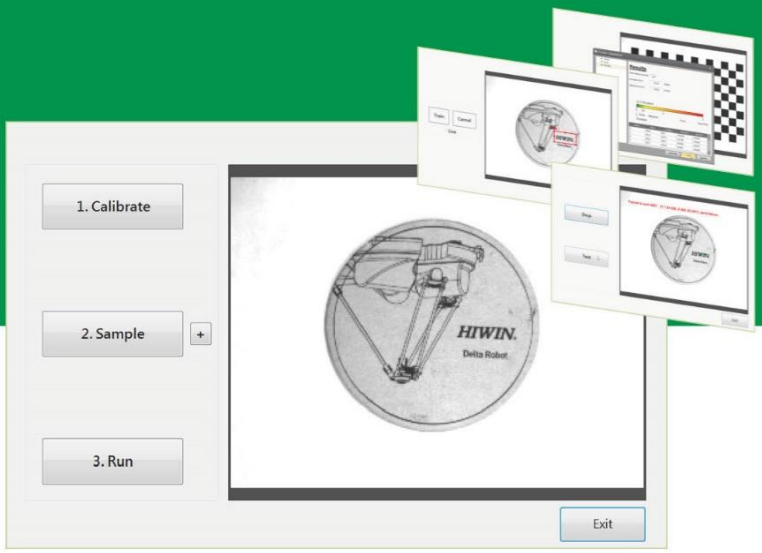
HIWIN®

Vision System

User Manual

Original Instruction



www.hiwin.tw

Safety Precautions

1. Safety Information

- Safety Responsibility and Effect
  - This chapter explains how to use the robot safely. Be sure to read this chapter carefully before using the robot.
  - The user of the HIWIN industrial robot has responsibility to design and install the safety device meeting the industrial safety regulations in order to ensure personal safety.
  - In compliance with the safety information on industrial robot described in this manual can't guarantee that *HIWIN* robot will not occur any safety problems.
  - This machine is defined as a partly completed machinery, the associated hazards must be handled by system integrator in accordance with ISO 102018-1/-2.
  - A safety-related part of control system (SRP/CS) should conform to the requirement of performance level d and category 3 according to ISO 13849-1.
  - The installation for emergency functions shall be defined by the system integrator in accordance with ISO 10218-1/2.

- Safety Operation Principle
  - Before connecting the power supply for HIWIN industrial robot startup assembly procedure, check whether the specification of factory output voltage matches the specification of input voltage of the product. If it does not match, ensure to use the corresponding transformer (HIWIN optional transformer is recommended).
  - Emergency Stop button (on Teach Pendant or from external emergency stop switch) must be pressed before turning off the power, and then switch off the power switch.
  - While connecting to the external I/O or the signal, please operate in the condition that the power switch is turned off to prevent from a shortcut caused by mistaken touch in the process, and resulting in damage.

2. Description Related to Safety

I. Safety Symbols

⦿ Carefully read the instructions in the user manual prior to robot use. The following shows the safety symbols used in this user manual.

Symbol	Description
DANGER	Failure to follow instructions with this symbol may result in serious hazard or personal injury. Please be sure to comply with these instructions.
WARNING	Failure to follow instructions with this symbol may result in personal injury or product damage. Please be sure to comply with these instructions.
CAUTION	Failure to follow instructions with this symbol may result in poor product performance. Please be sure to comply with these instructions.

II. Working Person

⦿ The personnel can be classified as follows

- Operator:
  - Turns robot controller ON/OFF
  - Starts robot program from operator's panel
  - Reset system alarm
- Programmer or teaching operator:
  - Turns robot controller ON/OFF
  - Starts robot program from operator's panel
  - Reset system alarm
  - Teaches robot
- Maintenance engineer:
  - Turns robot controller ON/OFF
  - Starts robot program from operator's panel
  - Reset system alarm
  - Teaches robot
  - Does maintenance, adjustment, replacement

⦿ Programmer and the maintenance engineer must be trained for proper robot operation.

3. Precautions

3.1 Common Safety Issues

DANGER	❖ All operating procedures should be assessed by professional and in compliance with related industrial safety regulations. ❖ When operating robot, operator needs to wear safety equipment, such as workwear for working environment, safety shoes and helmets. ❖ When encountering danger or other emergency or abnormal situation, please press the emergency stop button immediately. After danger is eliminated, move the robot away with low speed in manual mode. ❖ When considering safety of the robot, the robot and the system must be considered at the same time. Be sure to install safety fence or other safety equipment and the operator must stand outside the safety fence while operating the robot. ❖ A safety zone should be established around the robot with an appropriate safety device to stop the unauthorized personnel from access. ❖ While installing or removing mechanical components, be aware of a falling piece which may cause injury to operator. ❖ Ensure the weight of workpiece does not exceed the rated load or allowable load moment at wrist. Exceeding these values could lead to the driver alarm or malfunction of the robot. ❖ Do not climb on manipulator. ❖ Do not store the machine in the environment with corrosion and flammable gas or close to the flammable object. ❖ Do not operate the machine in the environment with moisture, water or grease. ❖ Do not operate the machine at the place where vibration or the strong impact occurs. ❖ Do not immerse the electric wires into grease or water.

	❖ Do not connect or operate the machine with wet hands. ❖ Do not operate the machine in potentially explosive environment. ❖ Please ensure the controller is grounded. ❖ Keep hands away from the inner part of the controller while it is connecting to the power or during operating. ❖ Do not touch the heat sink, regenerative resistance, the power supply or the computer inside the controller while it is operating due to its high temperature. ❖ Be sure power is disconnected prior to repair and maintenance, and ensure to operate under the condition of no electrical shock risk. ❖ Do not disassembly the controller without permission. If there's any issues, please contact our engineers.
⚠ WARNING	❖ The personnel installing robot should be trained and licensed. ❖ To ensure personal safety, robot installation must comply with this manual and related industrial safety regulations. ❖ The control cabinet should not be placed near high voltage or machines that generate electromagnetic fields to prevent interference that could cause the robot to deviation or malfunction. ❖ Using non-HIWIN spare parts to repair may cause robot damage or malfunction. ❖ Beware of the heat generated by the controller and servo motor. ❖ Do not overbend the cable to avoid poor circuit contact or unexpected damage. ❖ Do not stand on the controller or put heavy objects on it. ❖ Do not block the vent or put foreign objects into the controller. ❖ Please ensure the controller is fixed on the base.

	❖ Do not pull the connector violently or twist the electric wires excessively. ❖ Do not frequently switch ON/OFF the power switch and the control button. ❖ Please ensure that the robot, the emergency stop switch and the controller are functioning properly before performing any work. ❖ Do not shutdown the power switch during the operation. ❖ Do not open, modify, disassemble and maintain the machine without permission. ❖ The power must be disconnected when the machine does not operate in a long time. ❖ Do not turn off the power of the controller when modifying the program or parameter. Otherwise, the data stored in the controller will be damaged. ❖ After the brake of a servo motor is released, the robot will be moved due to gravity and it may injured the operator. ❖ The industrial robots can be applied for the different industrial environments. ❖ When the operating procedures are interrupted, the special attention should be paid during the troubleshooting.

3.2 Operation

DANGER	❖ Teaching, jogging or programming should be done outside of the safety fence. If it is inevitable to enter the safety fence, press the emergency stop button before entrance. Operation should be restricted at low speed and beware of surrounding safety. ❖ All operations shall be executed by trained staff.

3.3 Maintenance

DANGER	❖ Please contact us if the procedure not specified by HIWIN is needed. ❖ Please contact us if the replacement of the component not specified by HIWIN is needed. ❖ Be sure to carry out regular maintenance, otherwise it will affect the service life of the robot or other unexpected danger. ❖ Prior to repair and maintenance, please switch off power supply. ❖ Maintenance and repair should be performed by a qualified operator with a complete understanding of the entire system to avoid risk of robot damage and personal injury. ❖ When replacing the components, avoid foreign object going into the robot.

3.4 End Effector

The end effector can be classified as two types:

A. Gripper: Used to load and unload, such as pneumatic gripper, electric gripper and vacuum sucker.
B. Tool: Used to process, such as welding, cutting and surface treatment.

DANGER	❖ More attention must be paid to the design of the end effector to prevent power loss or any other errors that could lead to workpiece falling or damage. ❖ The tool-type end effector is usually equipped with high voltage, high temperature and active rotary shaft. Special attention should be paid to the operating safety. ❖ The end effector should be mounted firmly on the robot to avoid workpiece fall during operation which may cause personal injury or hazard.
WARNING	❖ The end effector may be equipped with its own control unit. During installation, pay attention to installed location. Ensure that the control unit does not interfere with robot operation. ❖ The gripper-type end effector should prevent the workpiece from dropping or damaging when the robot experiences a power error or other errors. If potential dangers or abnormal situations exist when using end effector, the associated hazards must be handled by the system integrator in accordance with the related standards.0

3.5 Pneumatic, Hydraulic System

DANGER	❖ When using the pneumatic or hydraulic system, the gripped workpiece may fall due to insufficient pressure or gravity. ❖ The pneumatic or hydraulic system must be equipped with the relief valve, so that it can be applied in an emergency.

WARNING	❖ More attention should be paid to the pressure remained in the pneumatic systems after the power is disconnected. ❖ The internal pressure must be released before the pneumatic systems are maintained. ❖ More attention should be paid to the pressure in the pneumatic system as it is several times more than the atmosphere pressure.

3.6 Emergency Stop Switch

DANGER	❖ The robot or other control component should have at least one device for immediate halt, such as an emergency stop switch. ❖ The emergency stop button must be installed in an easily accessible location for quick stop. ❖ While executing an emergency stop, power to the servo motor will be cut, and all movements will be stopped. And the control system will be shut down. Emergency stop should be reset if the restoration of operating procedure is wanted. ❖ Avoid using emergency stop to replace a normal stop procedure. This could reduce the lifespan of the robot.
WARNING	❖ The drive power and the control system will be disconnected to stop all actions during the emergency stop. ❖ If you want to restart the procedures, you should reset the emergency stop switch. ❖ Emergency stop established an immediate stop: Immediately stop the robot system, and disconnect the driver power. ❖ The emergency stop switch is used for emergency stop only. ❖ The *HIWIN* robot is equipped with two emergency stop switches, where one is installed on the teach pendant and the other is directly connected to the controller via a cable. If additional emergency stop switches are required, other connecting method can be applied for the same purpose.

	❖ Based on the relevant industrial safety regulations, the emergency stop switch is directly connected to the controller of the robot via the physical wires. ❖ If the version of the braking is not applied to the whole axis, once the emergency stop is executed and the heavy objects are loaded on the robot end, the axis without brake will move due to gravity. This attention must be paid for safety issue.

4. Intended use

HIWIN robots are industrial robots and intended for pick-and-place, handling, assembling, deburring, grinding and polishing. Use is only permitted under the specified environment, for more detailed information please see section 2.5 environmental conditions.

Use is not permitted under the following conditions:

- Use in potentially explosive environments
- Use without performing risk assessments
- Transportation of people and animals
- Operation outside the allowed operating parameters

5. Disposal

The disposal of HIWIN robot shall be in accordance with the local environmental regulations.

Content

1. Introduction

1.1. Target Group

This reference is designed for the users who have the following knowledge:

- Basic knowledge of the robot
- Ability to write industrial robot motion programs

CAUTION

We recommend our customers to be trained in HIWIN so that they may use them with the best success. For the training information, please visit our website www.hiwin.tw or contact our branch.

1.2. Robot References

The robot references are comprised of the following parts:

- Robot controller document
- HIWIN Robot system software operation and programming guide
- Conveyor tracking system technical manual

Each copy of guide is independent.

1.3. Representation of warnings and notes

Please carefully read and indeed obey this manual before operating the robot. In addition, the following symbols must be understood to avoid the personal danger and product damage.

Symbol	Description
DANGER	If you don't obey the description of this symbol, the major injury could take place. In order to guarantee the safe use of this product, please indeed follow this regulation.
WARNING	If you don't obey the description of this symbol, the major injury or product damage could take place. In order to guarantee the safe use of this product, please indeed follow this regulation.
CAUTION	If you don't obey the description of this symbol, the improper product operation could take place. In order to guarantee the safe use of this product, please indeed follow this regulation.

1.4. Safety Description

Please read carefully the following notices and follow them when operating the robot.

DANGER	❖ Please turn off all power prior to the maintenance and repairing. ❖ The end-effector must be firmly installed on the robot to prevent it separates from the robot arm during the operation, which could cause risk of person injury. ❖ This manual contains the recommended method for transporting the robot. Transporting by another method creates risk of personal injury or product damage.
WARNING	❖ A device that can immediately stop the procedure in progress is recommended. ❖ Provide an external fence for the workstation to avoid contacting the operator when the robot runs. ❖ Ensure the robot and the emergency stop switch work properly prior to the operation. ❖ Operation of the robot under conditions not recommended could cause personal injury or product damage. ❖ The robot must be mounted. Unstable installation could cause a shift in position or vibration. ❖ Excessive bending of the power cable could create a bad connection. ❖ The workpiece weight must not exceed the rated payload of the robot and tolerant torque. Driver alarm or failure could occur. ❖ Modifying the unit without permission or original parts could cause system error or failure.

⚠ CAUTION	❖ All operations must be executed by trained staff. ❖ Cables should be kept away from noise to avoid robot shift or failure. ❖ The velocity of the robot should be kept as low as possible, and operating conditions should be observed at all times. A workpiece could be dropped or an operator injury could occur. ❖ Do not turn off the controller power while modifying a program or parameter. Program data could be lost or damaged.

1.5. Trademark

Windows is a trademark of Microsoft Corporation.
WordPad is a trademark of Microsoft Corporation.

2. Product Description

2.1. Overview

- Overview

  HIWIN robot manipulator vision system can be used to perform image search on the image of the workpiece sample that has been trained, find the matching image of the workpiece image block in the image, using the coordinate data generated by the calibration process to conduct coordinate positioning and transmit the coordinate data to robot manipulator. It is suitable for a variety range of different robot manipulator application scenarios.

- Static pick-and-place application

  Figure 2-1 shows the system architecture of a typical single robot manipulator with a vision system for pick-and-place application. In this case, the vision system is powered by a network power supply (POE) and connected to the robot controller, and can be taught directly through the teach pendant for sample training and calibration of the vision system without the need to connect additional equipment.

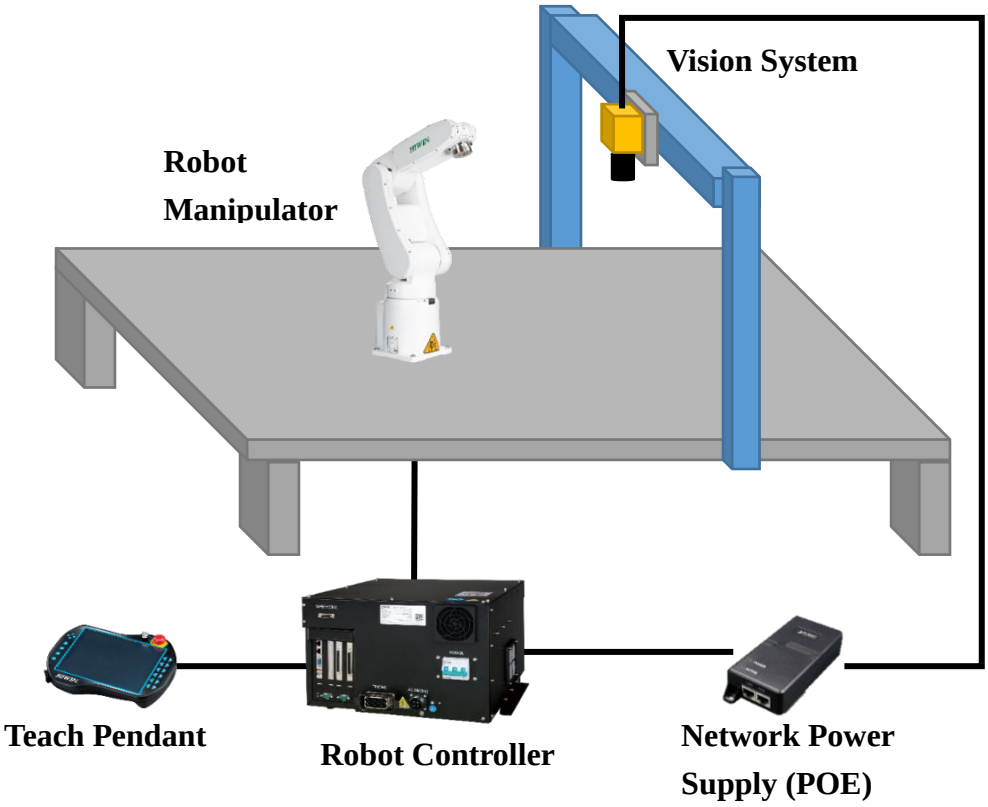


Figure 2-1 Static pick-and-place application system architecture diagram

- Conveyer tracking pick and place application

  Figure 2-2 shows the system architecture of a pick-and-place application for moving workpieces on a conveyer belt using HIWIN robot manipulator. In this case, the vision system connects multiple robot controllers through network power supply (POE) and network hub which can connect the teach pendant to any robotic arm controller and directly target the vision through the teach pendant. The system performs teaching exercises such as sample training and calibration without the need to connect additional equipment.

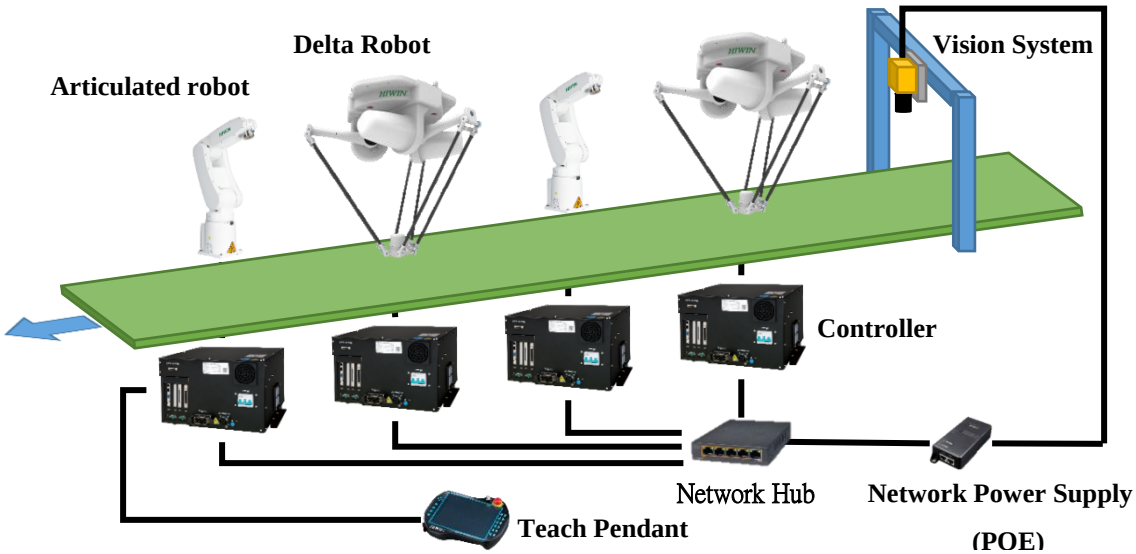


Figure 2-2 Conveyor belt tracking and pick-and-place system architecture diagram

2.2. HIWIN Robot System Software(HRSS) Vision System Function Overview

- Description

  HIWIN Robot System Software (HRSS) vision system provides a highly integrated, easy-to-use vision application environment that allows users to quickly build a complete vision-based automation solution in a short period of time. This feature includes:

  - Sample geometric feature identification
  - Synchronous identification of multiple samples (up to 8 types)
  - Switch identification target sample.
  - Sample center position offset and output coordinate value fixed error compensation
  - Ethernet TCP / IP trigger identification (static application)
  - Object Picking Order Sorting (Conveyor Tracking Application)
  - Dynamic object repeat identification filtering (conveyor tracking application)
  - Automatic conveyor speed measurement (conveyor tracking application)
  - Average load dispatching for multiple robotic jobs (conveyor tracking application)
  - Supports simultaneous connection of up to 4 robot arms (conveyor tracking application)

3. Usage Process

- Description

  Figure 3-1 shows the initial use of the vision system function. The vision system can be used in each step of the process. For detailed operation instructions, please refer to the section marked with the number next to each step. In addition to the system setup and network setting steps, it only needs to be performed once, and the remaining steps can be directly adjusted on the teach pendant to meet the actual needs.

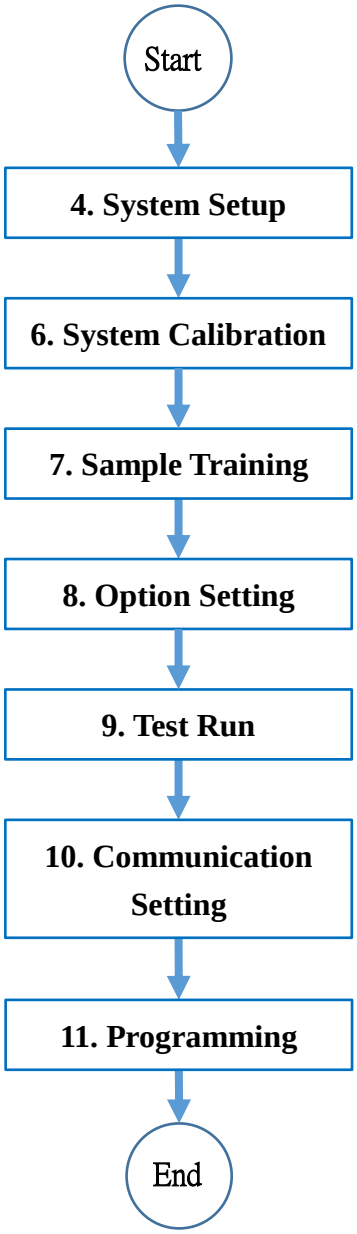


Figure 3-1 Vision system function usage process

4. System Setup

4.1. System Connection Overview

- Cable

  Figure 4-1 shows the communication cable and encoder signal output cable by the vision system. The communication cable is used to connect the vision system to the network power supply (POE), while the encoder signal output cable (CN5) is used to connect the vision system to the robot control.

Figure 4-1 Communication cable (left) and encoder signal output cable (right)

- Vision System Hardware Port

  Figure 4-2 shows the two hardware ports of the vision system; the "ENET" port and the "I/O" port, which correspond to the dedicated connector of the communication cable and the encoder signal output cable.

Figure 4-2 Vision System Hardware Port

- Basic connection architecture

  Figure 4-3 shows the basic connection architecture of the vision system. The encoder signal output cable is only connected for the “conveyor tracking application”. For more information of the network of the robot controller port IP1, IP2 and encoder, see sections 4.2 and 4.3 for further description. Figure 4-4 shows the actual connection diagram of the vision system.

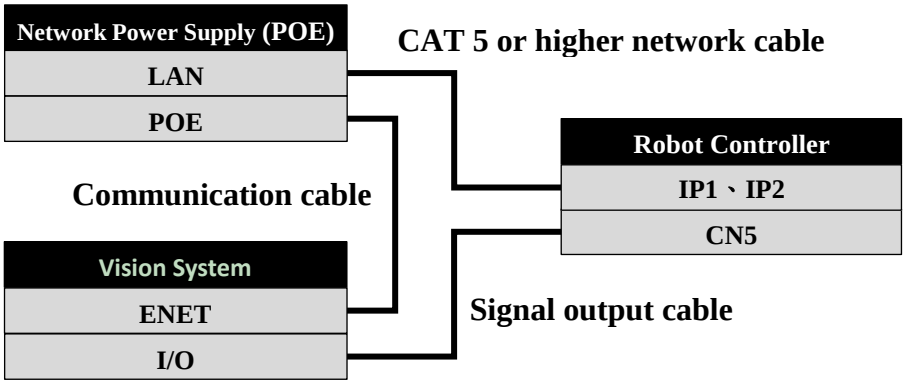


Figure 4-3 Vision system basic connection architecture diagram

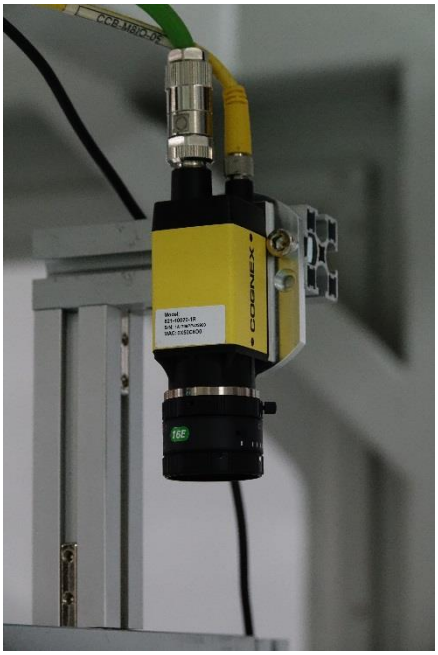


Figure 4-4 Vision system actual connection diagram

4.2. Network Cable Connection

- Network power supply (POE) cable connection

  As shown in Figure 4-5, the network power provider has two network ports: "LAN" port and "POE" port. Please connect "POE" port with the communication cable to the "Vision System", and "LAN" port with the network cable of CAT 5 or higher to the "Robot Controller".

Figure 4-5 Network power supply (POE) network port

- Controller cable connection

  As shown in Figure 4-6, the robot controller has an encoder capture module (CN5) and two network ports, each with its number: "IP1" at the top and "IP2" at the bottom. Please connect one of the network ports to the "LAN port" of the network power supply according to the actual connection.

Figure 4-6 Robot controller network port and encoder capture module (CN5)

4.3. Encoder Count Value Capture Signal Output Cable Connection

- Connection timing

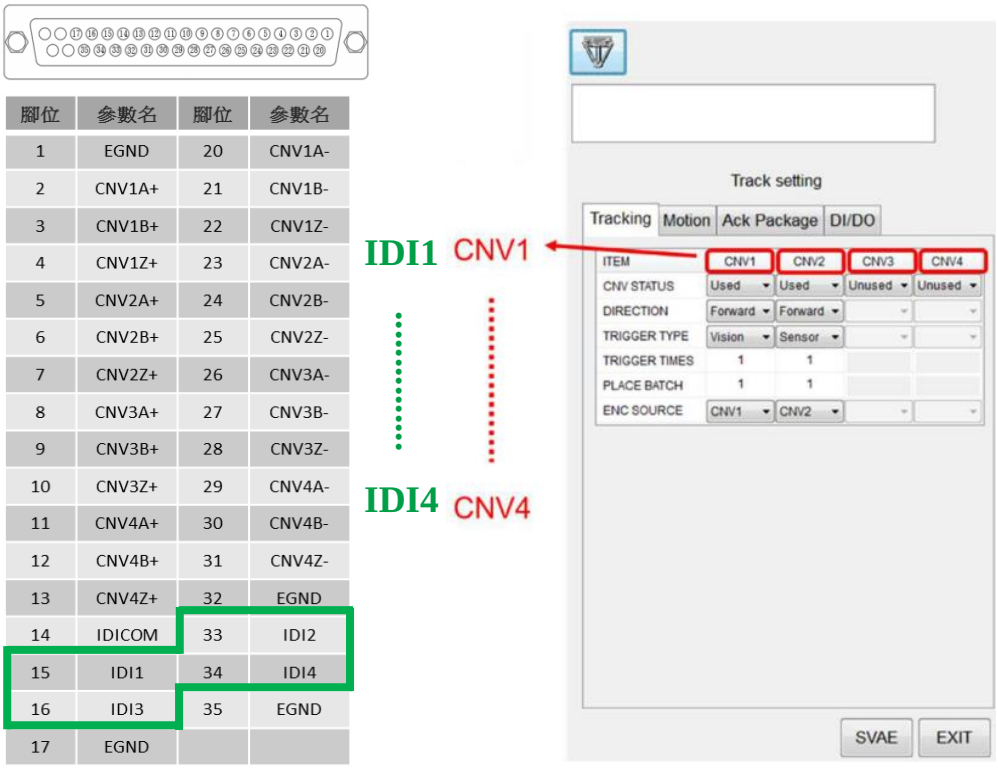
  This output line is only connected when you are in the Conveyor Tracking Application.

- Description

  The vision system captures the signal output through the encoder count value, and outputs a captured signal at the beginning of each image captured, so that the robot controller captures the encoder count value as a reference value for the current conveyor belt as a tracking and picking movement.

- Connection Method

  As shown in Figure 4-7, the encoder input (CN5) of the robot controller has 4 sets of encoder input channels, each of which has a capture signal input end, which is IDI1~IDI4, corresponding to the robot system. The encoder count value of each conveyor belt number CNV1~CNV4 in the software captures the signal source. Figure 4-8 and Figure 4-9 show the connection diagram of the signal output lines of the NPN and PNP circuits respectively, which can be wired according to the actual application.



腳位	參數名	腳位	參數名
1	EGND	20	CNV1A-
2	CNV1A+	21	CNV1B-
3	CNV1B+	22	CNV1Z-
4	CNV1Z+	23	CNV2A-
5	CNV2A+	24	CNV2B-
6	CNV2B+	25	CNV2Z-
7	CNV2Z+	26	CNV3A-
8	CNV3A+	27	CNV3B-
9	CNV3B+	28	CNV3Z-
10	CNV3Z+	29	CNV4A-
11	CNV4A+	30	CNV4B-
12	CNV4B+	31	CNV4Z-
13	CNV4Z+	32	EGND
14	IDICOM	33	IDI2
15	IDI1	34	IDI4
16	IDI3	35	EGND
17	EGND		

Figure 4-7 Schematic diagram of the correspondence between the signal input and the conveyor belt number.

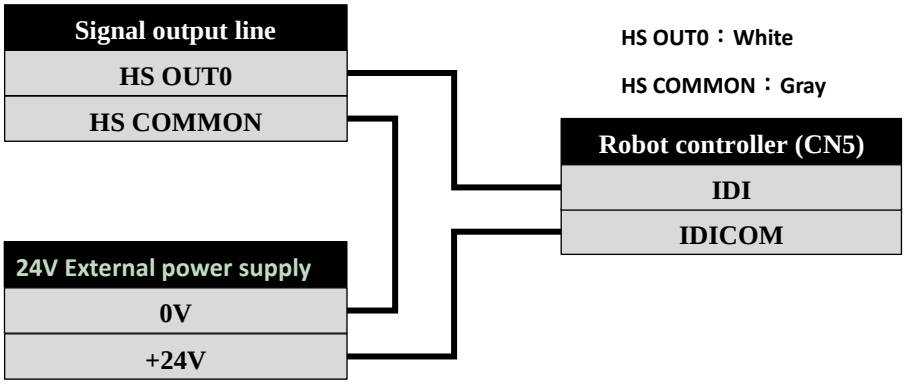


Figure 4-8 Signal output line connection diagram (NPN type circuit)

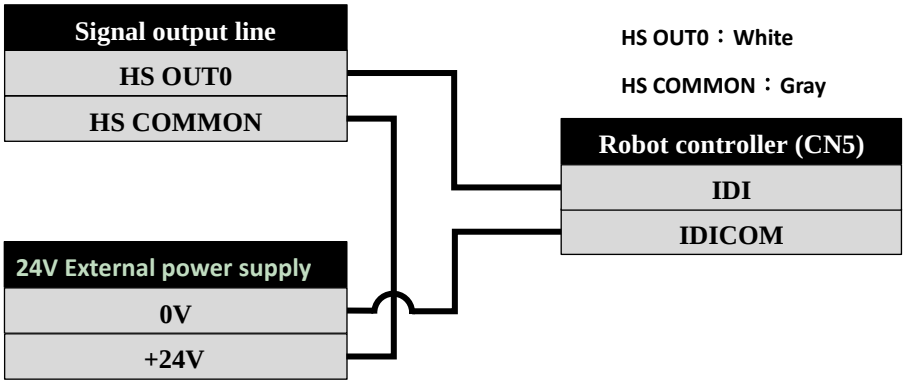


Figure 4-9 Signal output line connection diagram (PNP type circuit)

⚠ WARNING	❖ Before connecting the cable, please confirm the type of the electrical circuit and re-wire, otherwise the device will be damaged.
⚠ CAUTION	❖ For the connection description and electrical specifications of the "IDI" of the controller, refer to the paragraph "Encoder Socket" in the "Conveyor Tracking System Technical Manual". ❖ The number of the IDI of the robot controller should correspond to the following options. The conveyor tracking function can work normally: ⦿ "Conveyor No." tab on the robot arm (see section 6.5) ⦿ Vision system "conveyor belt number" setting (see section 8.2) ⦿ Conveyor belt number parameter in the robot arm command

4.4. Manipulator Local Address Setting

- Description

  In order to connect the robot controller to the vision system, local network communication and IP address setting are required.

- Setting procedure

  1. Press the "Change IP" button as shown in Figure 4-10.
  2. Select the network IP number as shown in Figure 4-11. Please refer to "4.2 Network Cable Connection" for instructions.
  3. Click on the “Static” option to select the setting static IP.
  4. Enter the IP.
  5. Press the "Set" button and wait for the setting to complete.

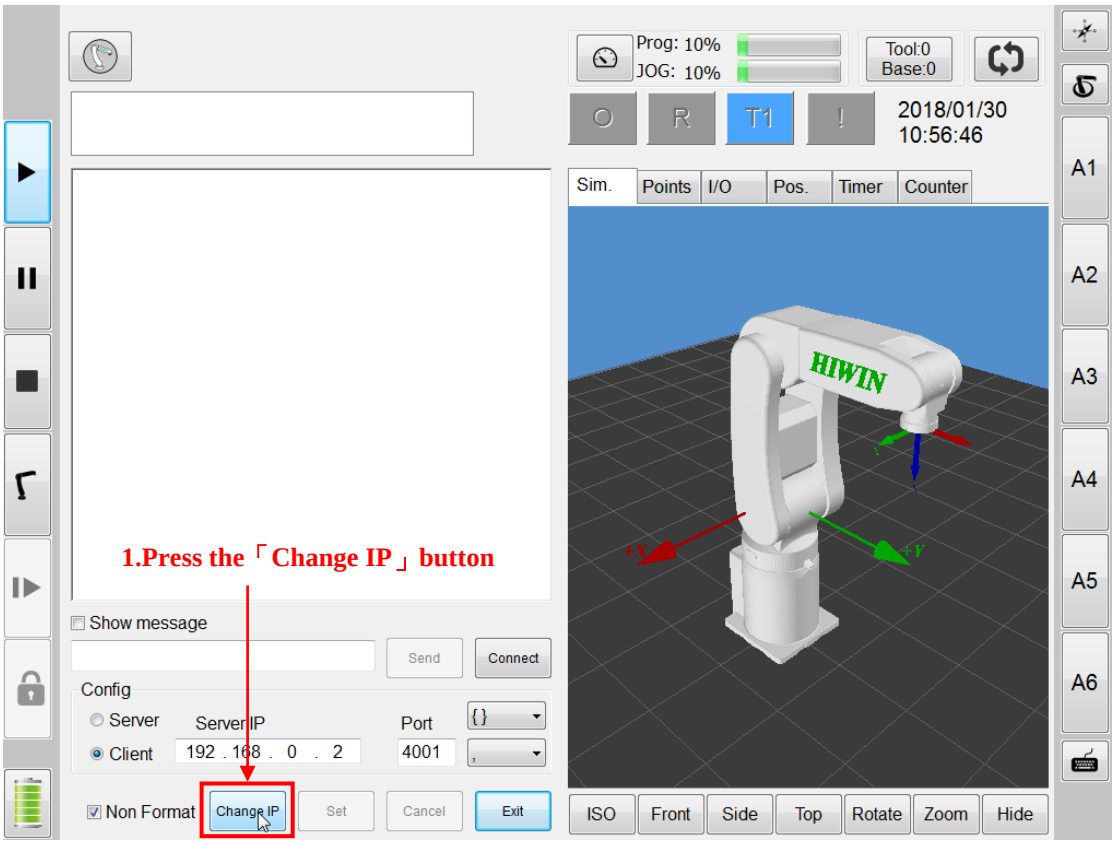


Figure 4-10 Press the "Change IP" button

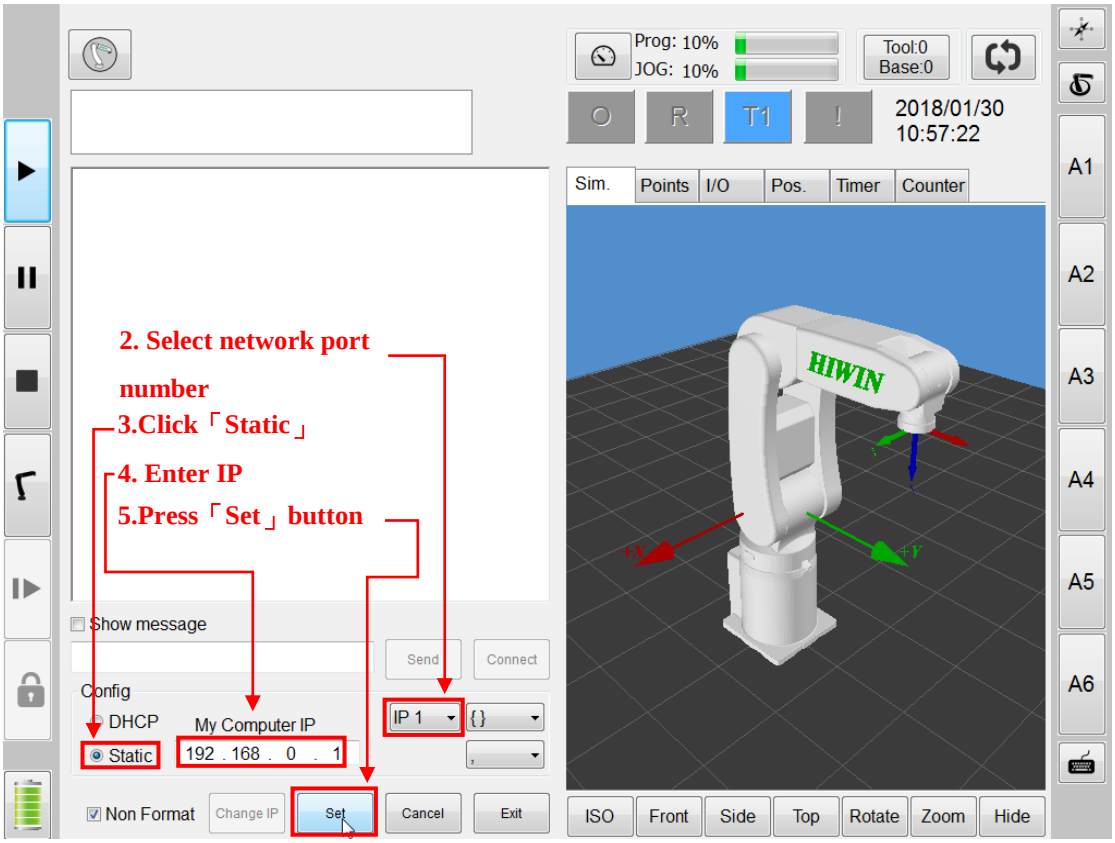


Figure 4-11 Set local network communication port IP

⚠ CAUTION	❖ If you are unable to connect to the vision system, please make sure that the selected network port number does not match the connected physical network port. Please refer to the section “Network Cable Connection”. ❖ The IP input area can be set to "192.168.0.X", and X needs to be an integer between 0 and 255 but not 2. ❖ After the IP setting is completed, you need to confirm whether the network communication port IP of other robot controllers are connected in the same network section that is set to “192.168.0.2” or “two or more identical”, if any, change to other settings that are not repeated. Each robot controller and the vision system have a "unique" address in the same section. Otherwise, an address conflict will occur that prevents the vision system from being connected.

5. Open Settings Interface

- Function description

  The software function of the HRSS can be set for different application scenarios. It can be divided into the following two application scenarios, and each has a corresponding setting interface:

  - Static pick and place application interface
  - Conveyor tracking and application interface

- Open interface setting process

  1. As shown in Figure 5-1, in the main menu, first press the "Configuration" button, then press the "Vision System" button.

  2. As shown in Figure 5-2, press the "Execute" button. At this time, if the startup is successful, the message “Execute Successfully” will appear. After closing the message window, wait for the vision system to connect and open the setting interface.

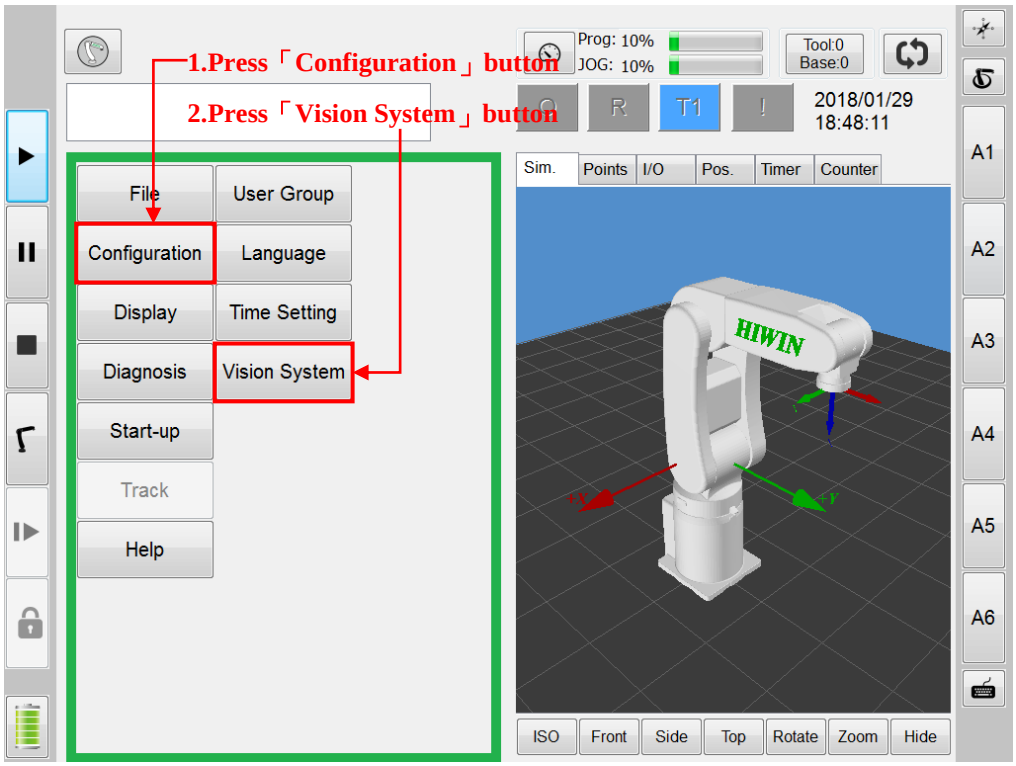


Figure 5-1 Open the "Vision System" menu

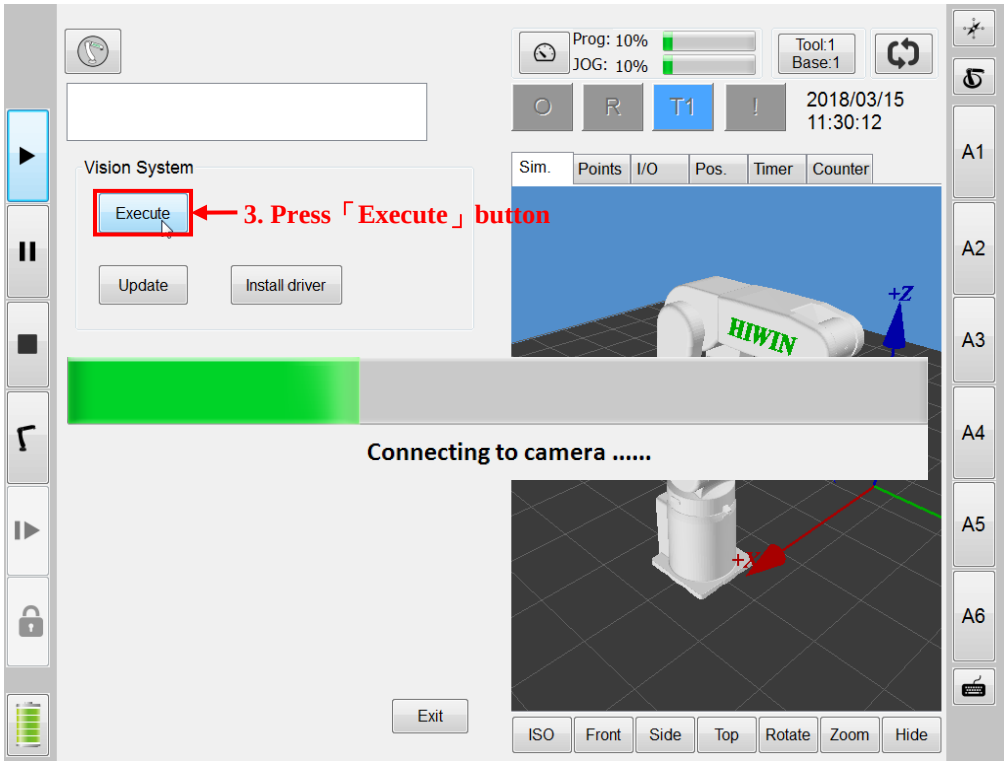


Figure 5-2 Waiting for vision system to be connected

⚠ CAUTION	❖ If you are unable to connect to the vision system, please confirm that the steps in the "System Setup" section have been completed.

- Application interface selection

1. As shown in Figure 5-3, in the drop-down menu, select the application interface.

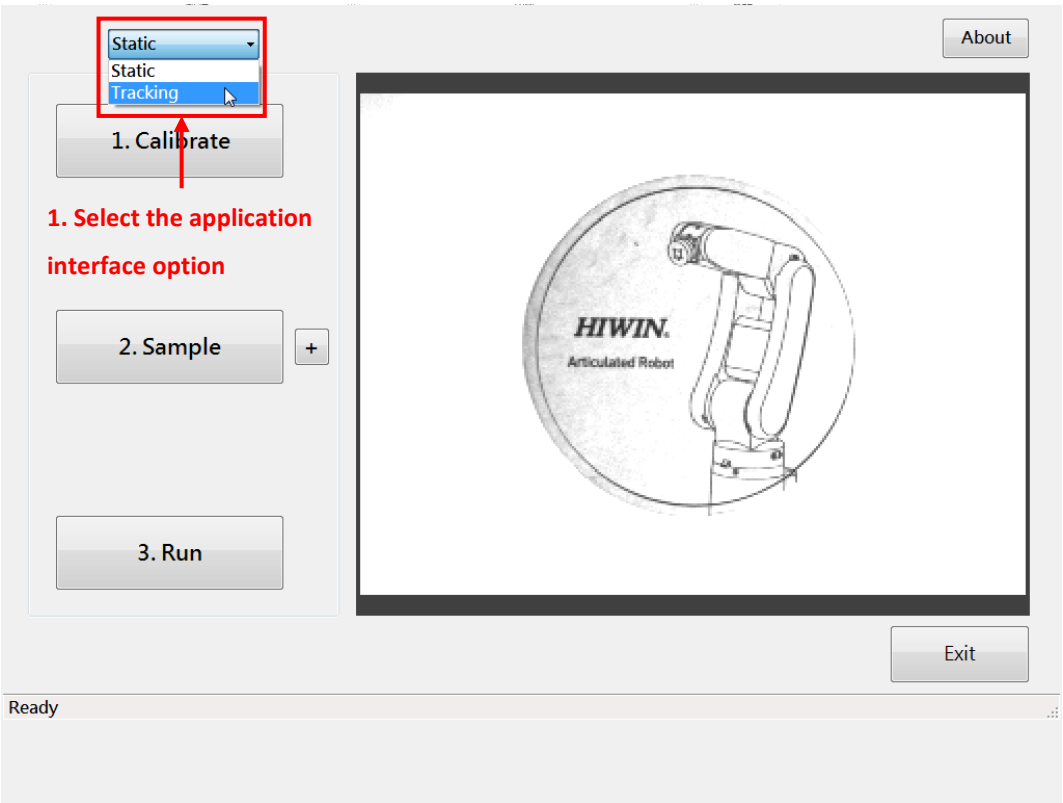


Figure 5-3 Select application interface

2. If you select a new application mode, the message window prompt to recalibrate will appear. As shown in Figure 5-4, press the "Yes" button to confirm to switch the mode. Press the "No" button to maintain the current mode.

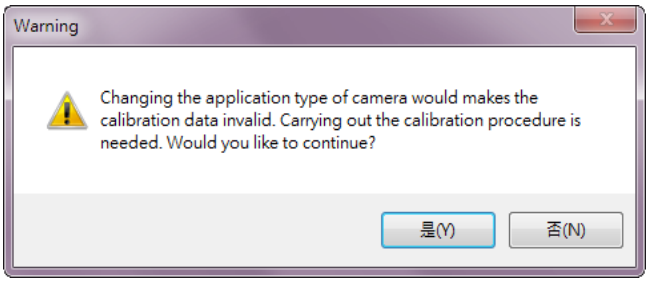


Figure 5-4 Recalibrate the prompt window

- Static pick and place application interface

  Figure 5-5 shows the setting interface of the static pick and place application, including the following items. The operation of each item will be described in the following sections:

  (1). Application interface switching: drop-down menu for switching the current application interface

  (2). Coordinate calibration of the world coordinate system: world coordinate system correction can be performed after clicking

  (3). Sample training: After the click, the workpiece image sample training can be performed.

  (4). Sample options: Click to set sample options

  (5). Test run: Click to test run

  (6). Prompt message display: display prompt message related to operation

  (7). Instant shooting screen display: display the scene image within the visible range of the current vision system

  (8). Version display: display the version number of the interface program

  (9). Leave: Click to leave the program

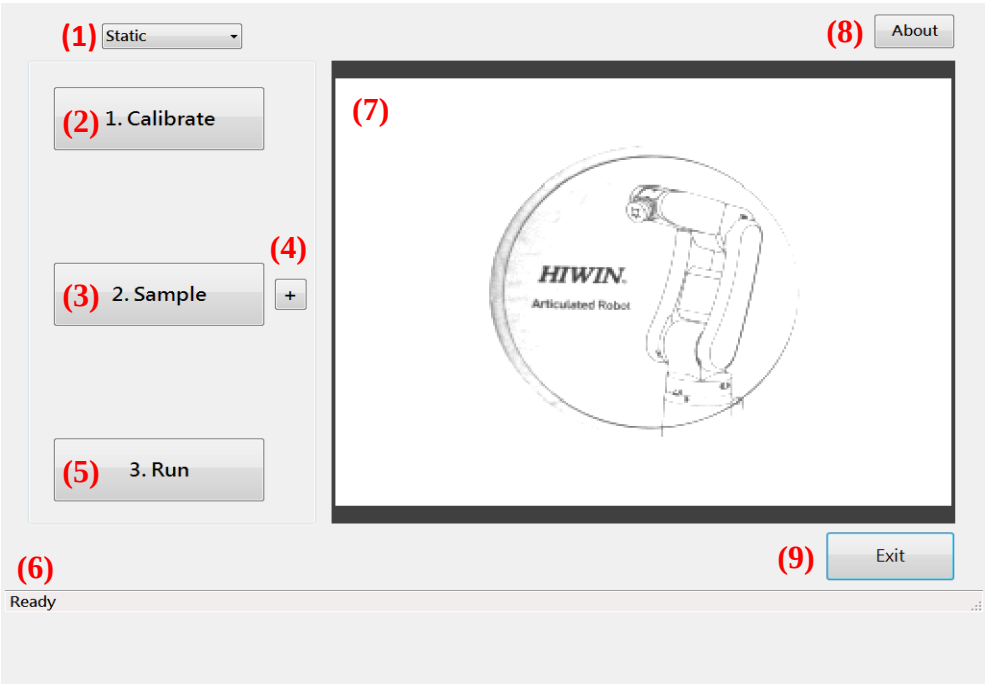


Figure 5-5 Static pick and place application interface

6. System Calibration

6.1. Flowchart

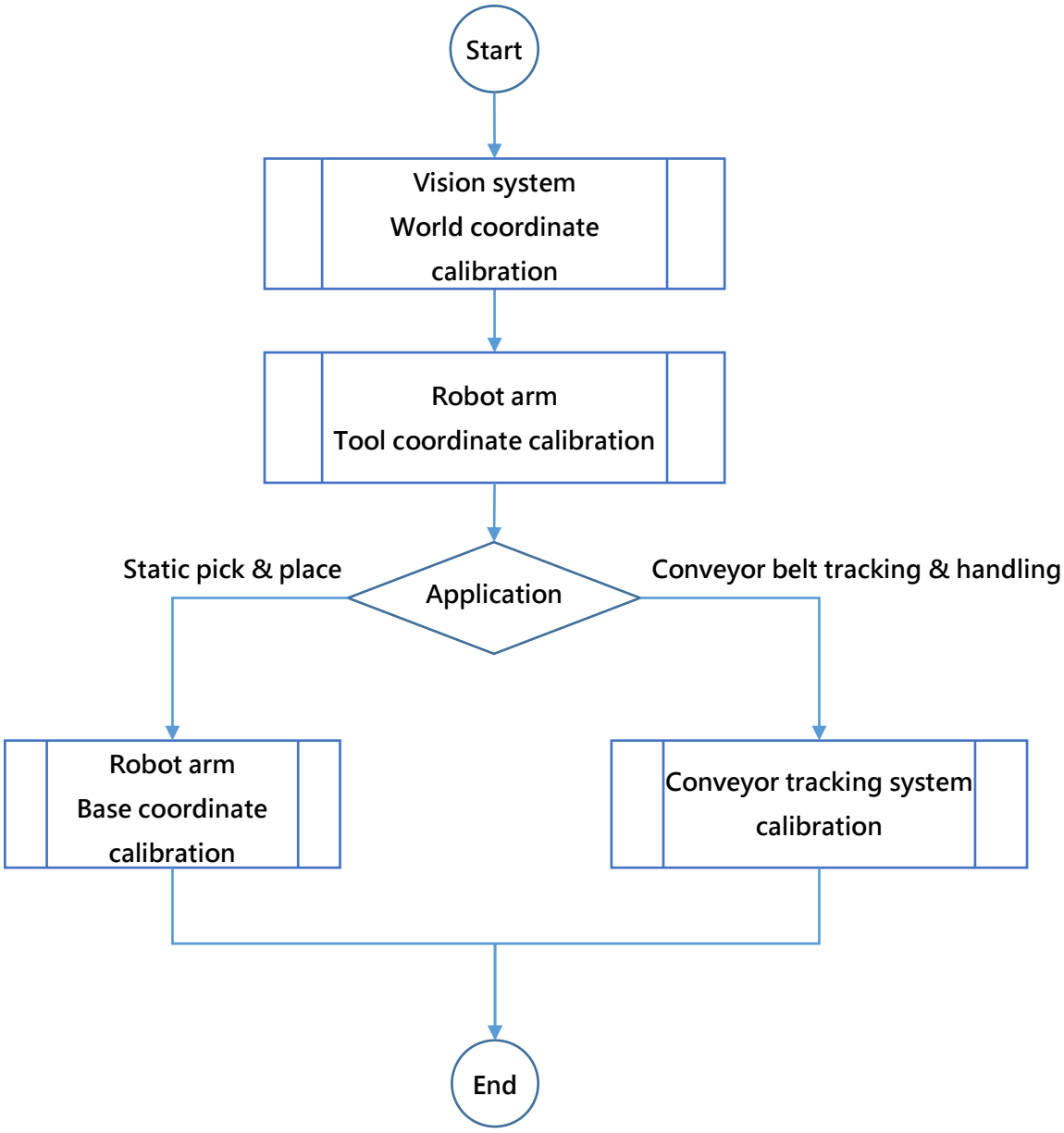


Figure 6-1 System calibration flow chart

6.2. Vision System World Coordinates Calibration

- Application

  This setting procedure are for two application scenarios: "static pick-and-place" and "conveyor tracking and pick-and-place".

- Description

  In the vision system, all location information is represented by its internal "image coordinate system" and is in "pixel" rather than the actual physical unit. Through the calibration of the world coordinate system, the conversion relationship between the image coordinate system and the real world coordinate system can be calculated, and the actual physical coordinate value of the workpiece can be calculated, so that the robot arm can use the position information to perform the pick and place operation.

- Calibration board

  Figure 6-2 shows the calibration plate used to calibrate the world coordinate system of the vision system. It consists of a checkerboard grid with a regular and fixed side length and a cross-shaped coordinate system (Fiducial), which defines coordinate axis of the world coordinate system. The following three different calibration plates are available for different shooting ranges:

  - A3: Grid side length 20 mm
  - A4: Grid side length 15 mm
  - A5: Grid side length 10 mm

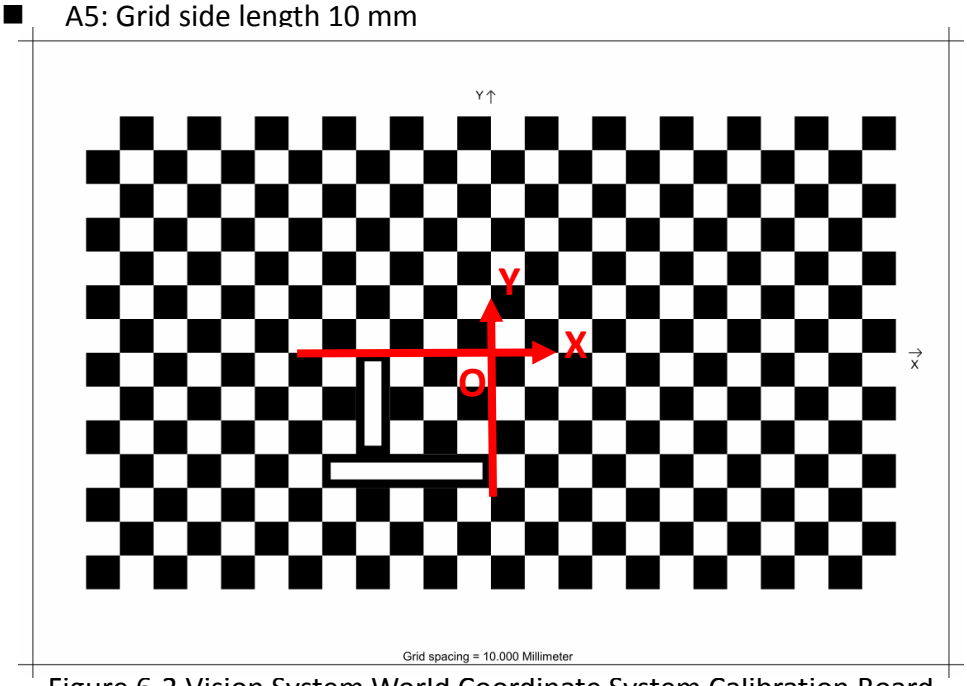


Figure 6-2 Vision System World Coordinate System Calibration Board

- Procedure

  1. Press the "Calibrate" button as shown in Figure 6-3.
  2. Set calibration board information:
     - Plate Type: Calibration plate type with three standard calibration plates and custom calibration plate options.
     - Grid: Grid type, including "Checkerboard" and "Dots".
     - Spacing: Grid spacing, in mm.
  3. Press the "OK" button to start the calibration.
  4. If the calibration is successful, the message shown in Figure 6-4 will be displayed. Press the “OK” button to end the calibration.
  5. If the calibration fails, please confirm the following:
     - The calibration plate is placed in the area near the center of the screen.
     - Adjust the lens aperture, focus ring and light source to maximize the edge characteristics of the calibration plate grid points.

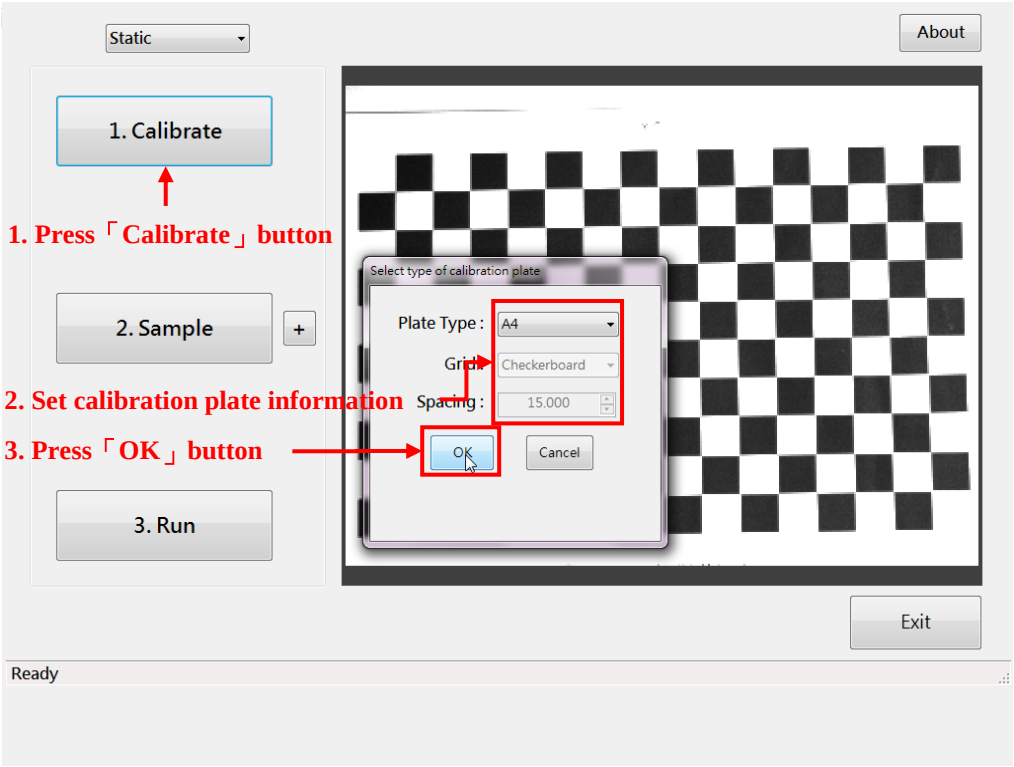


Figure 6-3 “Calibrate” button

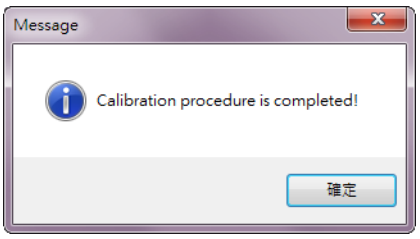


Figure 6-4 Calibration successful message

6.3. Robot Arm Tool Coordinate Calibration

- Application

  This setting procedure are for two application scenarios: "static pick-and-place" and "conveyor tracking and pick-and-place".

- Description

  The movement of the robot arm is control by the controller through the position and orientation of the control tool coordinate system. The origin of the tool coordinate system, also known as the Tool Center Point (TCP). The position of the tool center point depends on the type of tool. It is the working point of the actual work. For example, if the tool is a suction cup, the actual suction position is the suction cup center, so the tool center point needs to be set at the center of the suction cup.

- Base coordinate calibration tool

  In theory, any tool working point can be used for base calibration, but in practice, the tool type has a great impact on the calibration results. Figure 6-5 shows an example of the base calibration system. Because it has a reliable mounting surface and is easy to manufacture, the tool coordinate correction value and the actual physical calibration point are less. In addition, the tip is also convenient for the user to perform the vision auxiliary function when the base calibration is three-point calibrated. Therefore, it is recommended that the designed self-calibration tools needs conform to the characteristics of the above-mentioned calibration tool samples, so as to obtain more accurate pick and place results.

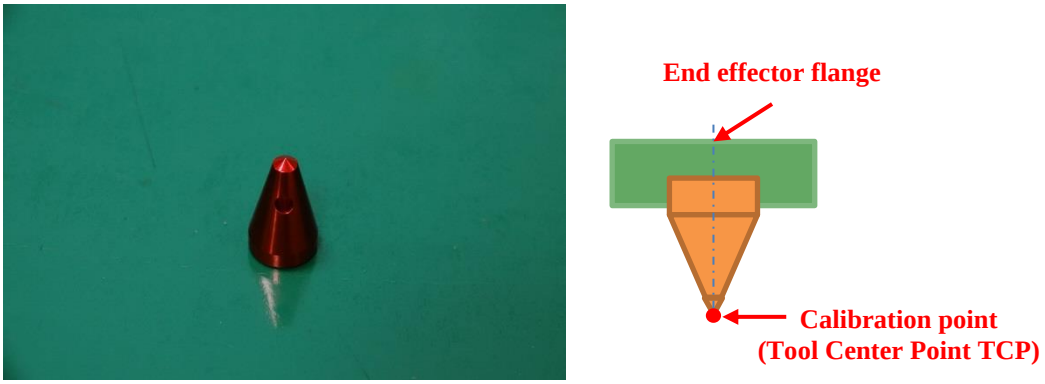


Figure 6-5 Base coordinate calibration tool example

- Procedure

  Please refer to the relevant section of the "Calibrate Tool Coordinates" in the "Robot Software Manual".

⚠ CAUTION	❖ The "set position" of the tool coordinate system must be the same as the "actual working position" on the tool, otherwise the deviation in the working position will occur.

6.4. Robot Arm Base Coordinate Calibration

- Application

  This setting procedure is only for "static pick-and-place" application.

- Description

  The location information generated by the vision system is based on its “world coordinate system". However, the movement of the robot arm is based on its "base coordinate system", and there is a positional deviation between these two. Through the calibration of the base of the robot arm, this deviation can be eliminated, and the robot can know the position of the workpiece through the position information generated by the vision system, and then perform the pick and place action.

- Procedure

  1. Select the tool coordinate system of the calibration tool as shown in Figure 6-6.
  2. In Figure 6-7, after selecting the base coordinate, press the “Measure” button.
  3. In Figure 6-8, move the robot arm to move the calibration point of the calibration tool to the green cross mark, the calibration point and confirm that the calibration point does touch the calibration plate. Record this point by pressing the "Measure" button.
  4. As shown in Figure 6-9, move the robot arm to move the calibration point of the calibration tool to any point on the green line segment and confirm that the calibration point does touch the calibration plate surface. Record this point by pressing the "Measure" button.
  5. As shown in Figure 6-10, move the robot arm to move the calibration point of the calibration tool to any point on the green block and confirm that the calibration point does touch the calibration plate. Record this point by pressing the "Measure" button. Record this point by pressing the "Measure" button.
  6. The calibration success message will be displayed, as shown in Figure 6-11. Press the "OK" button to end.

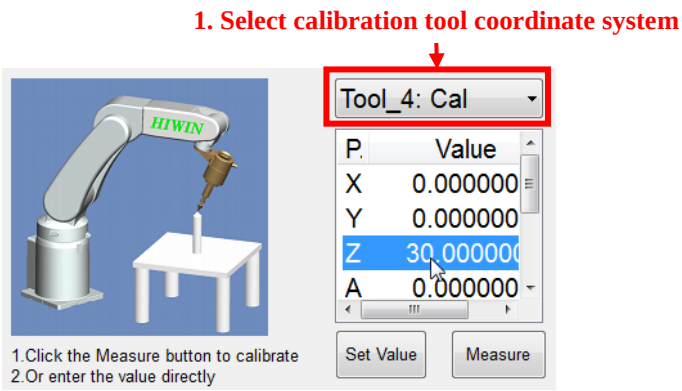


Figure 6-6 Select calibration tool coordinate system

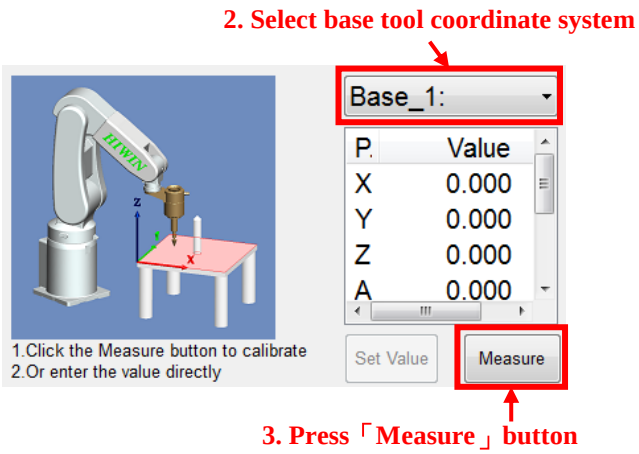


Figure 6-7 Select base tool coordinate system

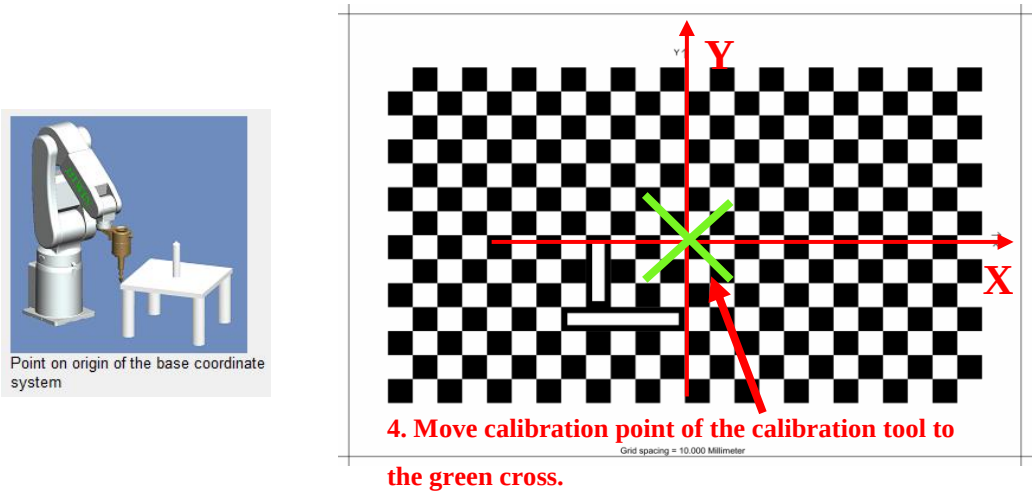
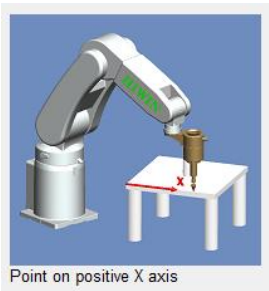


Figure 6-8 Teaching base coordinate origin



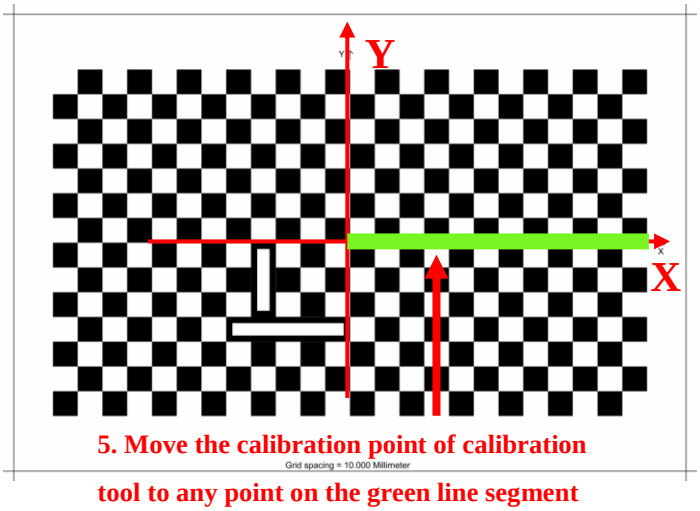
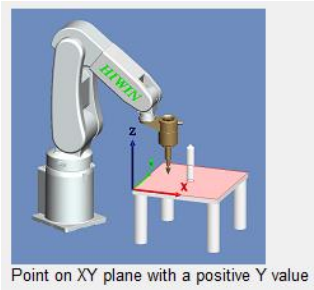


Figure 6-9 Teaching base coordinate standard X-axis point



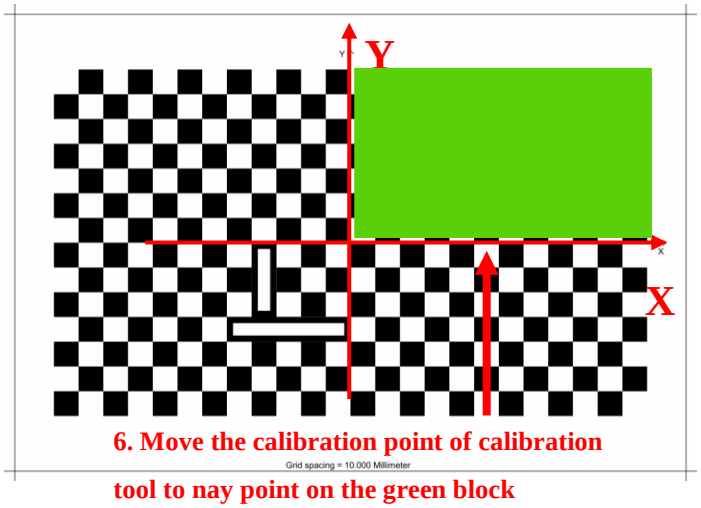


Figure 6-10 Teaching base coordinate XY plane first quadrant point

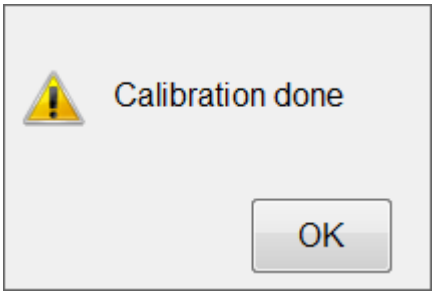


Figure 6-11 Base coordinate calibration success message

⚠ CAUTION	❖ Before calibration the base, please confirm whether the selected tool coordinate system origin corresponds to the calibration point of the calibration tool and whether the calibration value of the point is deviated. If the deviation is too large, the base will be offset and the pick and place operation will be inaccurate.

6.5. Conveyor Tracking System Calibration

- Application

  This setting procedure is only for the “Conveyor Tracking and Picking” application.

- Setting Procedure

  1. In the robot system software, click "Main Menu > Track > Setting".
  2. As shown in Figure 6-12, taking CNV1 as an example, you need to connect the capture signal output line to "IDI1" and set the "CNV Status" and "Trigger Type" options of CNV1 to "Used" and "Vision" respectively.

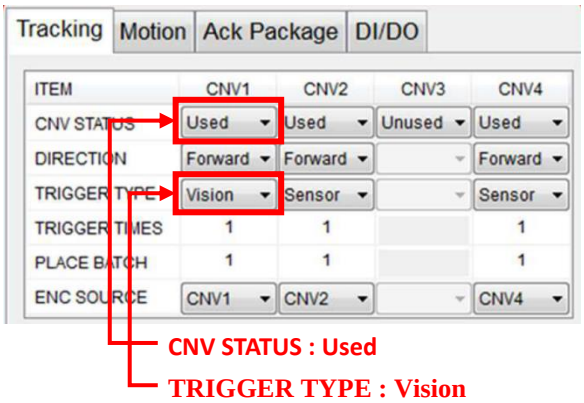


Figure 6-12 Conveyer tracking function basic setting

  3. In the robot system software, click "Main Menu > Track > Vision Setting".
  4. As shown in Figure 6-13, after clicking the "CNV1", set the distance between the O and P points in the "Vision System and Conveyor Belt Calibration". The length of X and Y can be calculated by determining the grid point spacing using the selected standard calibration plate.

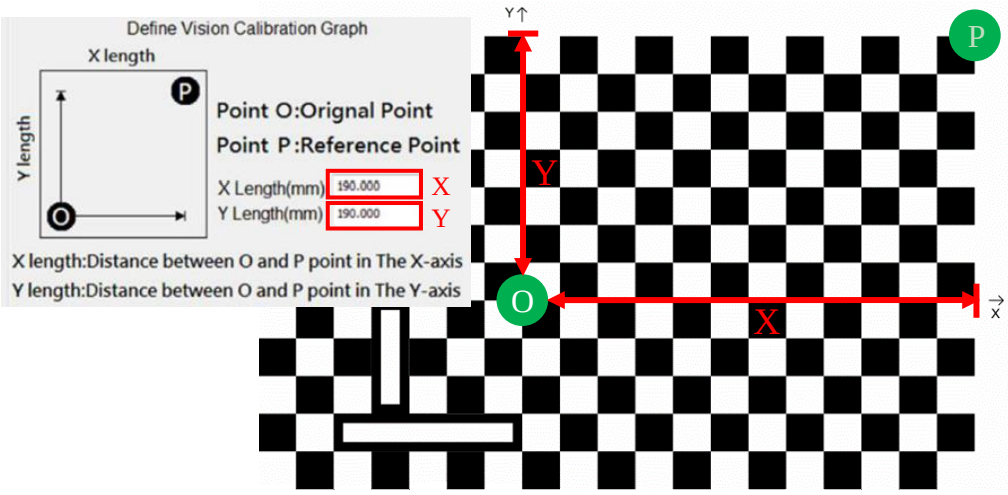


Figure 6-13 Schematic diagram of the relationship between the standard calibration plate and the O and P points.

5. Place the standard calibration plate within the vision range of the vision system.
6. Perform a calibration of the world coordinate system of the vision system, see the instructions in section 6.2.
7. Perform vision system and conveyor belt ratio calibration. For detailed steps, please refer to the paragraph “Conveyor Tracking System” in the “Calibration of Vision System”.

⚠ CAUTION	❖ For other software operation and function descriptions, please refer to “3.2 Calibration” in the “Conveyor Tracking System”.

7. Sample Training

- Application

  This setting procedure are for two application scenarios: "static pick-and-place" and "conveyor tracking and pick-and-place".

- Description

  The vision system uses the area of the region containing the target object and uses the "edge" feature information for sample training to obtain the target object sample. After the image is captured while triggered, the position of the image in the image range is matched with the edge feature information of the target object, and the position of the object similar to the target object is marked, thereby simultaneously achieving the function of object recognition and positioning.

- Setting Procedure

  1. As shown in Figure 7-1, press the "Sample" button.
  2. Select the sample number.
  3. Press the "OK" button to start the training process.
  4. As shown in Figure 7-2, if you want to re-shoot the object, you can tick the “Live” box to start continuous shooting.
  5. Adjust the red rectangular area and select the sample you want to identify.
  6. Press the "Train" button to start training.

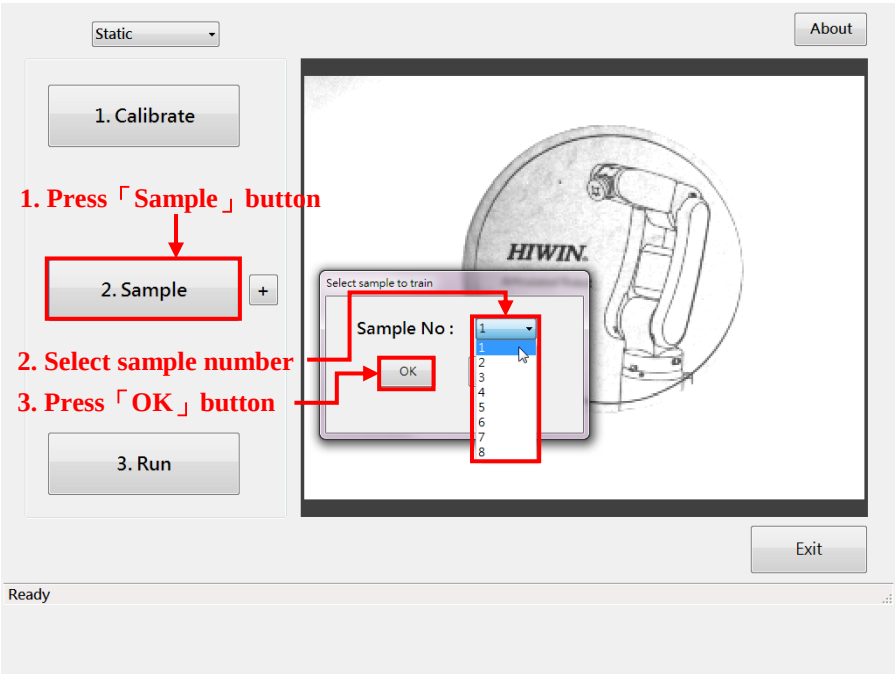


Figure 7-1 Select the sample number

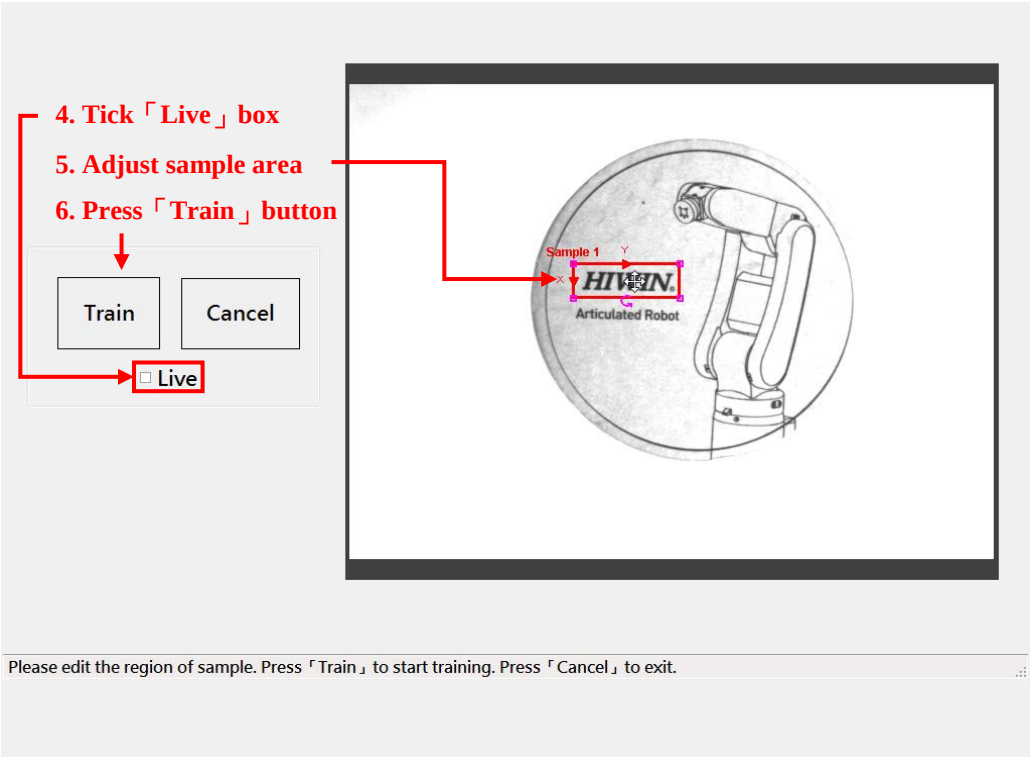


Figure 7-2 Adjust sample area

⚠ CAUTION	❖ Since the target of the sample training is the "edge" feature in the selected area, the area with uniform brightness should not be selected to avoid unrecognizable conditions. ❖ It is recommended to use the "only appearance" high contrast pattern or multiple features on the object as the target of sample training to save recognition time and improve success rate.

8. Option Settings

8.1. Sample Option Settings

- Application

  This setting procedure is for two application scenarios: "static pick-and-place" and "conveyor tracking and pick-and-place".

- Description

  This feature provides 7 setting options related to sample identification results to identify the needs and situations in response to a variety of sample sizes. Whether it is a static pick and place application or a conveyor tracking and picking application, both share the same set of sample option settings. In addition, it should be noted that some of the options are set independently for each sample. Each sample has its own set value, and some options are set for all samples together, and all samples have the same set value.

  As shown in Figure 8-1, press the “+” button in the interface to open the sample option setting interface. The function of each option will be detailed later.

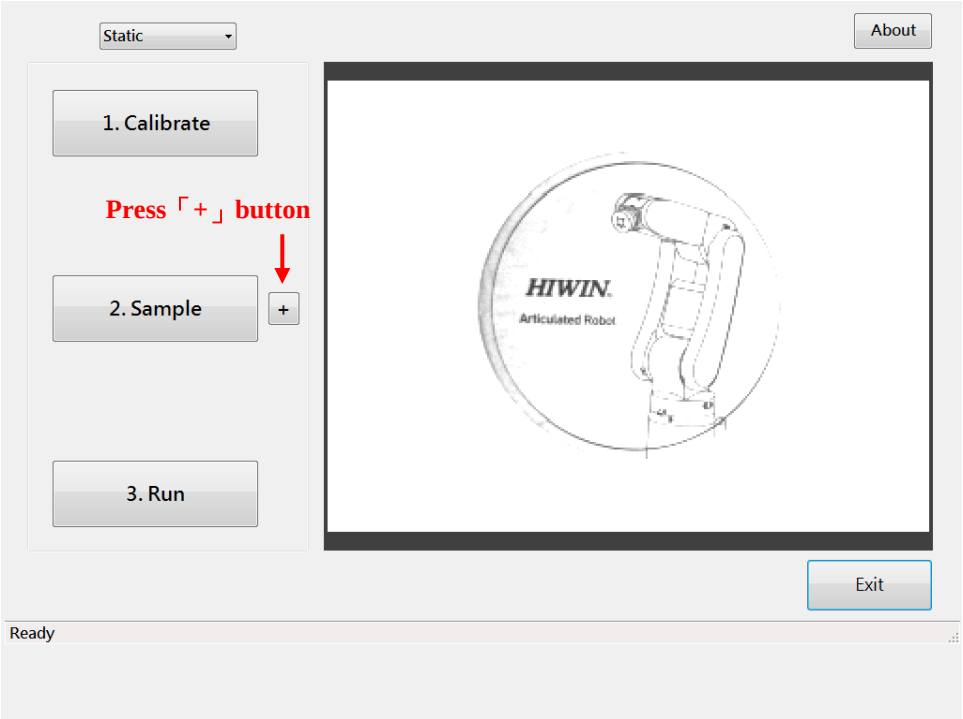


Figure 8-1 Open the sample option settings

- Sample Matching Enable

  As shown in Figure 8-2, this option determines whether the vision system recognizes the sample. Tick the “Enable” checkbox to enable the identification function of the sample. The default value for this option is "Checked".

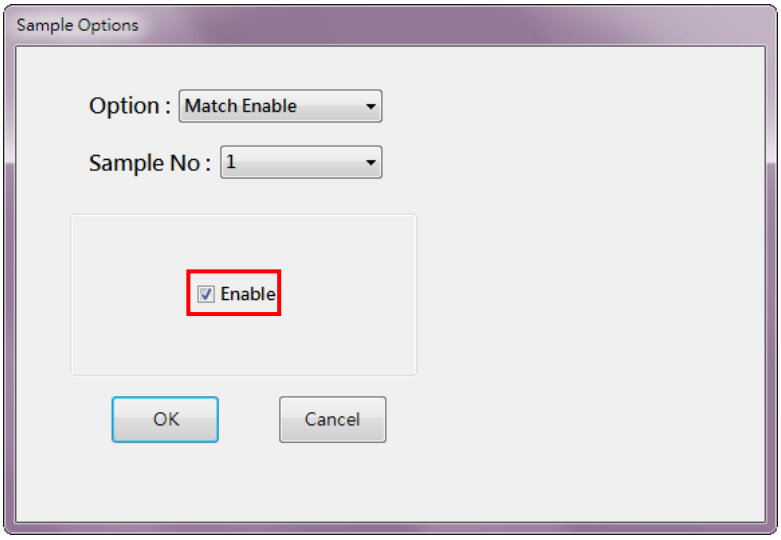


Figure 8-2 Sample matching enable option

⚠ CAUTION	❖ This option is “independent setting” for each sample. ❖ When a specific sample cannot be recognized while running the robot program, please confirm the following conditions: ⦿ Is the sample matching enable option of this sample ticked? ⦿ Sample selection package (refer to Chapter 10)

- Sample center offset

  As shown in Figure 8-3, this option determines the offset of the sample identification output position relative to the sample center. The offset is divided into two components, X and Y, which correspond to the direction displayed by the rectangular area of the sample, as shown in Figure 8-4. The default value of this option is "X:0, Y:0".

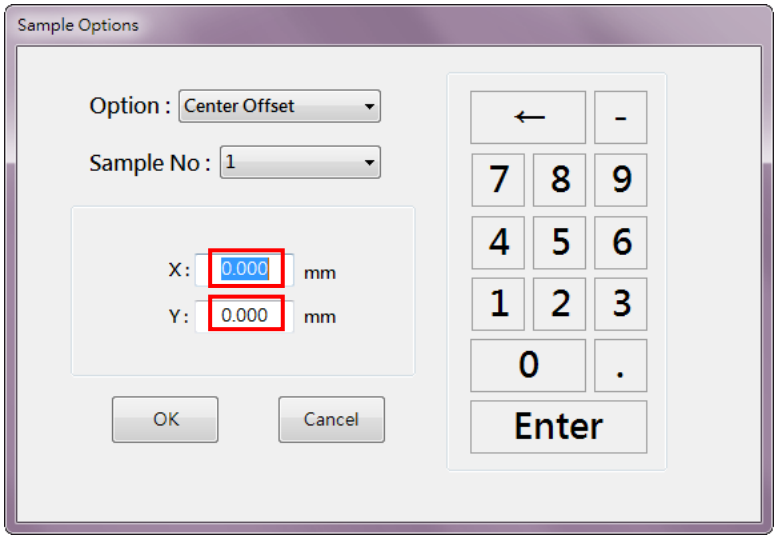


Figure 8-3 Sample center offset option

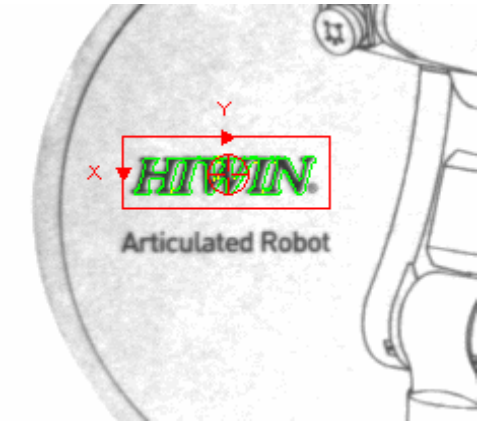


Figure 8-4 Sample center offset direction

⚠ CAUTION	❖ This option is “independent setting” for individual samples.

- Angle of Symmetry

  As shown in Figure 8-5, this option determines whether to specify the "rotational symmetry" feature of the sample feature to limit the effective output range of the sample angle. The default value of this option is "Unticked", which means that the sample features do not have rotational symmetry, so the output effective angle range is 0 degrees to 360 degrees.

  For example, Figure 8-6 shows an example of a cross-shaped sample. Since the rotational symmetry is the same as the original sample every 90 degrees, the output angle should be only between 0 and 90 degrees, so the symmetry angle needs to be set. It is 90 degrees.

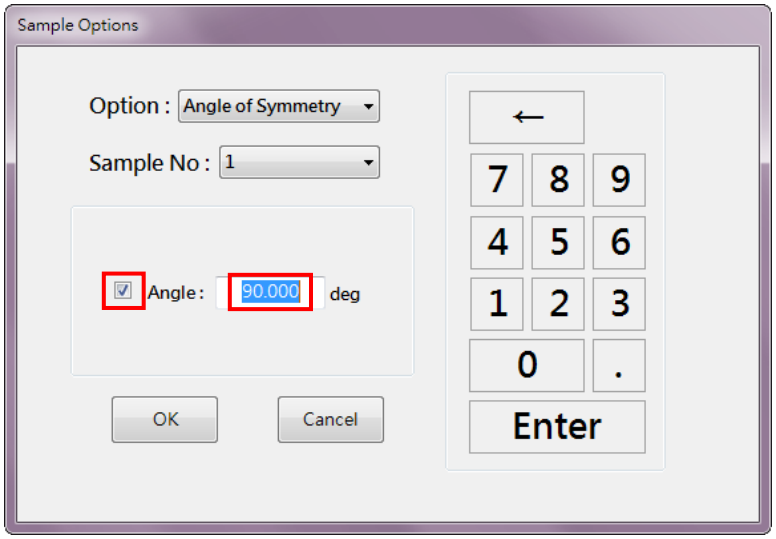


Figure 8-5 Symmetrical angle option

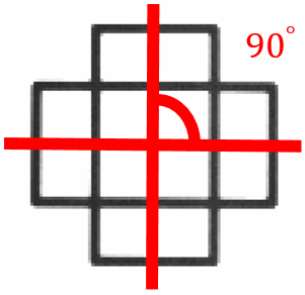


Figure 8-6 Example of a cross-shaped mark with a rotationally symmetric angle of 90 degrees

⚠ CAUTION	❖ This option is “independent setting” for each sample. ❖ This option should be set correctly according to the rotational symmetry of the sample features. Otherwise, the samples at certain angles will be unrecognizable and the identification will fail.

- Number to Find

  As shown in Figure 8-7, this option determines the maximum number of matching results for a given sample to be output in each image captured by the vision system. The default value of this option is "5". You can adjust the setting value by clicking the text box and clicking the right numeric keypad to enter the new setting value, or by dragging the scale bar.

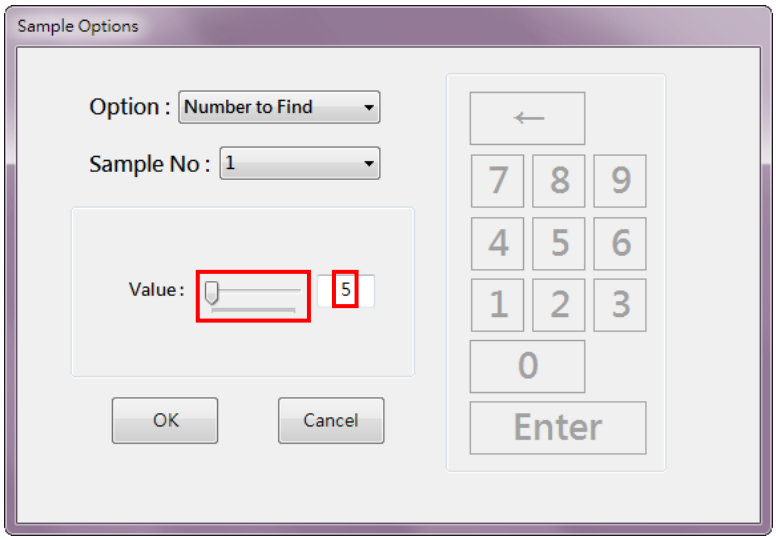


Figure 8-7 Number to find option

⚠ CAUTION	❖ This option is "independent setting" for each sample. ❖ When the number of specified samples included in the image exceeds the value set by this option, some matching results will be discarded.

- Score Threshold

  As shown in Figure 8-8, this option determines the "lowest similarity" required to match the block within the image that matches the specified sample. When the option setting value is larger, the higher the similarity required for the sample matching the block, the smaller the number of matching results will be. The default value of this option is "60". You can adjust the setting value by clicking the text box and clicking the right numeric keypad to enter the new setting value, or by dragging the scale bar.

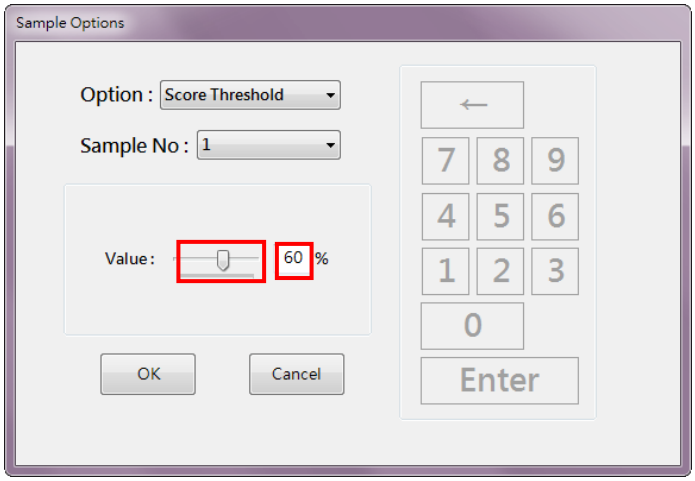


Figure 8-8 Score threshold option

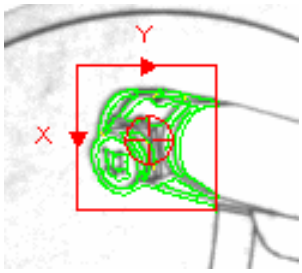


Figure 8-9 Complex sample feature diagram

⚠ CAUTION	❖ This option is "independent setting" for each sample. ❖ The adjustment of this option depends on the lighting conditions of the vision system environment and the complexity of the sample itself. When the lighting conditions are not good (such as: the amount of light is unstable, the surrounding stray light source is not properly shielded) or the sample itself has too many features, the setting value of this option should be appropriately reduced to avoid the matching threshold being too high after considering the above unfavorable factors.

- Coordinate offset

  As shown in Figure 8-10, this option determines the coordinate value offset of the final sample match result output. The position coordinates of the final matching result will be added with the offsets set in this option. The default value of this option is "X:0, Y:0, Angle:0". You can enter the new set value by clicking the text box and clicking the right numeric keypad.

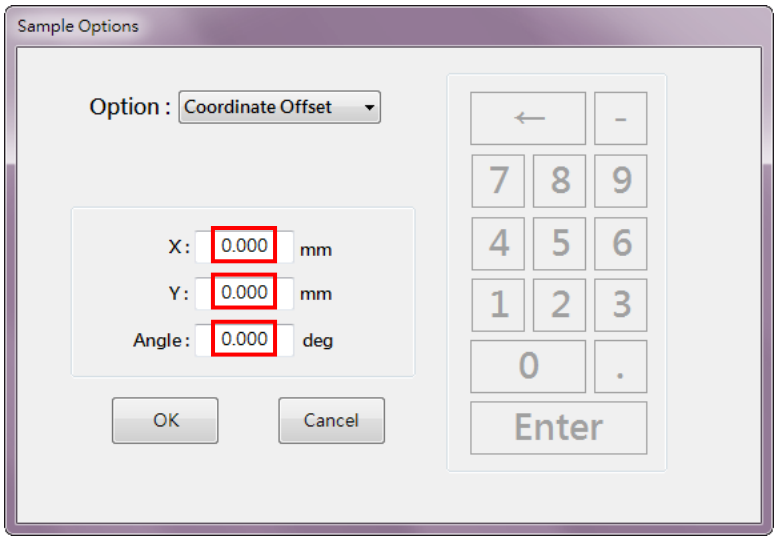


Figure 8-10 Coordinate value offset option

⚠ CAUTION	❖ This option is “common setting” for all samples. ❖ This option is only set when the actual pickup position of “All Samples” has a fixed deviation. If this is not the case, it is recommended not to adjust this option. ❖ This option “will not” automatically resets. Therefore, when the pickup position is deviated, please confirm that the setting value of this option matches the actual situation.

- Coordinate Fixture

  As shown in Figure 8-11, this option determines whether the specified coordinate value of the final sample output is fixed. When this option is set, the specified coordinate value will be fixed at the set value regardless of the sample matching result. The default value of this option is “X: Unticked, Y: Unticked, Angle: Unticked”, and the coordinate values of all matching results are output normally. After enabling the specified coordinate component, you can click on the text box and Click the numeric keypad on the right to enter the new settings.

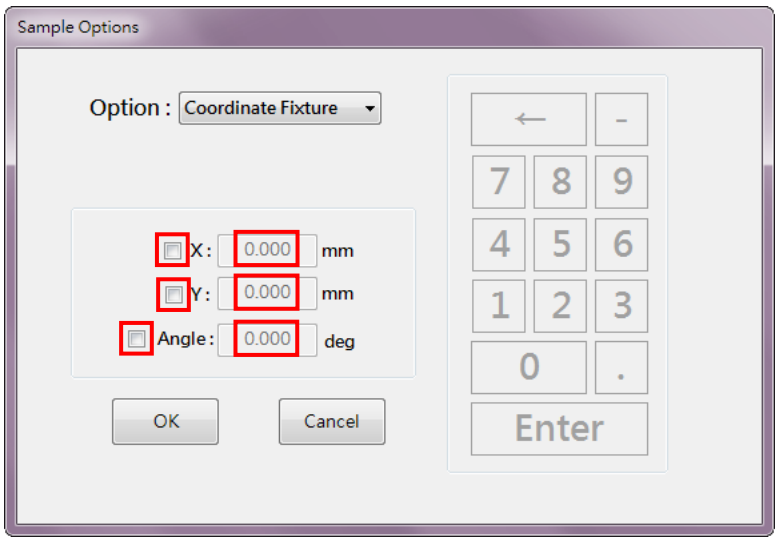


Figure 8-11 Coordinate value fixed output option

⚠ CAUTION	❖ This option is “common setting” for all samples. ❖ This option is only set when there are special needs (eg fixed pick angle). If this is not the case, do not adjust this option. ❖ This option “will not” automatically resets. Therefore, when the pickup position is abnormal, please confirm whether this option has been set.

8.2. Sample Option Settings

- Application

  This setting procedure is only for the “Conveyor Tracking and Picking” application.

- Description

  In addition to the sample options described in the previous section, this feature provides an additional set of 4 options for conveyor tracking and pick-and-place applications to address the specific needs of the conveyor tracking application. As shown in Figure 8-12, press the "3. Tracking" button to open the conveyor tracking and setting options setting interface. The function of each option will be detailed later.

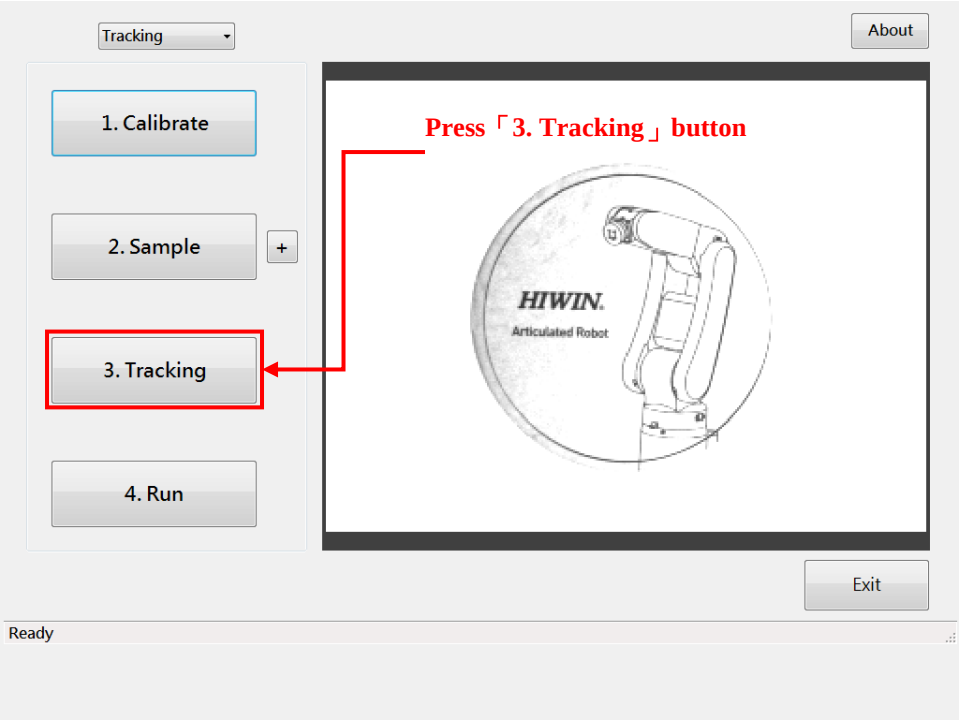


Figure 8-12 Open conveyor tracking and setting options setting

- Picking Order

  This option determines the order in which the matching results are transmitted to the robotic arm, thereby determining the picking order of the objects that match the sample, as shown in Figure 8-13. By specifying the key used for sorting and its order, you can determine the final picking order of the object. The default value of this option is "Sort Key: Real X, Order: Unchecked". The two are explained as follows:

  - Sort key: There are 4 coordinate axes available for sorting.
    - X: Image coordinate system X axis (image line vertical line down)
    - Y: Image coordinate system Y axis (image line horizontal line to the right)
    - Real X: Vision System World Coordinate System X-axis (default)
    - Real Y: Vision System World Coordinates Y-axis
  - Order: There are 2 states.
    - Unticked: Represents “Decrement Sorting”. The larger the key value, the earlier it will be sent.
    - Ticked: Represents “Incremental sorting”. The smaller the key value, the earlier it will be sent.

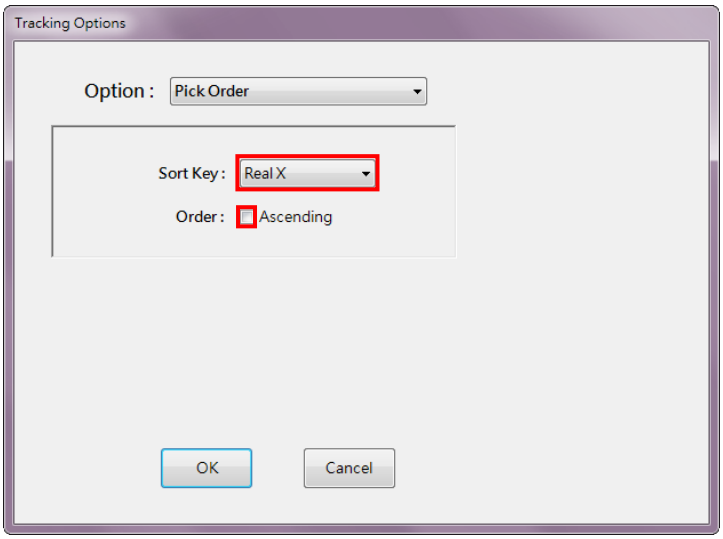


Figure 8-13 Pick order options

- Conveyor Belt Parameter

  This option is a parameter related to the conveyor belt itself and contains the following two sub-items:

  - Conveyor Number:

    As shown in Figure 8-14, this option sets the conveyor number corresponding to the sample matching result transmitted to the robot arm, so that the robot can identify which conveyor belt the object comes from. The default value for this option is "1".

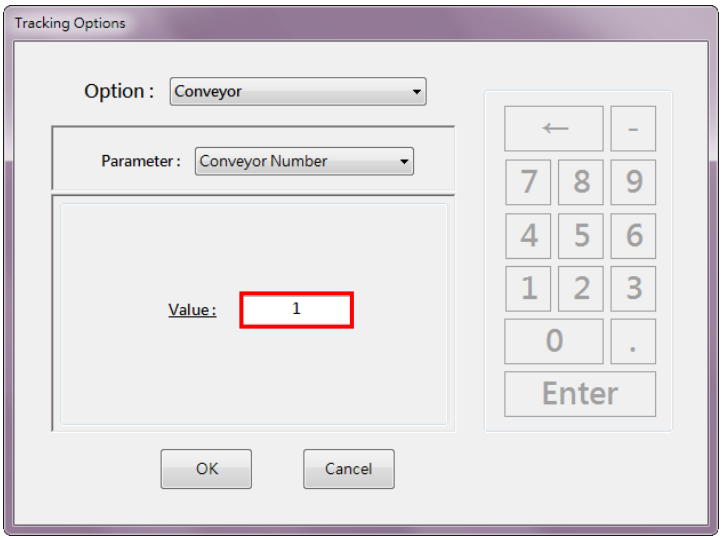


Figure 8-14 Tracking option for conveyor number

⚠ CAUTION	❖ The setting value of this option should be the same as the number of the Latch connect to the robot controller. Please refer to the description of Section 4.2 “Encoder Count Value Capture Signal Output Cable Connection”.

⚠ WARNING	❖ The set value of this option is the same as the set value of the tracking related to the robot arm and the conveyor belt number parameter of the command. If it is inconsistent, it may cause a collision. Please refer to the "3.1 Function Settings" and "4. List of Conveyor Tracking Commands" in the "Conveyor Tracking System" manual.

■ Conveyor Speed

This option sets the conveyor speed parameters used by the vision system to run the dynamic object repeat identification filter function. This option is divided into two sets of "Speed" and "Angle". The former represents the running speed of the conveyor belt, and the latter represents the angle of the "direction of the conveyor belt" and the "X-axis of the world coordinate system of the vision system". The default value of this option is "Measure mode: Manual, Speed: 1500, Angle: 0". There are two setting modes, as explained below:

◆ Manual (manual setting mode):

(1). As shown in Figure 8-15, select the "Manual" option.

(2). Click on the "Speed" or "Angle" text box.

(3). Click the numeric keypad to enter the new value.

(4). Click the "Enter" button to confirm the entry.

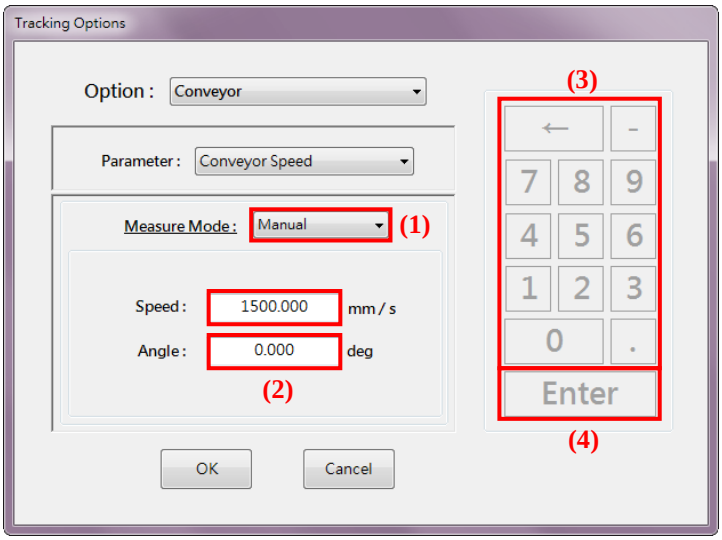


Figure 8-15 Conveyor speed manual setting mode

◆ Auto (automatic setting mode):

(1). As shown in Figure 8-16, select the "Auto" option.

(2). Press the "Clear" button to clear the previous measurement settings.

(3). Select the number of the trained sample as the measurement target.

(4). Press the "Start" button.

(5). As shown in Figure 8-17, enter the image capture interval in the "Interval" text box and press the "OK" button to start the measurement.

(6). Place the object corresponding to the selected sample number on the running conveyor belt.

(7). As shown in Figure 8-18, press the “Stop” button to end the measurement.

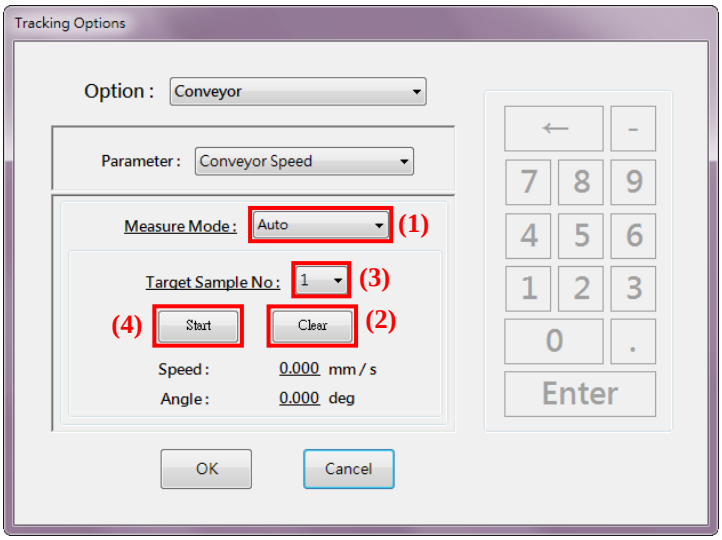


Figure 8-16 Conveyor speed automatic setting mode

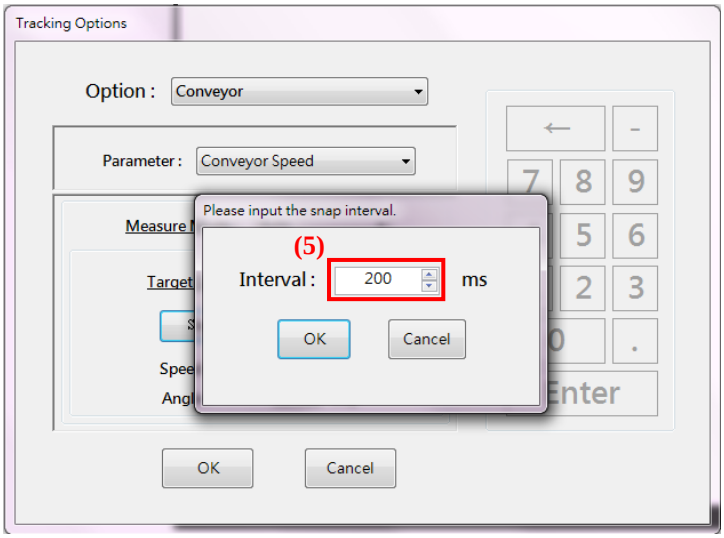


Figure 8-17 Input image capture interval

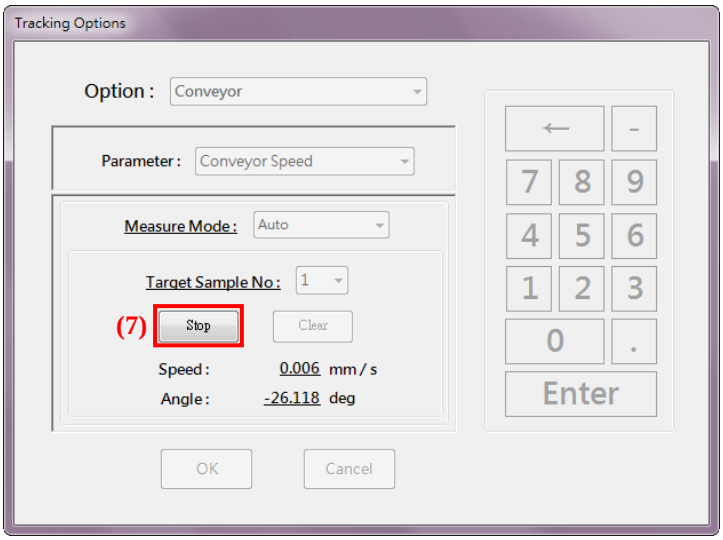


Figure 8-18 Press the "Stop" button to end the measurement

⚠ CAUTION	❖ If the difference of the setting value of this option is too large from the actual running condition of the conveyor belt, the object recognition result of the repeated shooting will not be properly filtered, which will cause the robot arm to malfunction and reduce the efficiency. ❖ When the specific conveyor speed setting mode is selected, the set value of this mode is selected as the current value and stored. Therefore, before the running the system, please confirm that the correct setting mode and corresponding setting value have been selected.

- Sample Selection Com Port

  As shown in Figure 8-19, this option determines the communication settings for the communication port used for the sample selection function. By sending a sample selection packet through this communication, the matching function for a particular sample can be enabled or disabled. The default value of this option is "Socket Type: Server, Server IP: Not enabled, Server Port: 4004". The description of each setting is as follows:

  (1). Socket Type: Communication type, which can be divided into Server or Client.

  (2). Server IP:

  The server IP address has different meanings depending on the Socket Type:

  - ◆ When Socket Type is Server: Cannot be set, the vision system itself is the server.
  - ◆ When the Socket Type is Client: the remote server IP address.

  (3). Server Port:

  Server nickname, which has different meanings depending on the Socket Type:

  - ◆ When Socket Type is Server: Local server nickname.
  - ◆ When the Socket Type is Client: the remote server nickname.

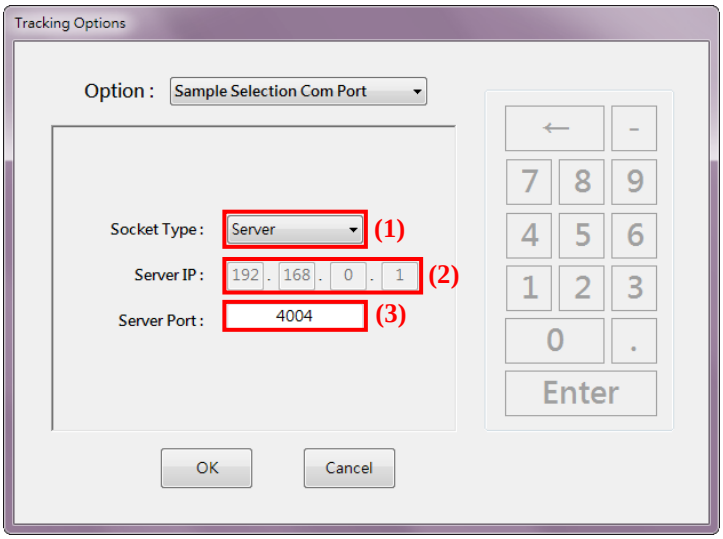


Figure 8-19 Sample selection communication port setting

⚠ CAUTION	❖ In the "Static Application" mode, the sample selection communication port setting value is fixed as follows: ⊙ Socket Type：「Server」 ⊙ Server IP：not set ⊙ Server Port：「4000」

- Dispatch Communication Port

  As shown in Figure 8-20, this option determines the communication settings for the communication port used to deliver the sample match results. According to the "average load" principle, the vision system automatically transmits the sample matching results to the enabled dispatch communication, so that the picking operation of the object is not excessively concentrated on a specific robot arm. The description of each setting is as follows:

  (1). Enable: Determines whether the currently selected communication port is enabled. The first communication port is preset to be enabled.

  (2). Port No: Currently selected communication port number can be switched.

  (3). Socket Type: Communication type, which can be divided into Server or Client.

  (4). Server IP: The server IP address has different meanings depending on the Socket Type:

  When Socket Type is Server: Cannot be set, the vision system itself is the server.

  When the Socket Type is Client: the remote server IP address.

  (5). Server Port: Server nickname, which has different meanings depending on the Socket Type:

  When Socket Type is Server: Local server nickname.

  When the Socket Type is Client: the remote server nickname.

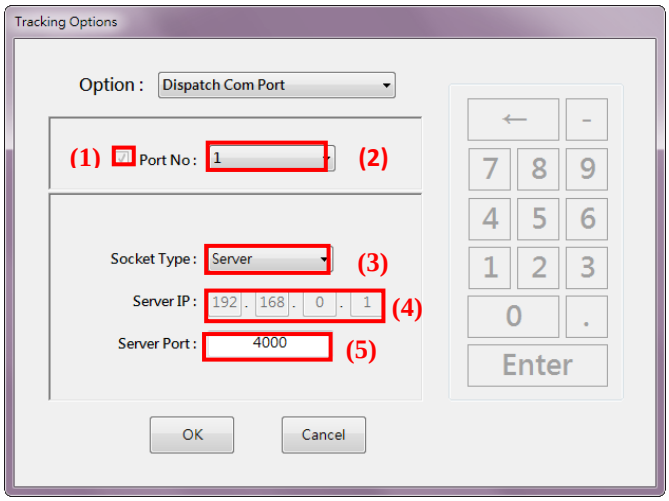


Figure 8-20 Sending communication setting

⚠ CAUTION	❖ If the unused dispatch communication is enabled, the vision system will be mis-delivered and the misplaced items will not be captured. Therefore, please make sure that all the enabled communication stations are connected to the robot arm. ❖ Do not set more than two identical server nicknames, otherwise the nickname will conflict and the server will

	not be able to be turned on.

9. Test Run

- Description

  After all relevant settings of the vision system have been completed, the test run function can be used to test whether the current settings meet the requirements for additional adjustments.

- Static pick-and-place mode trial operation process

  (1). As shown in Figure 9-1, press the "3. Run button" to start the test run.

  (2). As shown in Figure 9-2, press the “Test” button to perform a single identification test.

  (3). Display the current maximum identification time.

  (4). Press the "Stop" button to end the test run.

Figure 9-1 Start static pick and place test run

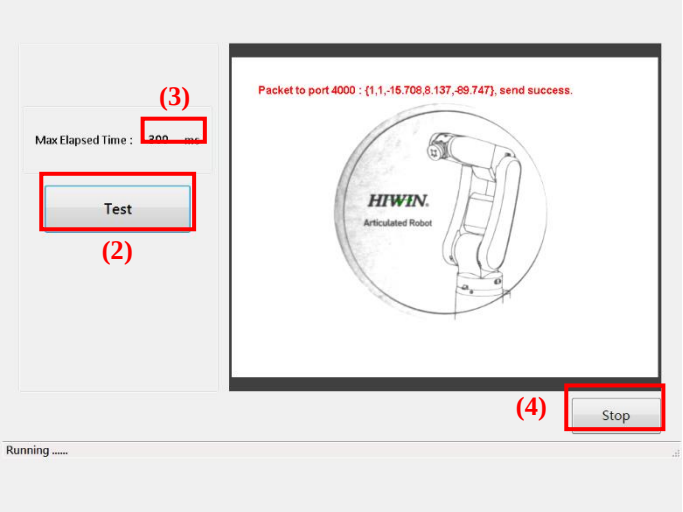


Figure 9-2 Static pick and place test run

- Conveyor Belt Tracking and Picking Mode Trial Operation Process

  (1).In Figure 9-3, press "3. Run button".

  (2). Enter the image capture interval and press the "OK" button to start the test run.

  (3). In Figure 9-4, the vision system will automatically perform a continuous identification test and update the maximum identification time so far.

  (4). Display the current image capture interval. If the maximum recognition time has exceeded the current acquisition interval, this interval will automatically increase.

  (5). Press the "Stop" button to end the test run.

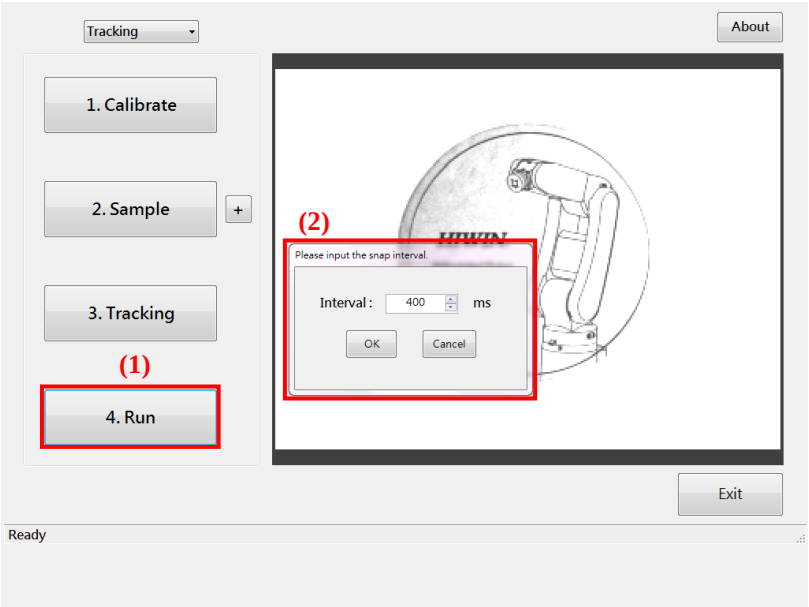


Figure 9-3 Start conveyor tracking pick and place test run

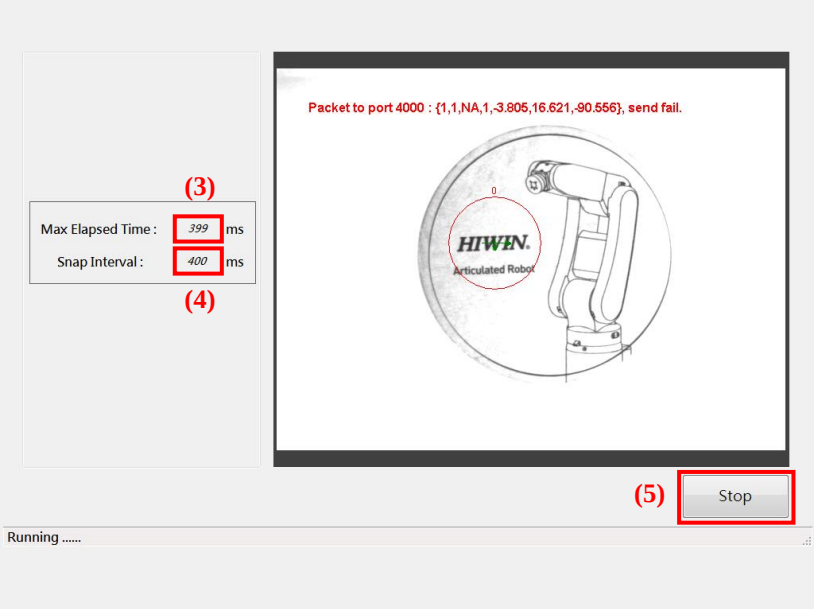


Figure 9-4 Conveyor tracking pick and place test run

- Close the Program

  (1). As shown in Figure 9-5, press the Exit button.

  (2). As shown in Figure 9-6, if you are in the conveyor tracking pick and place application mode, you need to input the image capture interval. After the input is completed, press the "OK" button.

  (3). As shown in Figure 9-7, the program will display the shutdown progress. After the program is closed, the program ends.

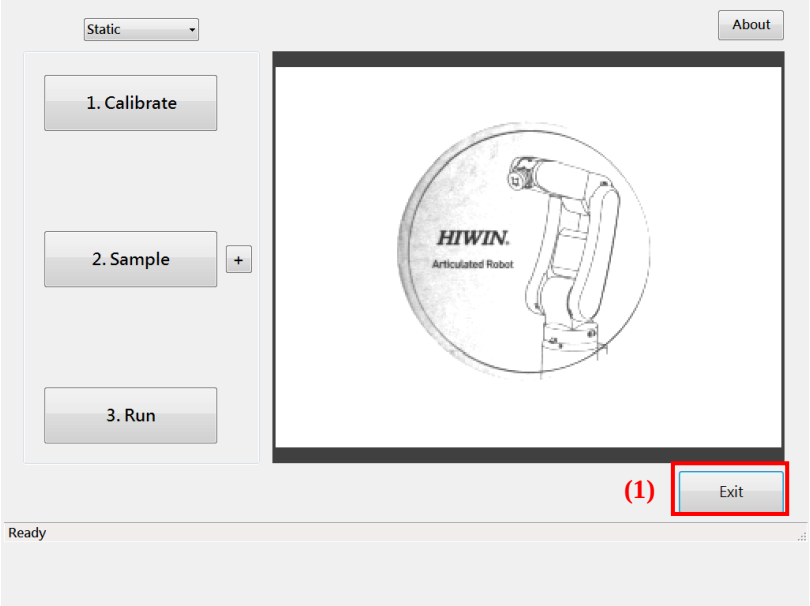


Figure 9-5 Press Exit button

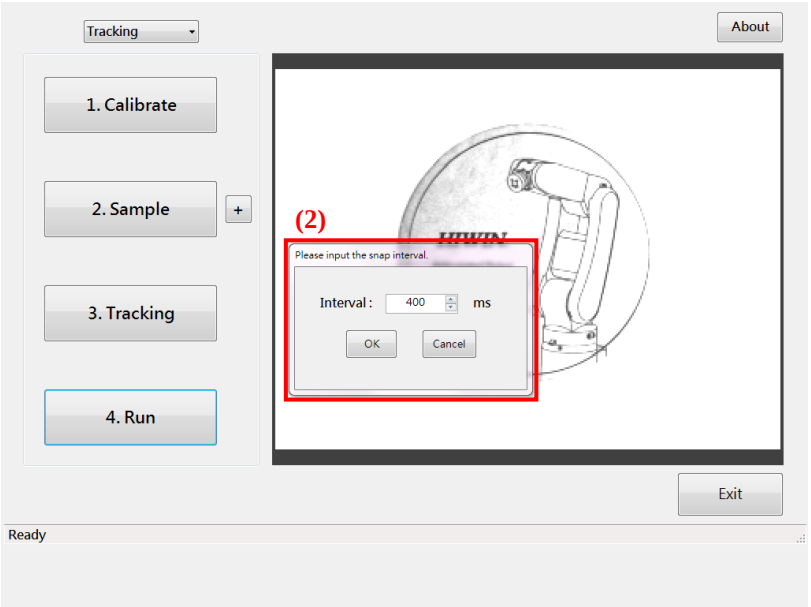


Figure 9-6 Input image capture interval

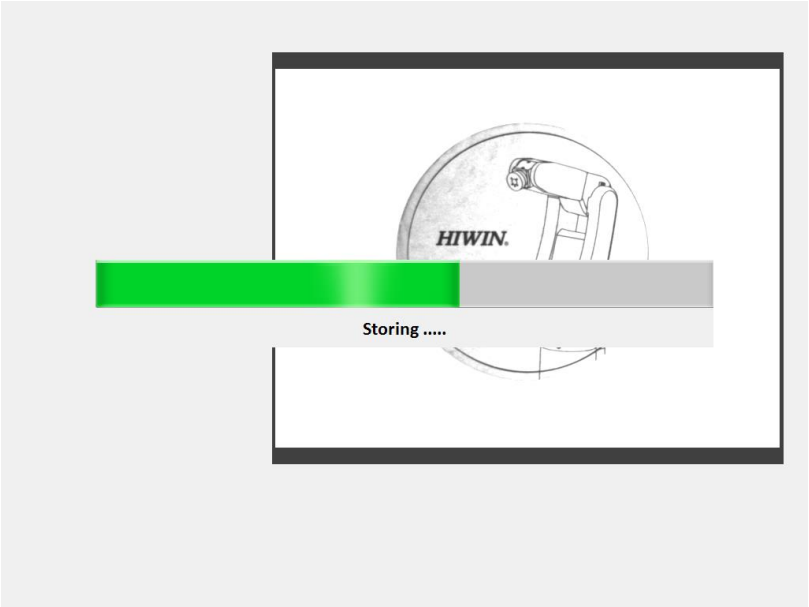


Figure 9-7 Program shutdown progress display

⚠ CAUTION	❖ In the conveyor tracking pick and place application mode, the “minimum image capture interval” can be set to be related to the “sample size matched to the enabled sample”. The more samples that need to be sample matched, the longer it takes, so the minimum value of the image interval is larger. ❖ In the conveyor tracking and application mode, if the image capture interval is less than the maximum identification time, there will be a chance that the encoder lock signal and the sample match result packet will be out of sync, so that the object picking action will result in “conveyor running direction”. The deviation on the top. Therefore, during the trial run, please try to test the actual situation of the object to confirm whether there is any risk of the above situation.

10. Communication Settings

10.1. Static Pick and Place Applications

- Description

  In the static pick-and-place application mode, the vision system adopts the "trigger" mode: the recognition trigger command is sent by the robot arm to trigger the vision system to perform the recognition function. In this mode, the vision system has a "one" communication port, which has two functions: "sample selection" and "identification trigger". The sample selection function enables the matching function of the sample to be identified by transmitting a sample selection instruction, and the recognition trigger function triggers the vision system image acquisition and matches the selected sample, and returns the matching result. Programmer writes commands for the corresponding functions in the program, and then the robotic arm runs to the command to notify the vision system to perform the corresponding functions.

- Sample Selection Command
  - Transfer instruction packet format: {1000, Sample_No_Set}
  - Description: Sample_No_Set is any combination of numbers 1-8, representing the set of samples to be enabled.
  - Response packet:
    - Successful selection: {1}
    - Selection failed: {0}
  - Example: As shown in Table 10-1:

Command	Received Command	Packet	Response packet
Close all sample	CWRITE (H, 1000)	{1000}	{1}
Open all sample	CWRITE (H, 1000, 1, 2, 3, 4, 5, 6, 7, 8)	{1000, 1, 2, 3, 4, 5, 6, 7, 8}	{1}
Open sample 1	CWRITE (H, 1000, 1)	{1000, 1}	{1}
Open multiple sample	CWRITE (H, 1000, 1, 3, 5, 7)	{1000, 1, 3, 5, 7}	{1}
Invalid command example	CWRITE (H, 1000, 9)	{1000, 9}	{0}

Table 10-1 Sample selection command and description

⚠ CAUTION	❖ For the description of the sample selection communication, please refer to the option setting description of “Sample Selection Communication Port” in Section 8.2.

- Identification Trigger Command
  - Transfer instruction packet format: {1001}
  - Response packet: {N, Obj_Data}
    - N: Number of objects identified
    - Obj_Data: Object data, including a total of N sets of data, each set of data contains 4 values:

      Sample_No, X, Y, C

      - Sample_No: sample number matching the object
      - X: Output object world coordinate system X-axis coordinate value
      - Y: Output object world coordinate system Y-axis coordinate value
      - C: output object world coordinate system angle value
  - Example of receiving instructions: as shown in Table 10-2:

Response packet	Received Command	Description
{0}	CREAD (H, N, No1, X1, Y1, C1)	N = 0， Objects without matching samples, Receive 0 group object data
{1, 1, 10.0, 20.0, 30.0}	CREAD (H, N, No1, X1, Y1, C1)	N = 1， Receive 1 set of object data, The object data of this group is sample No. 1. (X1, Y1, C1) = (10.0, 20.0, 30.0)
{2, 4, 2.0, 3.0, 4.0, 8, 5.0, 6.0, 7.0}	CREAD (H, N, No1, X1, Y1, C1)	N = 2， Receiving the first group of object data, The object data of this group is sample No. 4. (X1, Y1, C1) = (2.0, 3.0, 4.0), The second group of object data is sample No. 8. But abandoned due to insufficient receiving command fields

Table 10-2 Identification trigger command response packet example and description

⚠ CAUTION	❖ Please confirm whether the number of command fields received by the robot arm is enough to receive the object data to avoid data loss. ❖ When building the robot arm program, please confirm that the sample selection command containing the sample number to be enabled is executed before executing the identification trigger command. Otherwise, the original sample to be identified will not be recognized.

- Communication Port Connection Setting Procedure

  1. As shown in Figure 10-1, open the robot network communication interface.
  2. As shown in Figure 10-2, select “Client” to set the robot arm as the client.
  3. "Server IP" is filled with "192.168.0.2", which is the vision system network communication port IP address.
  4. "Port" is filled in with "4000", which is the vision system server communication nickname.
  5. Select "{}", "," to separate the characters and fields from the beginning of the communication packet.

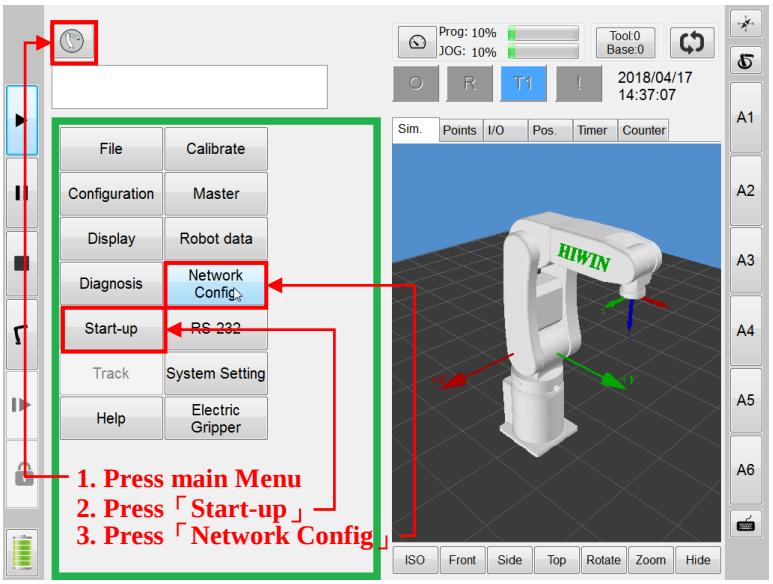


Figure 10-1 Open the robot arm communication interface

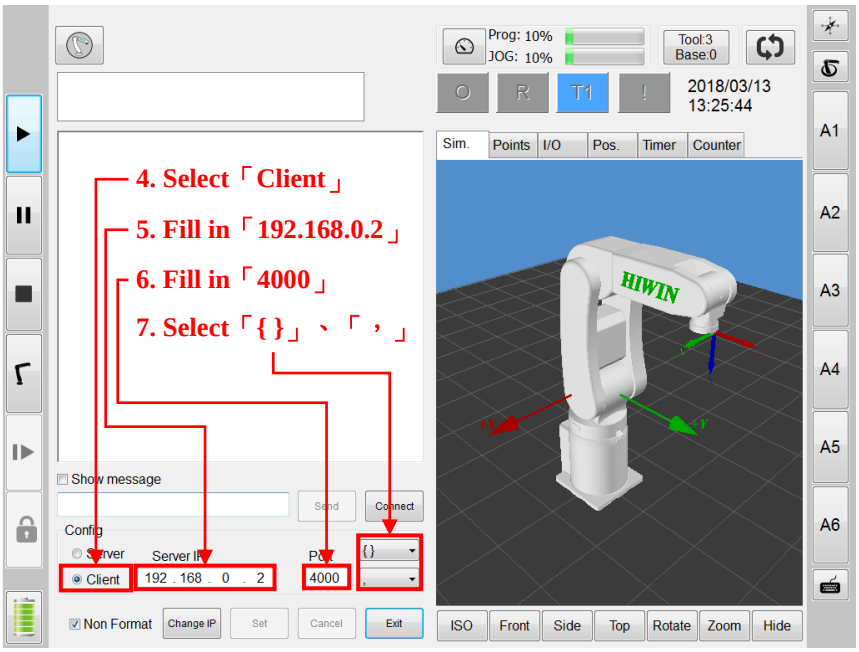


Figure 10-2 Robot arm communication setting interface

10.2. Conveyor Belt Tracking Pick and Place Application

- Description

  In the conveyor tracking and application mode, the vision system adopts the "automatic" mode: the vision system automatically triggers the image acquisition and performs the recognition function at the set image capture interval, and then performs object sample identification for the enabled dispatch communication port. Delivery of results.

  In this mode, the vision system has "one" independent sample selection communication and "up to four" dispatch communication. Among them, only the sample selection communication has the "sample selection" function, but there is no communication and the identification trigger function. The sample selection function enables the matching function of the sample to be identified by transmitting a sample selection command.

- Sample Selection Command

  Please refer to the paragraph description of the "Sample Selection Command" in the section "10.1 Static Pick and Place Applications".

- Sample Selection Communication Port Connection Setting Procedure

  (1). As shown in Figure 10-3, the robot communication type (left side) is set to "Client", and the sample selection communication type (right side) opened by the vision system is set to "Server".

  (2). The server IP address (the left side) of the robot communication port is set to "192.168.0.2", and the vision system communication port IP is not set.

  (3). The server port (left side) of the robot communication port is set to "4004", and the sample selection communication port (right side) opened by the vision system is set to "4004".

  (4). The header and character of the robot header and the field separator character are set to "{}" and ",".

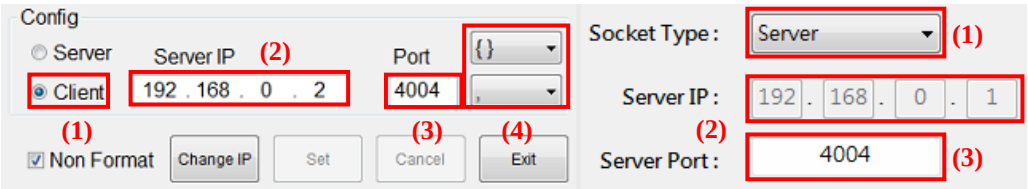


Figure 10-3 Sample selection communication port setting interface (left: robot arm, right: vision system)

⚠ CAUTION	❖ For the description of the vision system sample selection communication, please refer to the option setting description of "Sample Selection Communication Port" in Section 8.2. ❖ Do not set the Vision No. of the Vision System Sample Selection Protocol to the same port as any of the dispatched communications. Otherwise, the sample selection function will not work properly.

- Send Communication Port Connection Setting Procedure

  (1). As shown in Figure 10-4, in the robot system software, click "Main Menu > Track > Vision Setting" (left side).

  (2). Click the conveyor label number tab you want to use.

  (3). Select the number of the communication station to be connected and enable it.

  (4). Select "Server" for "Socket Type" (on the right).

  (5). Fill in "192.168.0.2" for "Vision IP" (on the left). "Server IP" (on the right) remains unset.

  (6). "Vision Port" (left side) is filled in with the same setting as "Server Port" (on the right).

  (7). Press the "Save" button to save the settings.

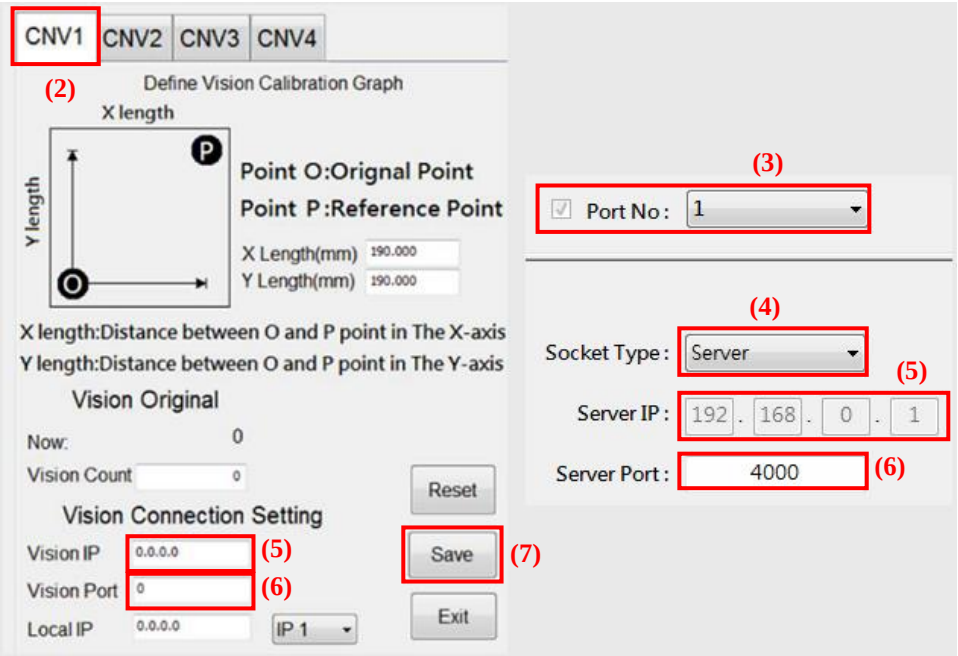


Figure 10-4 Send communication port interface setting (left: robot arm, right: vision system)

⚠ CAUTION	❖ For instructions on the vision system communication, please refer to “Dispatch Communication Port” in section 8.2. ❖ The “Conveyor No.” input value must be the same as the number in the “Conveyor Numbering Tab”, otherwise the matching result will not be received. ❖ Do not set the port of the selected dispatch communication to be the same as the sample selection communication or any other dispatch communication, otherwise the communication will not be connected properly.

11. Robot Program Example

11.1. Example 1: Static Pick and Place Application

- Application Situation
  - Pick up the No. 1 object with a suction cup and the height of the object is 10 mm.
  - TOOL[2] is the center coordinate system of the suction cup, and BASE[1] is the calibration base coordinate.
  - P1 is the teaching point of the suction cup on the center of the desktop, recorded by TOOL [2], BASE [1].
- Program

E6POS targetPt	
INT HANDLE	
REAL objHeight = 10	
REAL pickUpDist = 100	
REAL ACK, N, SampNum, X1, Y1, C1	
COPEN (ETH, HANDLE)	; Connect the vision system communication port
CWRITE(HANDLE, 1000, 1)	; Select sample No. 1 for identification
CREAD(HANDLE, ACK)	; Receive sample selection command reply
Find_Object:	
CWRITE(HANDLE, 1001)	; transmit identification trigger command
CREAD(HANDLE, N, SampNum, X1, Y1, C1)	; Select sample No. 1 for identification
IF N < 0.001 THEN	
GOTO Find_Object	
ENDIF	
targetPt.X = X1	
targetPt.Y = Y1	
targetPt.Z = P1.Z + pickUpDist	
targetPt.A = P1.A	
targetPt.B = P1.B	
targetPt.C = C1	
LIN targetPt FINE=1 Vel=1000 mm/s Acc=50% TOOL[2] BASE[1]	; move above the suction point
targetPt.Z = P1.Z + objHeight	
LIN targetPt FINE=1 Vel=1000 mm/s Acc=50% TOOL[2] BASE[1]	; move to the suction point

11.2. Conveyor Belt Tracking Pick and Place Application

- Application Situation
  - Use the No. 1 conveyor belt, and the signal output line needs to be connected to IDI1.
  - There is a suction cup at the end of the robot arm that draws the No. 1 object.
  - P1 is the position where the object is placed, which is a fixed point, recorded by TOOL[0], BASE[0].
- Program

INT HANDLE REAL ACK	
CNV_START CNV=1 CNV_PICK_QUANTITY = 1	; Start No. 1 conveyor tracking
COPEN (ETH, HANDLE)	; Connect the sample selection communication
CWRITE(HANDLE, 1000, 1)	; Select sample No. 1 for identification
CREAD(HANDLE, ACK)	; Receive sample selection command reply
LOOP	
WHILE CNV_FULL == FALSE CNV_PICK CNV=1 Down=10.000mm FINE=1 Vel=1000mm/s Acc=100% TOOL[0] BASE[0] ENDWHILE	; Tracking the No. 1 conveyor belt
WHILE CNV_EMPTY == FALSE CNV_PLACE P1 FINE=1 Vel=1000mm/s Acc=100% TOOL[0] BASE[0] ENDWHILE	; Place the picking object at point P1
ENDLOOP	

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