

TOGETHER IN ROBOTICS

VISION MODULE and VISION PLUGIN

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The Vision Plugin is an evolving product. Kinova continually works towards improving the reliability and performance of its products. Kinova does its best to ensure the content of the Vision Plugin user guide is accurate and precise with respect to the latest version of the robot. However, Kinova does not take responsibility for any erroneous, inaccurate, or missing information.



Note: Colors of the user interface in the guide may appear differently than in the actual user interface in an attempt to increase readability.



Note: The user guide may be updated from time to time. Please make sure to look at the latest version on our website.

The version of the document is in the header of the pages of the document.

The perspective of the Vision Module and Vision Plugin user guide is of Kinova and Link 6. To acquire more information about non-Vision Module hardware, please refer to the Vision Module documentation from FRAMOS.

Any questions or comments concerning this document, the information it contains or the product it describes may be addressed through support@kinova.ca.

Regulatory compliance

Vision Module is classified as a Class 1 Laser Product under the EN/IEC 60825-1, Edition 3 (2014) internationally.

The Vision Module complies with FDA performance standards for laser products except for conformance with IEC 60825-1 Ed. 3 as described in Laser Notice No. 56, dated May 8, 2019.

For more information, please refer to "Intel® RealSense™ Product Family D400 Series Datasheet", revision 015, March 2023, 337029-013(Intel-RealSense-D400-Series-Datasheet-March-2023.pdf).

Abbreviations

JSON

JavaScript Object Notation

TCP

Tool Center Point

USB device

Universal Serial Bus

Overview

Two distinct components, Vision Module and Vision Plugin, that work together, but can also work separately.

The Kinova Vision Module and the Kinova Vision Plugin are sold separately.

The Kinova Vision Module can work with 3rd party software, such as the FRAMOS RealSense™ Viewer/API.

The Kinova Vision Plugin can work with the FRAMOS D435 module.

The Kinova Vision Module and the Kinova Vision Plugin work seamlessly together.

Kinova Vision Module overview

The Vision Module consists of a camera and additional illumination; it is easily fixed to the wrist. It may also come with a calibration plate.

Even when the Vision Module is attached, the robot can have a gripper attached to it; it has the same mechanical ISO interface as the robot flange.



Figure 1: Front of Vision Module with and without end cap

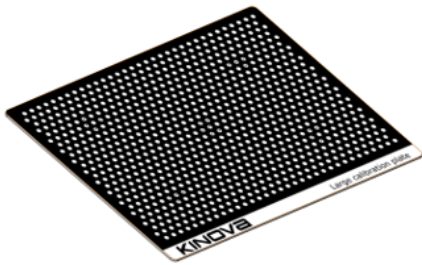


Figure 2: Calibration plate - sold separately

The Vision Module has a *field of view (FOV)* color sensor and an infrared sensor. Program Link 6 through the module to find and identify objects.

Table 1: Specifications of the vision module

Item	Specifics	Approximate value
Color sensor	Horizontal FOV	69 °
	Vertical FOV	42 °
	Diagonal FOV	77 °
Infrared	Horizontal FOV	87 °
	Vertical FOV	58 °
	Diagonal FOV	94 °
Temperature	Switch off	90 °C

Item	Specifics	Approximate value
	Switch on	80 °C
Power from the wrist		24 V
Total illumination		1200 lumens

The Vision Module can be installed on Link 6 with or without additional tools. When it is installed with additional tools, the Vision Module is placed between the Link 6 and the adapter for the tool.



Important: It is recommended to install the Vision Module before the Vision Plugin so that the plugin can find the module.

Related topics

[Installing the camera](#) on page 57

Calibration plate

The calibration plate is an accessory for the Vision Module and is sold separately.

The calibration plate is placed on the workplane and is used to calibrate the camera with the robot. The plate is white with nothing on it; that is the side that is placed downwards. The other side of the plate has a pattern; the pattern side of the plate must face upwards.

Always keep the calibration plate clean to minimize false positive detections.

Kinova Vision Plugin concepts

Link 6 is designed modularly, which makes it easy to expand on its capabilities. The extensions are added on as *plugins*.

All installed plugins start to run when the controller is switched on. However, they can be stopped so the settings can be modified or deactivated.

Many plugins contain actions that the user can use when programming the robot with the visual programming interface in Kortex Web App. Each plugin may also contain parameters that can be modified in Kortex Web App from the corresponding plugin page. **Deactivate** the plugin before modifying the plugin parameters.

All plugins have two pages: **Configurations** and **About**.

Vision plugin

Install the plugin to control the Vision Module.

The Vision Plugin can be used with the Kinova Vision Module. It can also be used with an external Intel RealSense FRAMOS D435e.

Use the Vision Plugin to calibrate a specific camera to identify and find a pre-defined object on a specific workplane, using shape-matching techniques.

The plugin contains different configuration roles.

- Configure and establish communication between the Vision Module and Link 6.
- Configure and establish communication between a FRAMOS camera and Link 6
- Configure and define the Vision Module on the **Tools** page.
- Configure the actions that the Vision Module can perform for visual programming.

Table 2: Tools supported by the Vision Plugin

Vision tool	Part number	Vision Plugin version
Vision Calibration plate	KR32326	1.1.0
Vision Module	KR22879	1.1.0
Intel RealSense FRAMOS D435	n/a	1.1.0

Overview of working with plugins

Tapping a plugin from the **Plugins** page launches the page of that plugin.

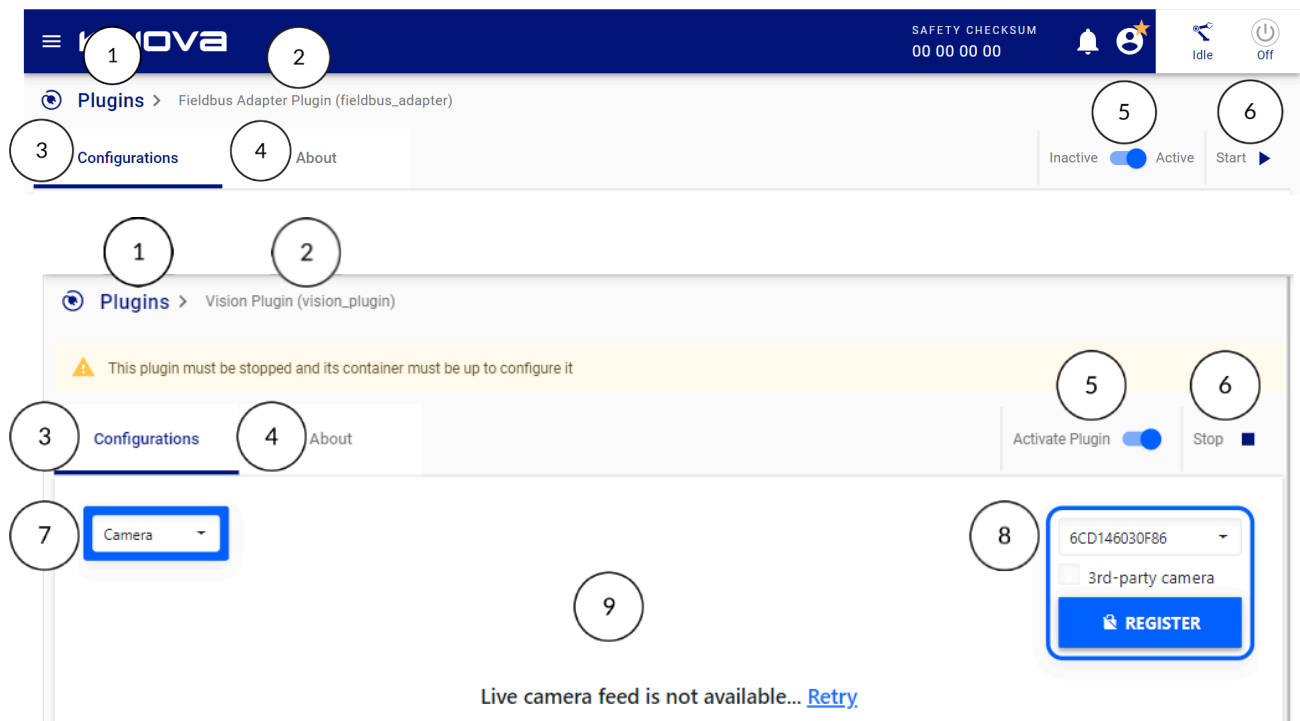


Figure 3: Example of a plugin page of a plugin that is stopped

- 1 Tap **Plugins** to return to the list of plugins.
 - 2 Name of the selected plugin with the name of the namespace associated with the selected plugin in parentheses.
 - 3 Tap **Configurations** to view and modify the current configurations of the selected plugin.
- Important:** Tap **Stop** (Stop ■) before you attempt to modify the current configurations.
- Important:** Tap **Start** (Start ►) after you modify the configurations. The plugin runs with the latest configuration values.

When there are no modifiable configurations in the plugin, a message is displayed.

This plugin does not expose any configuration.

- 4 Tap **About** to view important information about the selected plugin.
 - Name
 - Version
 - Plugin SDK Version
 - Installation Type
 - Licenses
 - Libraries
 - Description
 - Email
- 5 Toggle **Active** to deactivate plugins that need to be installed but are not being used. When the toggle is white, it is off.
 Tap **Active** to activate a deactivated plugin. When the toggle is blue, it is on.
- 6 The current operating state of the plugin.
 Tap **Stop** (Stop ) to stop the plugin from running. The button changes to **Start** (Start )
 Tap **Start** to restart the plugin after modifying its settings. The button changes to **Stop**.
- 7 Tap to access one of the two types of configurations that need to be performed for the Vision Plugin.
 - **Cameras:** Register and unlock the camera that is physically mounted on Link 6
 - **Vision Jobs:** Configure all parts of a generic **Vision Job** action.
- 8 Select the camera that is installed.
 Tap **REGISTER** to register the camera.



Note: Only one camera can be registered at a time. The camera must be a RealSense camera or the Vision Module.
- 9 Message, action, and configuration visualization area.

Related topics

[Registering the camera](#) on page 76

[Vision plugin action overview](#) on page 15

Tool configuration fields

There may be times when the default configuration of the Vision Module, or camera, needs to be modified. You can modify specific information about the Vision Module, or camera, as long as the module, or camera, is not active.

Field name	Description	Modifiable
Tool type	Type of tool being used There are two types of tools. • Custom • Plugin When you create a tool by tapping the +, the type is Custom. When the Vision plugin is installed, the plugin creates and adds the Vision tools to the Tools page. The type is Plugin.	No
Connection state	State of the connection between the robot and the device • Connected • Disconnected • Unspecified	No
Name	Configured name of the tool	Yes  Note: When the Vision Module is installed on the robot, the default name is Vision Module (KR22879). To change the name, drag the Vision Module from the Active pane to the Inactive (drag & drop) and change the name from the Tools page. Remember to drag the module back to the Active in the correct order on the flange.

Field name	Description	Modifiable
Mass	Mass of the Vision Module tool, measured in kg	Yes
Transform	Position and orientation of the TCP, relative to the reference frame of the previous element in the tool stack Position is measured as x,y,z in mm. Orientation is measured as thetaX, thetaY, thetaZ in °.	Yes
Center of Mass	Position of the center of mass of the tool, relative to the flange of the robot Position is measured as x,y,z in mm.	Yes
Inertia Matrix	Specific three-dimensional positions measured as $ixx, iyy, ixy, iyz, ixz, izz$ in kg/m^2 , relative to the center of mass	Yes

Related topics

[Configuring tools](#) on page 80

Overview of camera calibration

The camera, whether it is the Vision Module or a FRAMOS D435 module, must be calibrated with the robot to recognize objects.

Camera calibration refers to the ability to calibrate the relationship of where the camera is looking with respect to the location of the robot. All camera calibrations involve the aid of a calibration plate.

You can perform your own camera calibrations by creating your own program that uses at least five waypoints, nine **Calibration Snapshot** actions, and one **Robot-Camera Calibration** action.

A faster way to calibrate the Vision Module is to run the **Robot-Camera Calibration** program that comes installed with the Vision Plugin. It is a default camera calibration.

The **Robot-Camera Calibration** program takes snapshots with the camera and calculates the calibration results according to the images taken.

Using the **Robot-Camera Calibration** program means getting the robot calibrated with the camera quickly.

Robot-Camera Calibration program

The program, bundled with the Vision Plugin, can be used to calibrate the camera you have installed on your robot.

Access the **Robot-Camera Calibration** program from the **Programs** page.

The **Robot-Camera Calibration** program takes several snapshots using the **Calibration Snapshot** tile, each one with the robot in a different position. Each snapshot is a sample for the calibration. The result of the calibrations made is stored at the end of the **Robot-Camera Calibration** in the **Robot-Camera Calibration** action.

The parameters of the resulting calibration are saved automatically as a calibration file.

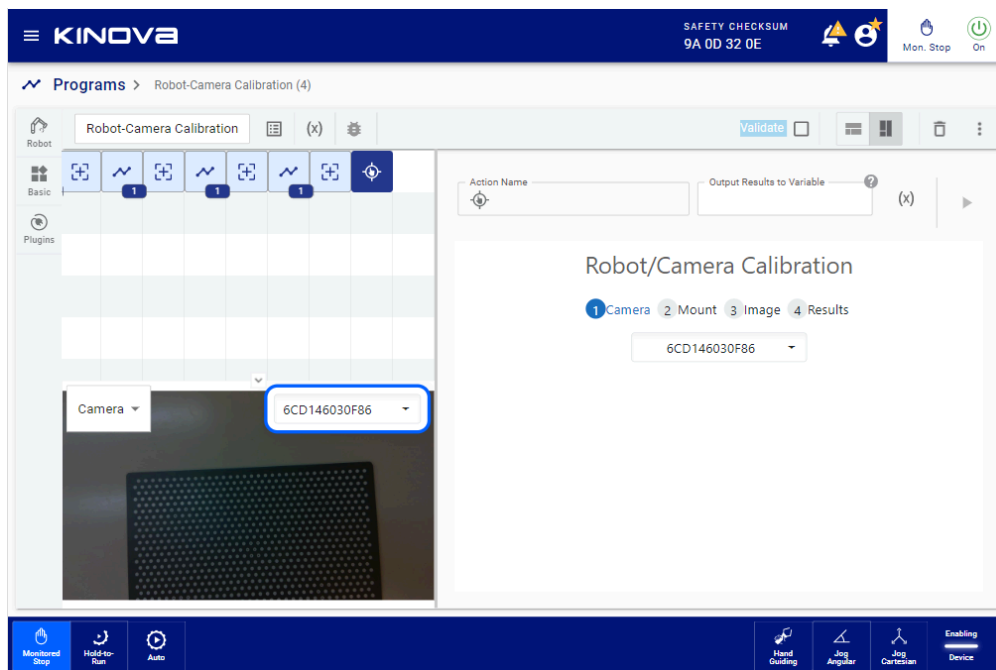


Figure 5: Robot-Camera Calibration program and wizard

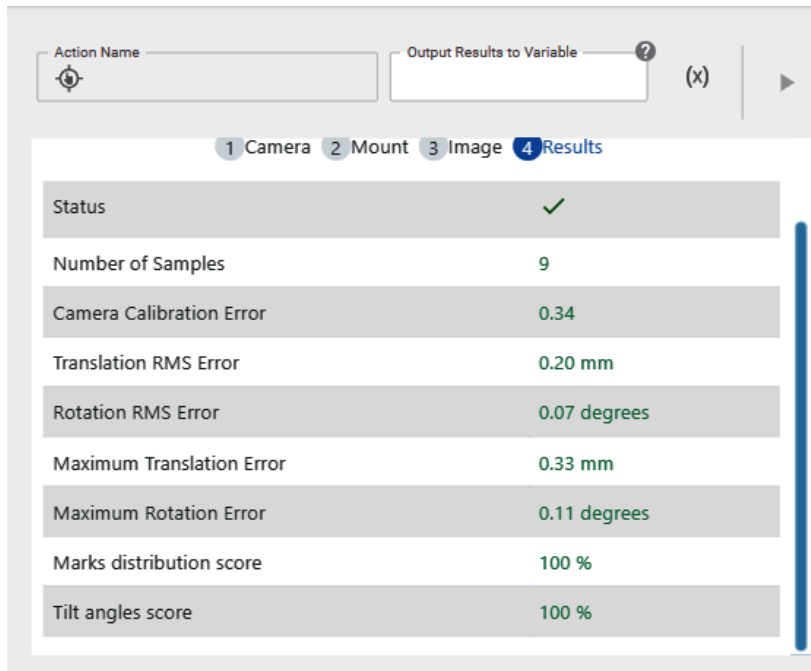


Figure 6: Result of a successful run of the Robot-Camera Calibration program

Related topics

[Vision plugin action overview](#) on page 15

[Calibrating the camera with the default program](#) on page 83

Vision plugin action overview

The Vision Plugin has its own set of actions available for further configuration when programming Link 6.

All actions associated with the Vision Plugin are available as tiles that can be dragged into the **Sequence editor** pane of the current program.

Whenever any of the Vision actions are dragged into the **Sequence editor**, the parameters and wizards associated with the action are displayed in the **Tile configuration** pane.

The Vision Plugin has three actions available.

- **Robot-Camera Calibration**
- **Calibration Snapshot**
- **Vision Job**

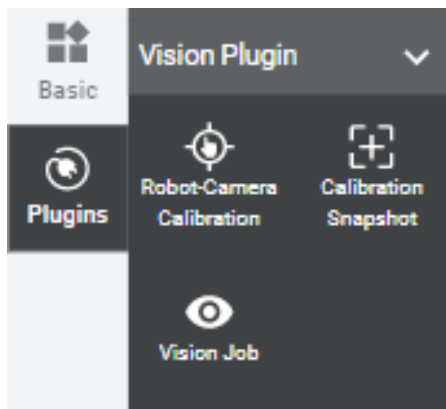
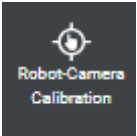
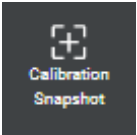
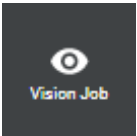


Figure 7: Actions available from the Vision plugin

Table 4: Parameters of Vision plugin actions

Action	Icon	Description
Robot-Camera Calibration		Display the status of the camera parameters and the calibration results.
		Change the camera parameters before calibrating the camera.
		The calibration parameters cannot be stored in an output variable.
Calibration Snapshot		Take a snapshot of the view of the camera.
		The action does not have any input parameters.
		The action does not return any output parameters.
Vision Job		Define and configure a Vision Job to detect an object.
		When an object is detected, the Cartesian poses of the object, with respect to the base frame, can be saved in the output object <code>Vision Plugin - Vision Job - Output</code> .



Important: Only the **Vision Job** action has output that can be saved in a variable.

Related topics

[Overview of working with plugins](#) on page 8

[Robot-Camera Calibration program](#) on page 14

Overview of the Robot-Camera Calibration action

The actual work of calibrating the camera with the robot is done with the **Robot-Camera Calibration** action.

The **Robot-Camera Calibration** action can be used in multiple ways.

- Drag into the **Sequence editor** by itself for the sole purpose of adjusting camera parameters.
- Use it in a **Robot-Camera Calibration** program to calibrate a camera with the robot.

Overview of the Calibration Snapshot action

The **Calibration Snapshot** action must be used with waypoints in a program.

To be successful in calibrating a camera with the robot, you must take a snapshot of the object that is to be detected at different angles. The more positions you use, the more accurate the camera calibration becomes.



Tip: Taking one snapshot of the object in nine different positions for a total of nine snapshots is recommended.

The **Calibration Snapshot** action does not return any output. Instead, it stores the image of the object at that position. The images are related to the waypoints the robot takes to change its view of the object.

Copy the pattern of dragging **Waypoints, Calibration Snapshot, Waypoints, Calibration Snapshot**, and so on, into the **Sequence editor**.

Overview of the Vision Job action and its Wizards

Defining one or more **Vision Job** actions increases the flexibility of a robot performing tasks, based on specific visual requirements of the object to be detected. With increased flexibility comes increased number of parameters.

Access the **Vision Job** parameters in the **Tile configuration** pane by dragging the **Vision Job** action into the **Sequence editor**.



Tip: Vision jobs may also be configured in the Plugin configuration page.

When you select **Camera** in the main **Visualization** pane in Kortex Web App, the **Visualization** displays the view from the registered camera.

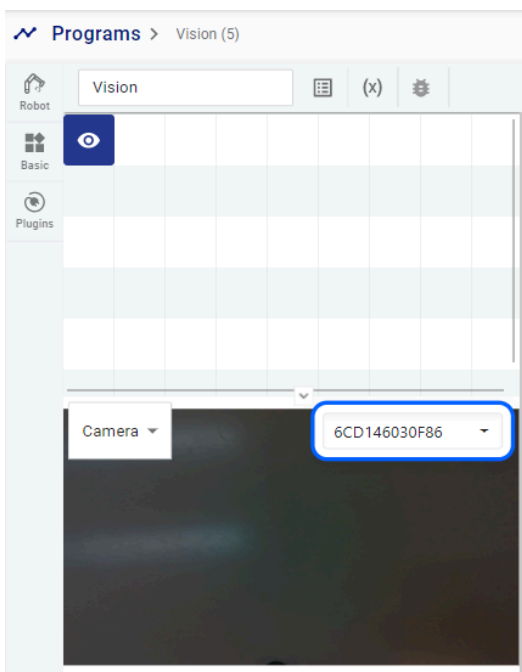


Figure 8: View of the Visualization pane when Camera is selected and the camera is registered

Each **Vision Job** action can detect one and only one type of part. You can use several **Vision Job** actions in a program to perform a task.

Each **Vision Job** action in the **Sequence editor** is defined with the use of a wizard in the **Tile configuration** pane.

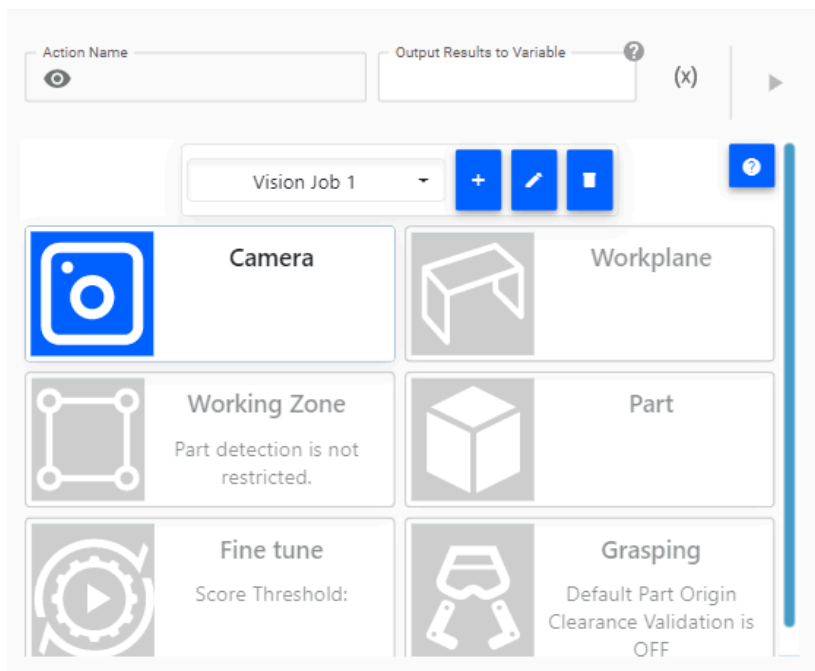
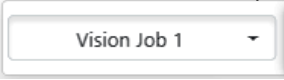


Figure 9: Wizard of the Vision Job action

Table 5: Basic tasks of the Vision Job action

Icon	Name	Description
	n/a	Select an existing Vision Job action.
	Create	Tap to create a Vision Job .  Note: The name of the vision job is added to the list of Vision Job actions.
	Modify	Tap to modify the name of the Vision Job .
	Delete	Tap to delete the selected Vision Job .
	Help	Tap to read instructions.

Each tile step in the **Vision Job** wizard represents a set of parameters that need to be configured.

Grey tiles in the **Vision Job** wizard indicate the steps that have yet to be defined. Blue tiles indicate the next configuration step to take.



Note: Some steps in the main wizard are optional.

Table 6: Steps in configuring the parameters of the Vision Job action

Step	Parameter	Icon	Description
1	Camera		Select the camera to be used. If no camera is selected, the default camera is used.

Step	Parameter	Icon	Description
2	Workplane		Define the <i>workplane</i> to be used.
3	Working Zone		Define the region where detection is of interest.
4	Part		Choose, or define, an object to be detected.
5	Fine tune		Fine tune the parameters of the detection.
6	Grasping		Define a gripper clearance zone around the defined part.

Each step in the main wizard may have its own wizard to configure the parameters. The sub-wizards launch within the **Tile configuration** pane.

Related topics

[Creating a Vision Job](#) on page 98

Select Camera wizard

The **Vision Job** action requires a calibrated camera. Although multiple cameras may be registered and available, only one camera can be assigned to a single **Vision Job** action.

Access the **Select Camera** wizard by tapping **Camera** in the main **Vision Job** wizard.

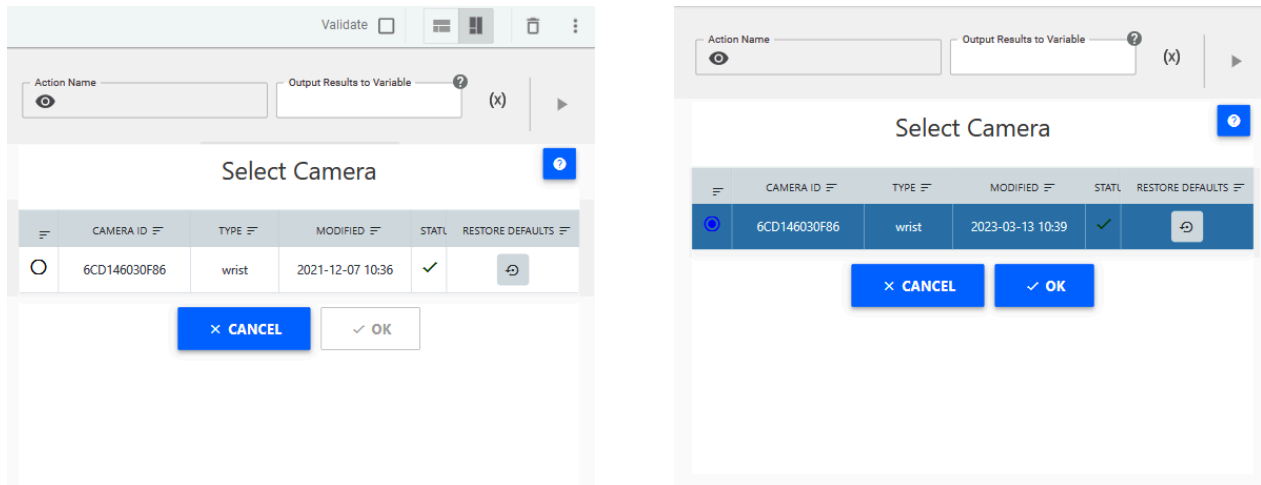


Figure 10: Select Camera wizard before and after the camera is selected

Table 7: Parts of the Select Camera wizard

Icon or Name	Description
	Instructions for the step
	Camera selector
CAMERA ID	Name of each available camera Same identifier as found on the Configurations Camera page
TYPE	Camera is on the wrist or is external to the robot
MODIFIED	Last date of the configuration of the camera  Important: Take note of the modified date. When the date matches the installation date, the camera is using the default configuration.
STATUS	Whether the camera is calibrated ✓ indicates the camera is calibrated
RESTORE DEFAULTS	Restores the default camera configuration
CANCEL	Revert any selection made from the list of cameras.
OK	Accept the selection and return to the main Vision Job wizard.

Related topics

[Selecting a camera](#) on page 103

[Calibrating the camera with the default program](#) on page 83

Select Workplane wizard

The **Vision Job** action requires a workplane to be defined.

Access the **Select Workplane** wizard by tapping **Workplane** in the **Vision Job** wizard.



Note: The **Select Workplane** wizard is accessible only when it is blue in the **Vision Job** wizard.

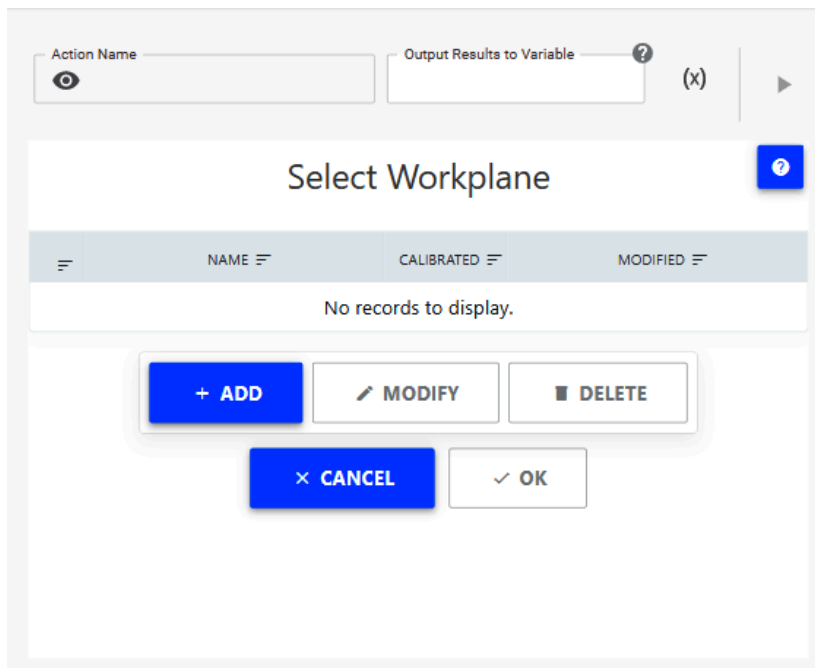


Figure 11: Select Workplane wizard when there are no workplanes selected

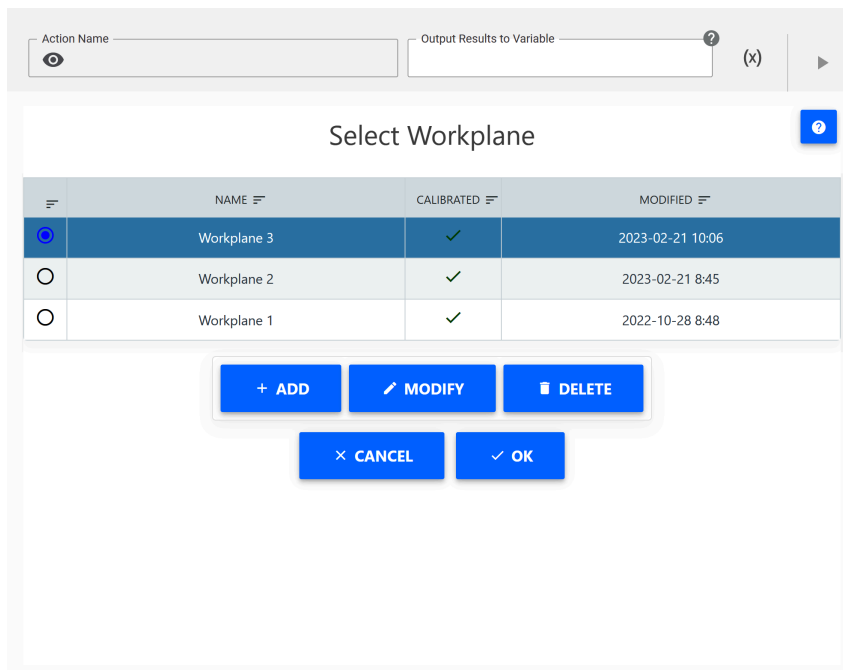


Figure 12: Select Workplane wizard when a workplane is selected

Table 8: Parts of the Select Workplane wizard

Icon or Name	Description
	Instructions for the step
	Workplane selector
NAME	Name of each defined workplane
CALIBRATED	Whether the workplane is calibrated
	 Note: It is possible to create a workplane and have it added to the list of available workplanes without it being calibrated. If the workplane is not calibrated, it can be modified or deleted.
	✓ indicates the workplane is calibrated
	⊘ indicates the workplane is not calibrated
MODIFIED	Last date of the configuration of the workplane
ADD	Add a new workplane Launches the Workplane Calibration wizard

Icon or Name	Description
MODIFY	Modify the selected workplane Launches the Workplane Calibration wizard
DELETE	Delete the selected workplane
CANCEL	Revert any selection made from the list of cameras.
OK	Accept the selection and return to the main Vision Job wizard.

Related topics

[Selecting a workplane](#) on page 104

[Workplane Calibration wizard](#) on page 24

Workplane Calibration wizard

The workplane that is going to be used in a **Vision Job** action must be calibrated to make it easier for the robot to find the specific object in a task.

Access the **Workplane Calibration** wizard from the **Select Workplane** wizard.

- Tap **ADD**.
- Select a workplane that is in the list and tap **MODIFY**.

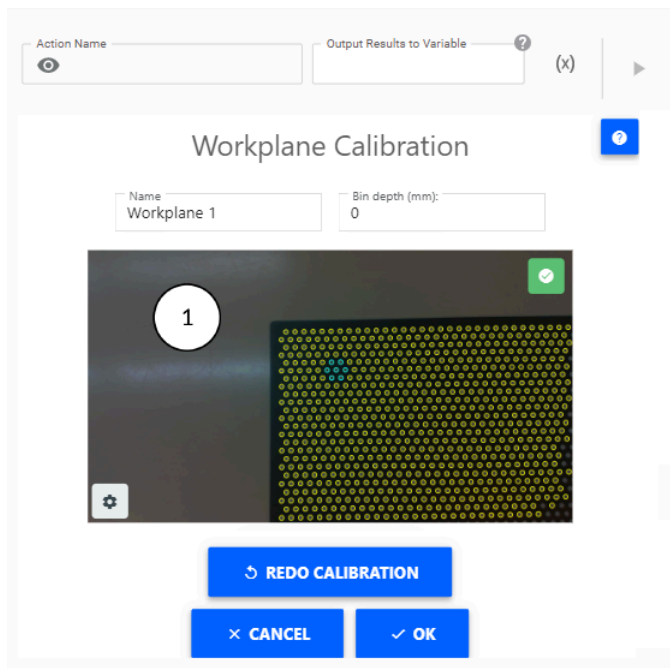
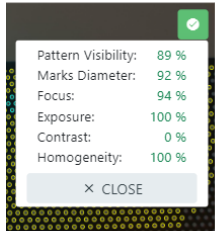
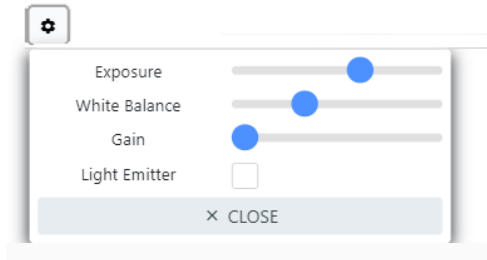


Figure 13: Workplane Calibration wizard

Table 9: Parts of the Workplane Calibration wizard

Icon or Name	Description
	Instructions for the step
NAME	Enter the name of the workplane
Bin depth (mm)	Enter the distance between the calibration board and the surface that the robot must pick up the robot  Note: If the calibration plate is inside the bin, the bin depth is 0 regardless of the actual depth of the bin. Example: The bin is 100 mm deep. The calibration plate is inside the bin. The distance that must be entered is 0.
1	Camera viewer Area that displays the view of the camera
	Display the current results of the view of the camera of the workplane Launches the dialog that displays the current results of calibrating the workplane with the camera 
	Launches the Camera parameters dialog  Tip: Modify the different camera parameters until you see the desired results in the Workplane calibration results. 

Icon or Name	Description
CALIBRATE	Calibrate the workplane with the current camera parameters
	Important: The calibration plate must be used for calibration.
REDO CALIBRATION	Do the calibration again
	Note: Available only after the workplane has undergone one calibration
CANCEL	Revert any selection made from the list of cameras.
OK	Accept the selection and return to the main Vision Job wizard.

Related topics

[Camera settings](#) on page 26

[Calibrating a workplane](#) on page 105

Camera settings

The camera must be able to see the object. Parameters can be set to ease the visibility of objects.

Tap the cog () in the **Camera viewer** of the **Robot-Camera Calibration** wizard to access the configurable parameters of the camera.

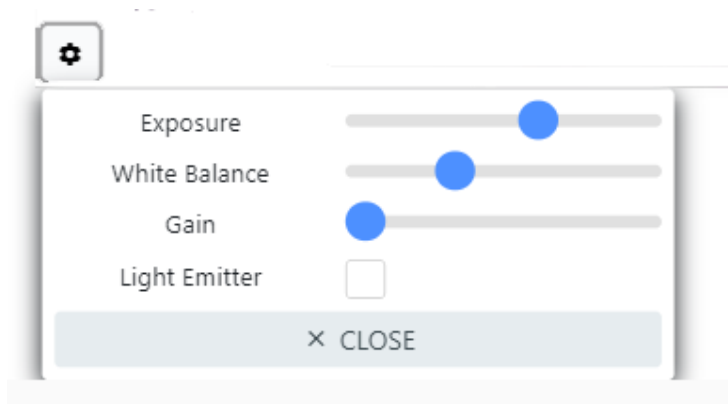


Figure 14: Camera parameters

Table 10: Configurable parameters in camera management

Parameter	Description
Exposure	Adjust the exposure level by dragging the slider. The higher the exposure, the more light the camera captures.

Parameter	Description
White Balance	Adjust the color to establish the true color of white in your lighting conditions.
Gain	Adjust the gain. High levels of gain results in brighter images with sharpened contrast. Low levels of gain results in darker images with softened contrast.
Light Emitter	Enable to emit a powerful light from the camera. Enable in dark environments.

Related topics

[Calibrating a workplane](#) on page 105

Working Zone wizard

The working zone restricts the area in which the part that is used for object detection can be found.

The working zone is configured using the [FOV](#) of the camera for convenience. However, the working zone is actually defined in a physical zone in the reference frame of the robot. The [FOV](#) of the camera during run time has no impact on the working zone.

Access the **Working Zone** wizard by tapping **Working Zone** in the **Vision Job** wizard.



Note: The **Working Zone** wizard is accessible only when it is blue in the **Vision Job** wizard.



Note: It is not mandatory to restrict an area to be able to define a **Vision Job**.

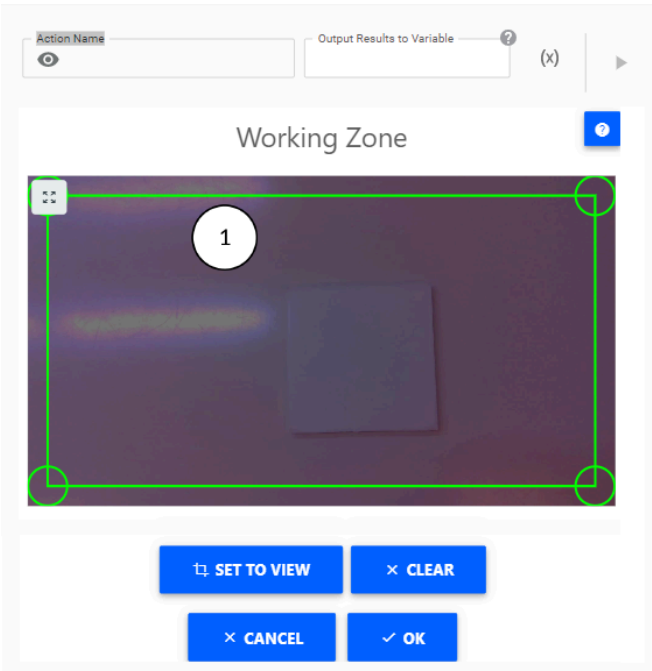


Figure 15: Working Zone wizard

Table 11: Parts of the Working Zone wizard

Icon or Name	Description
	Instructions for the step
1	Camera viewer
	Magnify the camera view within the crop marks Launches a magnifier slider
	
	Crop mark handle
	Crop mark line

Icon or Name	Description
SET TO VIEW	Place crop marks around entire working zone
CLEAR	Erase the current working zone as it is displayed in the Camera viewer
CANCEL	Revert to the previous working zone definition
OK	Accept the selection and return to the main Vision Job wizard.

Related topics

[Creating the working zone](#) on page 109

Select Part Model wizard

A model of the part of the object that is used for object detection must be selected.

Access the **Select Part Model** wizard by tapping **Part** in the **Vision Job** wizard.



Note: The **Select Part Model** wizard is accessible only when it is blue in the **Vision Job** wizard.

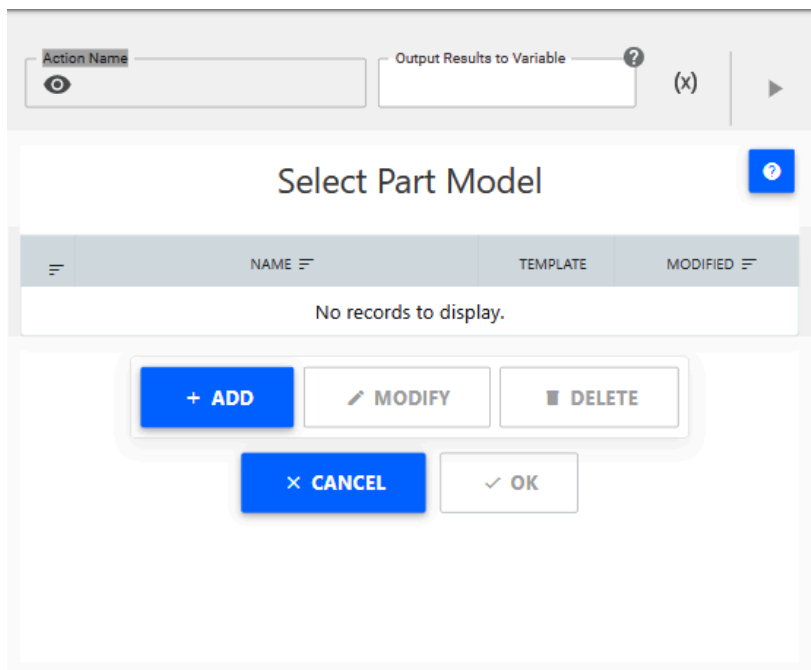


Figure 16: Select Part Model wizard before any models of parts exist

Table 12: Parts of the Select Part Model wizard

Icon or Name	Description
	Instructions for the step
	Part model selector
NAME	Name of each part model that is available
TEMPLATE	Name of the template Image of what the object to be detected looks like Used for part detection
MODIFIED	Date the part model is created or modified
ADD	Create a part model Launch the Create Part Model wizard
MODIFY	Modify the selected part model Launch the Create Part Model wizard
DELETE	Delete the selected part model
CANCEL	Revert any selection made from the list of part models.
OK	Accept the selection and return to the main Vision Job wizard.

Each step in creating a part model has its unique set of tasks available to it.



Important: At any time, you can return to any previous step in the wizard without losing your modifications by tapping on the breadcrumb.

Related topics

[Selecting a part for the Vision Job to detect](#) on page 110

[Create Part Model wizard](#) on page 30

Create Part Model wizard

Modeling the part that needs to be detected involves several steps. Each step is outlined as selectable steps as breadcrumbs of a wizard.

Access the **Create Part Model** wizard from the **Select Part Model** wizard.

- Tap **ADD**.
- Select a part model that is in the list and tap **MODIFY**.

The wizard has numbered breadcrumbs along the top so that you can return to any step within the wizard and make adjustments.

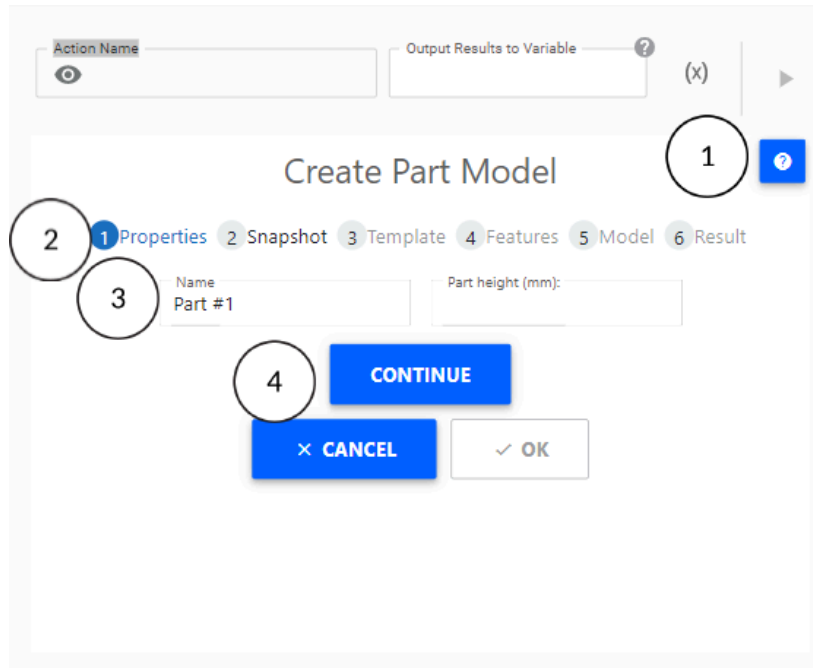


Figure 17: Create Part Model wizard

Table 13: Parts of the Create Part Model wizard

1	Help
2	Breadcrumbs for the Create Part Model wizard, where each breadcrumb is associated with a step required for creating a part model • Properties • Snapshot • Template • Features • Model • Result  Tip: Return to any step within a wizard by tapping on the breadcrumb where you need to make adjustments.
3	Parameters specific to the current breadcrumb
4	Action that can be taken at the current breadcrumb location in the wizard

Camera viewer (not shown) View from the point of view of the camera

Related topics

[Creating a part for the Vision Job to detect](#) on page 111

Properties of the part model

Multiple part models can be created. Defining properties for each one helps to tell them apart for different **Vision Job** actions.

The first step in creating a part model is to define the basic properties of the part. The first breadcrumb in the wizard is called **Properties**.

Figure 18: Part Model wizard: Properties

Table 14: Parameters and actions for the Properties of the part model

Name	Description
Name	Name of the part model that is under construction
Part height (mm)	Height, in mm, of the part
CONTINUE	Proceed to the next step in creating a part model according to the breadcrumb sequence
CANCEL	Remove any modifications made in the current part of the wizard

Name	Description
OK	Accept the selection and return to the main Vision Job wizard.

Related topics
[Defining properties of the part model](#) on page 114

Snapshot of the part model

A snapshot of the part model is the basis of the generalization of the object.

With the name and height of the object saved, the robot needs to know what the object looks like. The robot needs to learn what the sample object looks like by taking and saving its picture for reference. The picture includes the workplane.

The breadcrumb in the wizard is **Snapshot**.

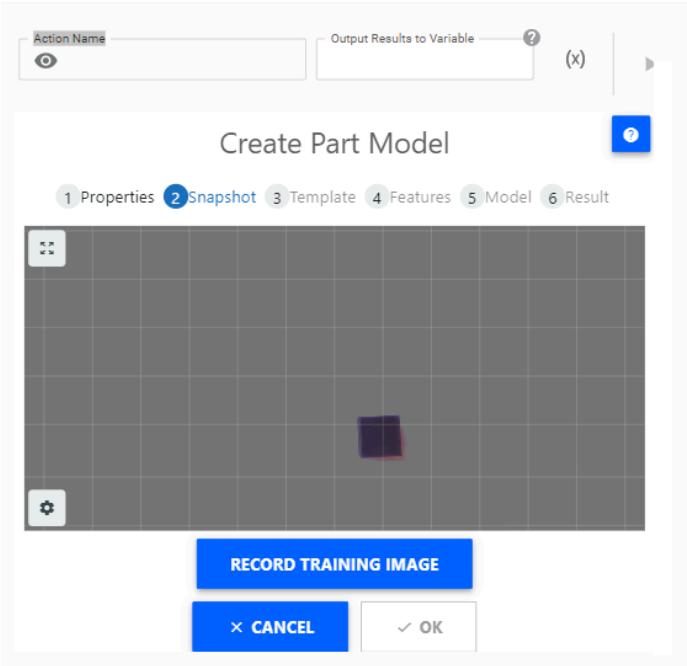
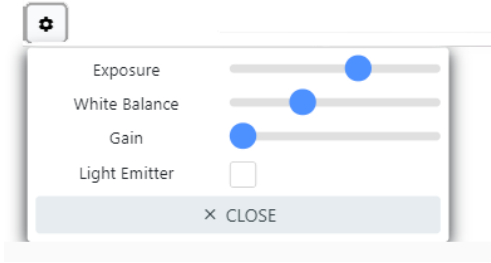


Figure 19: Part Model wizard: Snapshot - top half

Table 15: Parameters and actions for the Snapshot of the part model

Name	Description
	Launch the magnifier
	

Name	Description
	Launch the Camera parameters dialog to adjust the camera settings
	
RECORD TRAINING IMAGE	Take a snapshot of the object on the workplane
CANCEL	Remove the snapshot
OK	Accept the selection and return to the main Vision Job wizard.

Related topics

[Taking a snapshot of the part model](#) on page 115

Template of the part model

The template is used as the basis of one or more models of the same part.

Although it is useful to have a general picture of the object with respect to the workplane, it is important to have a picture of the object, or part of the object, to focus on.

The breadcrumb in the wizard is **Template**.

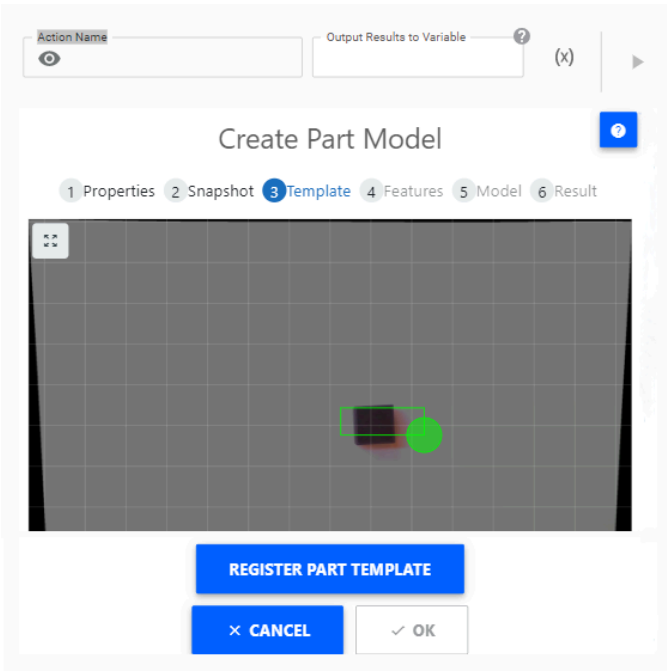


Figure 20: Part Model wizard: Template

Table 16: Parameters and actions for the Template of the part model

Name	Description
	Launch the magnifier
	Handle to box off the area of interest for the part
REGISTER PART TEMPLATE	Take a snapshot of the object on the workplane
CANCEL	Remove the snapshot
OK	Accept the selection and return to the main Vision Job wizard.

Related topics

[Creating a template for the part model](#) on page 117

Features of the part model

The definition of the location of the specific features to look for on the part model helps the robot to pinpoint parts more precisely.

The feature may be as simple as an outline of the object to be detected. For instance, the robot may need to locate all cubes in a bin that has cubes and rectangular cuboids. In this case, the feature of the part model is an outline of the cube.

The feature may also be a pattern found on an object. For instance, the robot may need to locate only those cubes with the word "Hello" engraved on it. In this case, the feature of the part model is an outline of the word "Hello".

The breadcrumb in the wizard is **Features**.

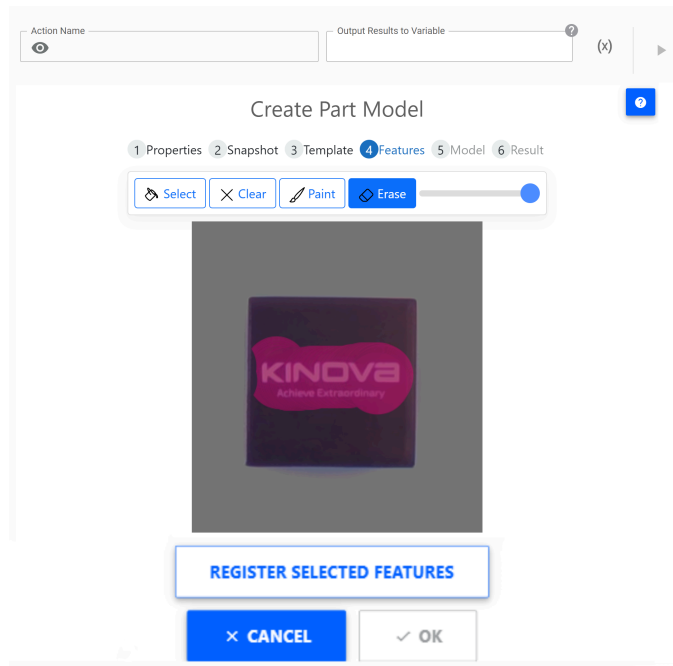
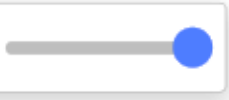


Figure 21: Part Model wizard: Features

Table 17: Parameters and actions for the Features of the part model

Name	Description
Select	Select the entire area in the Camera viewer
Clear	Remove all paint in the Camera viewer
Paint	Paint over the area on the object that is of interest
Erase	Erase a portion of the paint
	Change the size of the paint brush used for painting the features of interest on the part
REGISTER SELECTED FEATURES	Save the features

Name	Description
CANCEL	Remove the snapshot
OK	Accept the selection and return to the main Vision Job wizard.

Related topics

[Defining features](#) on page 118

Model of the part

Make the area of interest even more precise by defining attributes of the part.

The physical characteristics of an object can be added to the definition of the part the robot has to locate. These characteristics are needed to model the part. The information is used to teach the robot more about the part.

The breadcrumb in the wizard is **Model**.

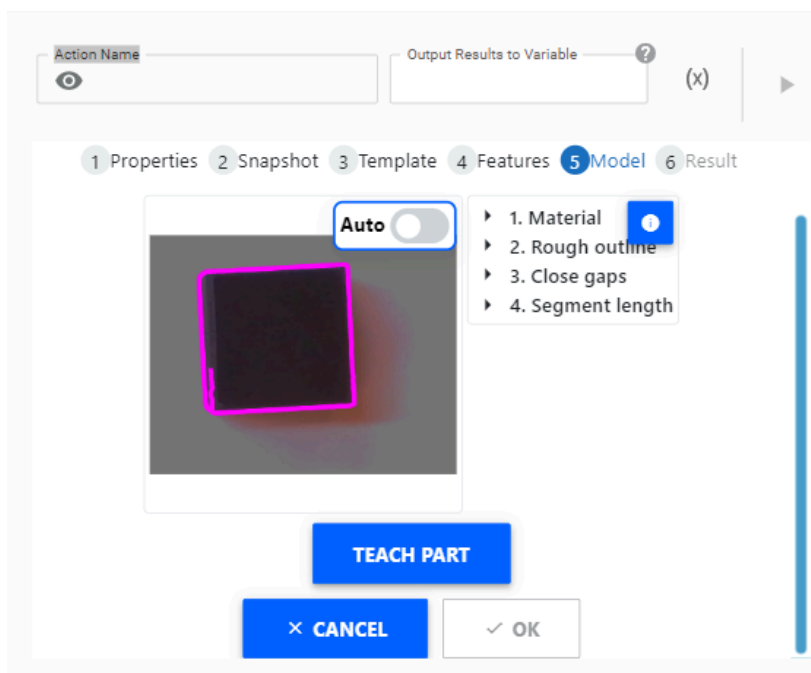


Figure 22: Part Model wizard: Model

Table 18: Attributes and actions for the Model of the part model

Name	Description
Auto	When on, no attributes need to be defined

Name	Description
1. Material	• Normal • Reflective • Mixed Color
2. Rough outline	Define the edges of the shape
3. Close gaps	Close any gaps in the painted part outline
4. Segment length	Remove undesired segments in the painted part outline
	 Note: Undesired segments are segments that are not to be detected.
TEACH PART	Save the part model
CANCEL	Remove the snapshot
OK	Accept the selection and return to the main Vision Job wizard.

Related topics

[Defining the model](#) on page 120

Result of the part model

View the result of the part model in case you need to return to any of the steps in the **Create Part Model** to make adjustments.

The result is the final image of the object with the features defined in green. The modeling characteristics are saved for the part.

The breadcrumb in the wizard is **Result**.

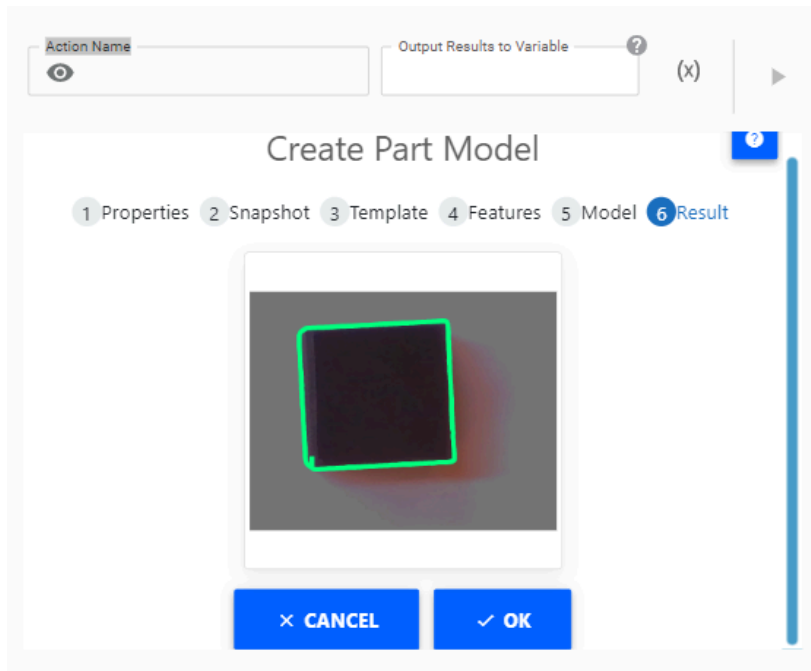


Figure 23: Part Model wizard: Result

Table 19: Actions for the Result of the part model

Name	Description
CANCEL	Remove the snapshot
OK	Accept the selection and return to the main Vision Job wizard.

Related topics

[Accepting or rejecting the model of the part](#) on page 122

Fine-tune part detection

After the part model is created, it is possible to fine-tune the detection even more.

Access the **Fine-Tune Part Detection** wizard by tapping **Fine tune** in the **Vision Job** wizard.

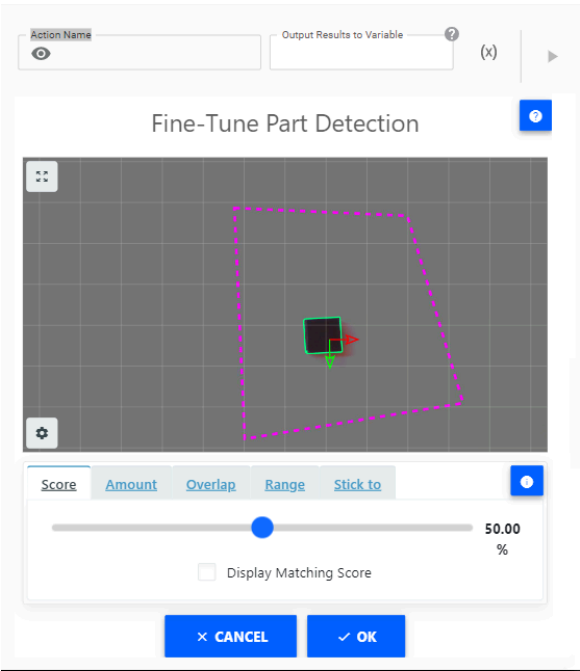


Figure 24: Fine-Tune Part Detection wizard

Table 20: Parts of the Fine-tune part detection wizard

Parameter	Description
	Instructions for the step
	Launch the magnifier
	Launch the Camera parameters dialog to adjust the camera settings

Parameter	Description
Fine-tune parameters	Parameters for fine-tuning how the camera detects the object • Score • Amount • Overlap • Range • Stick to
CANCEL	Revert any changes made at that part of the wizard.
OK	Accept the changes and return to the main Vision Job wizard.

Related topics

[Fine-tuning the part](#) on page 123

Fine-tune score

The score is an indication of how close the plugin determines the object is a match for the actual object.

By default, **Score** is set to 50.00%.

Use the slider to fine-tune object detection until the part is recognized in all positions and orientations.



CAUTION: A very low score can lead to false detection of the object.

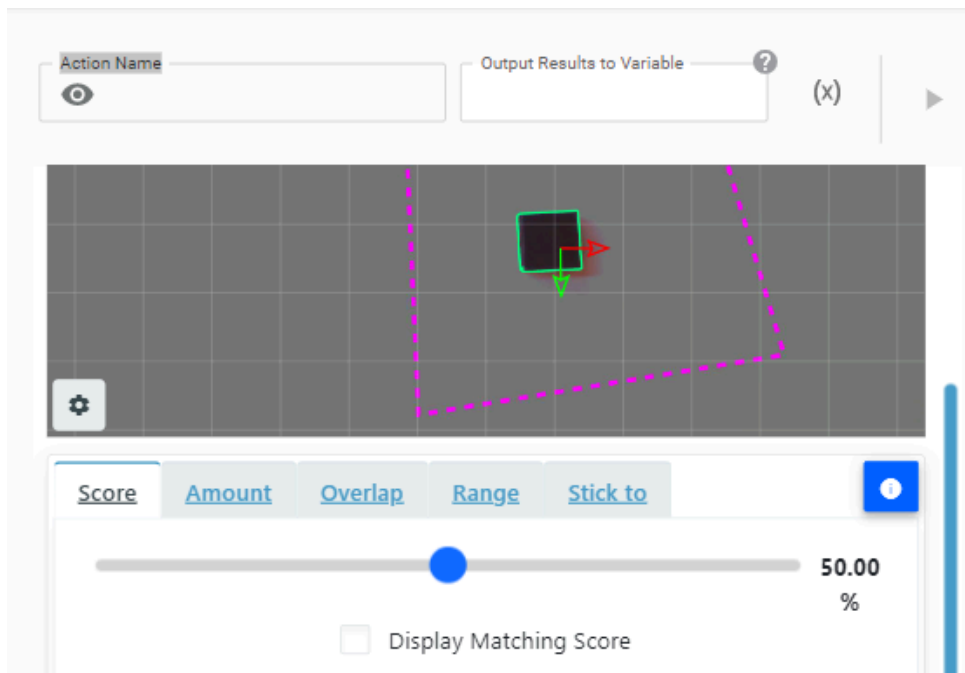


Figure 25: Fine-tune Score

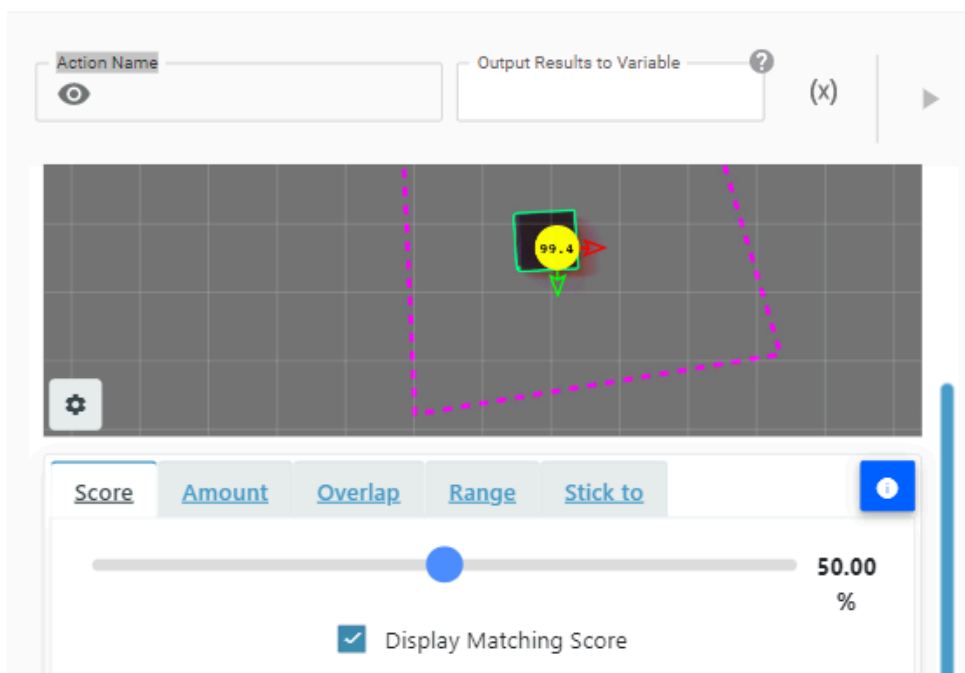


Figure 26: Fine-tune Score with Matching Score: default score

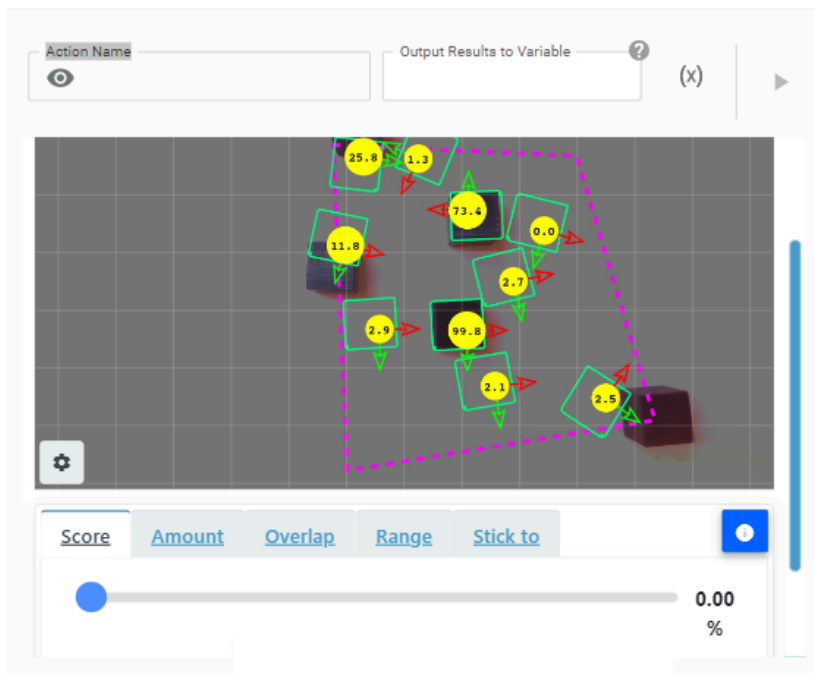


Figure 27: Fine-tune Score with Matching Score: lowest score

Table 21: Parameters of the Fine-tune part detection wizard: Score

Parameter	Description
Display Matching Score	Display the score of how well the camera detects the object, when selected

Fine-tune amount

Fine-tune object detection by selecting which strategy works best for the task: one-shot-pick-all or one-shot-one-pick.

The one-shot-pick-all strategy means that the robot picks any of the detected objects within the area.

The one-shot-one-pick strategy means that the robot picks the best matching object that is detected within the area.



Note: Although the strategy name implies picking, any vision will only output target coordinates which should be reached using a separate tile to handle robot motion.

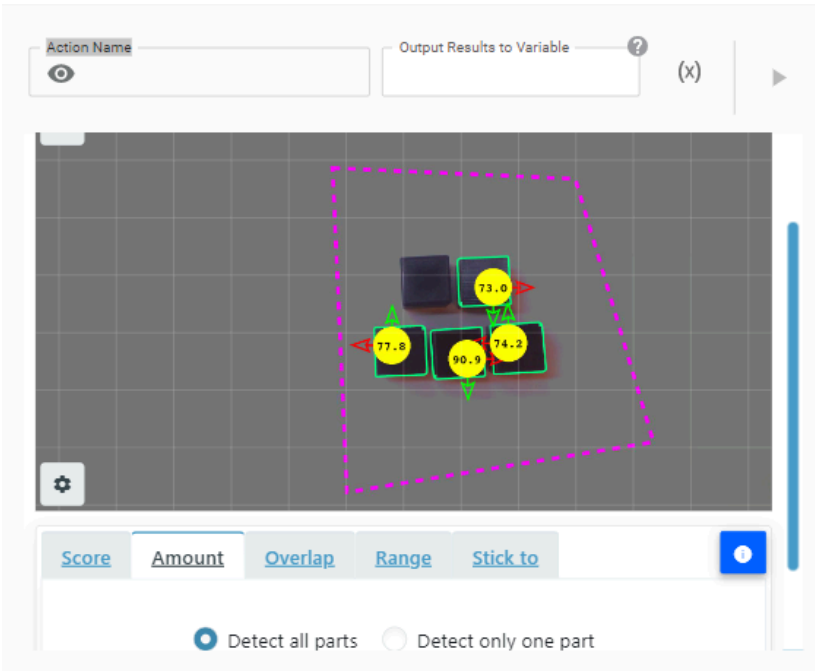


Figure 28: Fine-tune Amount: detect all parts

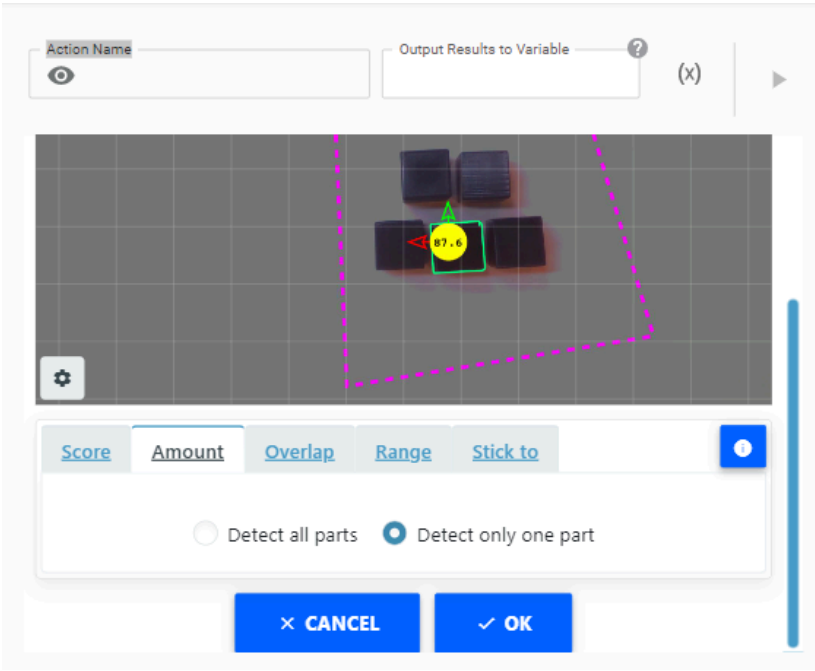


Figure 29: Fine-tune Score Amount: detect one part

Table 22: Parts of the Fine-tune part detection wizard: Amount

Parameter	Description
Detect all parts	Display all parts that match the current score within the defined area

Parameter	Description
Detect only one part	Display only one part that best matches the current score within the defined area

Fine-tune overlap

Parts may overlap each other within the area. It is wise to adjust the amount of overlap that is acceptable.

When no overlap is allowed, fewer objects may be available for picking at a single time.

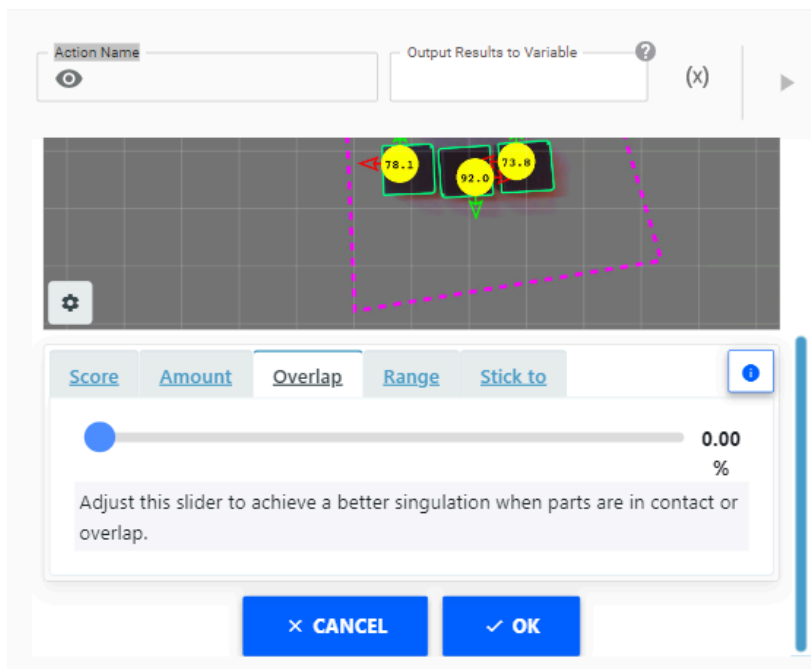


Figure 30: Fine-tune Overlap: no overlap allowed

When overlap is defined, more objects may be available for picking at a single time.

Overlap is particularly useful for objects that are shaped irregularly. For instance, L-shaped objects sitting close to each other require the overlap to be defined so that all parts of an L-shaped object can be detected. With an overlap of 60, two L-shape objects beside each other can be detected.



Figure 31: Fine-tune Overlap: overlap defined

Fine-tune range

Range enhances the ability to pick an object.

Object detection is determined from the upper left corner of the object. The symmetry of the object helps determine how much to rotate the wrist to be successful in picking the object.



Tip: Select the symmetry that is the closest match to the object that is to be detected.

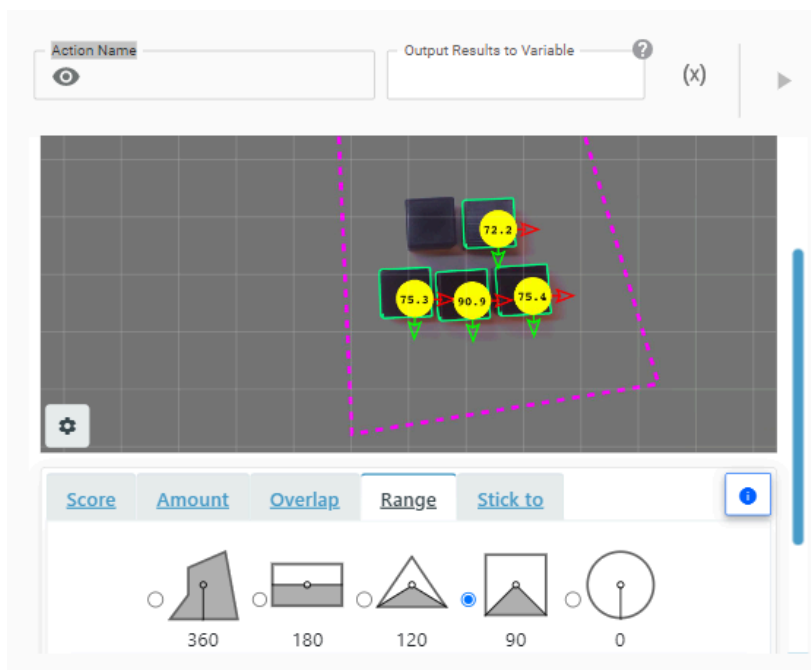
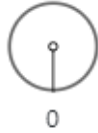


Figure 32: Fine-tune Range

Table 23: Parts of the Fine-tune part detection wizard: Range

Parameter	Description
 360	Arbitrary shape The part has no symmetry. Its orientation can be anything between 0° and 360°.
 180	Rectangular shape The wrist rotates between -90° and 90° to pick a rectangular object.
 120	Triangular shape The wrist rotates between -60° and 60° to pick the triangular object.
 90	Square shape The wrist rotates -45° and 45° to pick the square object.

Parameter	Description
	Circular shape
	The object can be picked up in any orientation. No wrist rotation is needed. The orientation of the part is always 0°; the orientation is relative to the Stick-to option.

Fine-tune stick to

The fixed position is displayed on the object in the **Camera viewer** to help understand the actual orientation of the object.

When fine-tuning object detection, it is important to denote whether the origin of the part is fixed to the **Workplane** or fixed to the **Camera**.

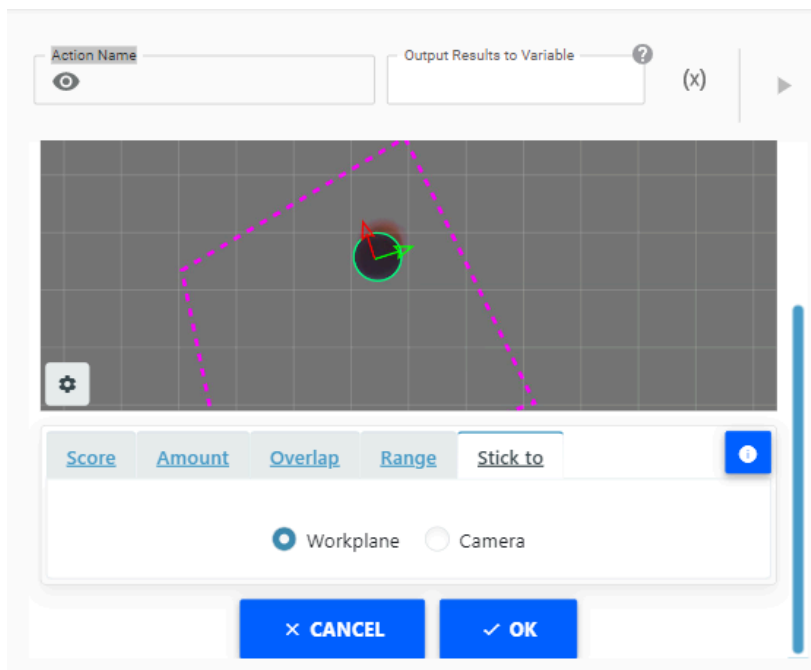


Figure 33: Fine-tune Stick to: Workplane

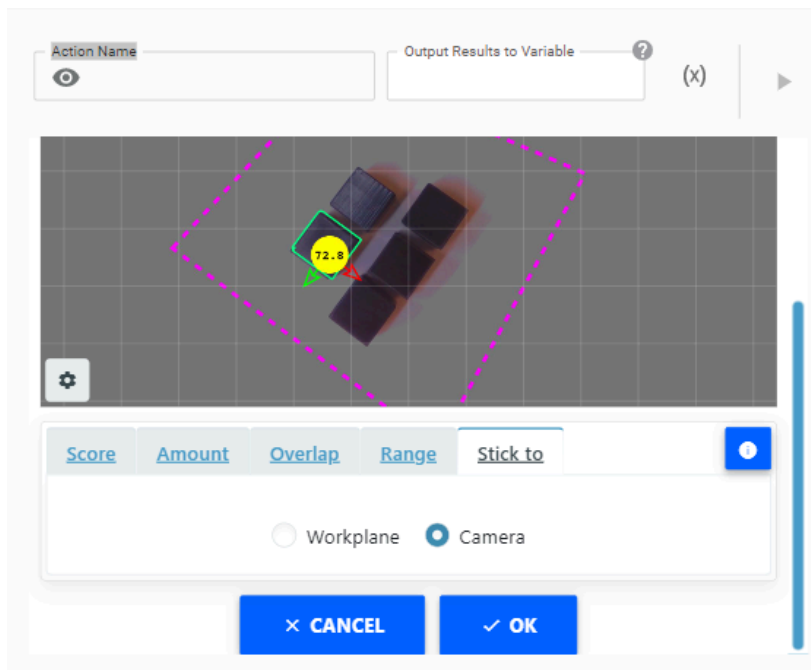


Figure 34: Fine-tune Stick to: Camera

Table 24: Parts of the Fine-tune part detection wizard: Stick to

Parameter	Description
Camera	Origin of the object relative to the camera.
Workplane	Origin of the object relative to the workplane.

Grasping Configuration wizard

When grippers are attached to the robot, use the wizard to define how the grippers approach the object and retrieve it.

When the camera and workplane are configured correctly, the object is detected. The center of origin and the angle of origin are displayed in the **Camera viewer**.

Access the **Grasping Configuration** wizard by tapping **Grasping** in the **Vision Job** wizard.

The wizard has numbered breadcrumbs along the top so that you can return to any step within the wizard and make adjustments.

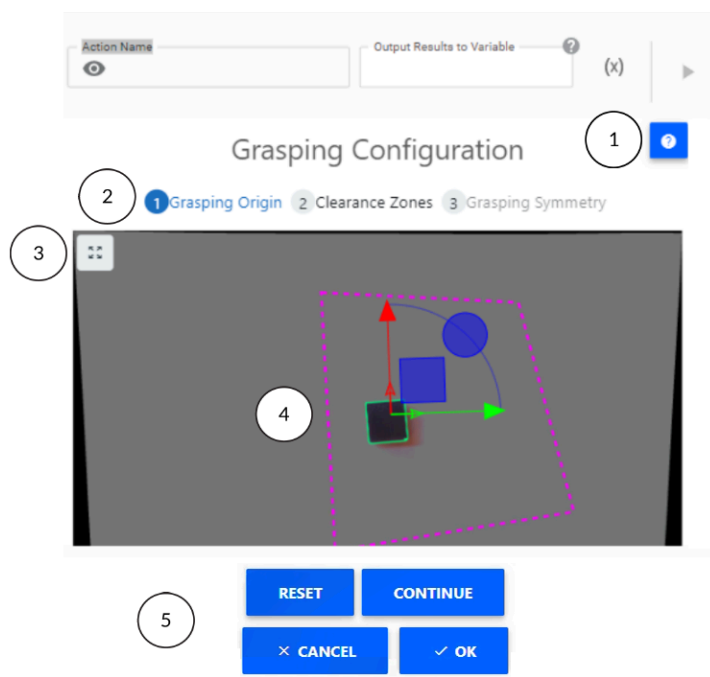


Figure 35: Grasping Configuration wizard

Table 25: Parts of the Grasping Configuration wizard

1	Help
2	Breadcrumbs for the Grasping wizard, where each breadcrumb is associated with a step required for controlling how the robot grasps the object • Grasping Origin • Clearance Zones • Grasping Symmetry  Tip: Return to any step within a wizard by tapping on the breadcrumb where you need to make adjustments.
3	Magnifier
4	Camera viewer View from the point of view of the camera
5	Action that can be taken at the current breadcrumb location in the wizard

Related topics

[Grasping configuration](#) on page 127

Grasping Origin

The default origin is displayed in the **Camera viewer** as long as the camera detects the object on the workplane.

The center of origin and the angle of origin can both be moved to optimize grasping the object.

The breadcrumb in the wizard is **Grasping Origin**.

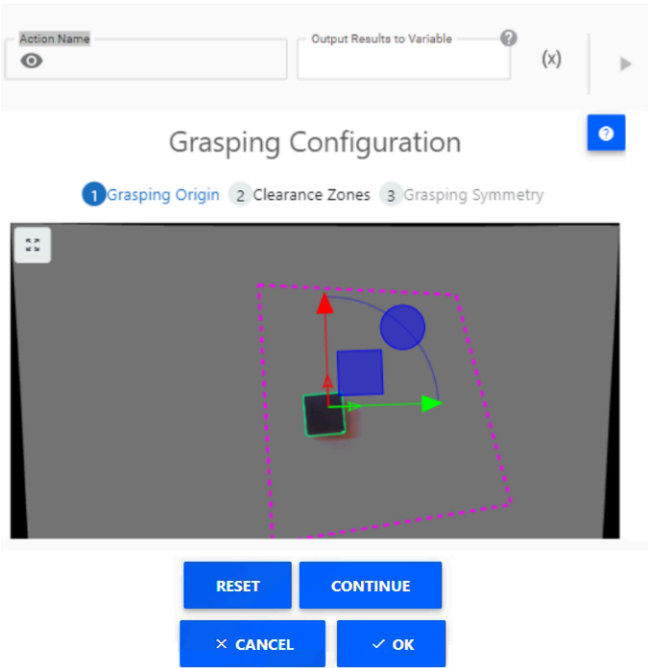
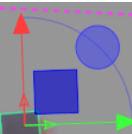
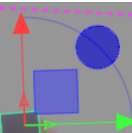


Figure 36: Grasping Configuration wizard: Grasping Origin

Table 26: Parameters and actions for the Grasping Origin

Name	Description
	Define origin  Note: Origin is defined by dragging the blue square.
	Define angle of origin  Note: Angle is defined by dragging the blue circle.
RESET	Reset the grasping origins of the object

Name	Description
CONTINUE	Save the modification and proceed to the next step in configuring the approach to grasping the object according to the breadcrumb sequence
CANCEL	Remove any modifications made in the current part of the wizard
OK	Accept the modification and return to the main Vision Job wizard.

Clearance Zones

Up to four active clearance zones can be defined in the **Grasping Configuration** wizard.

An active clearance zone is an area in which the robot can always reach the object even when other objects are around.

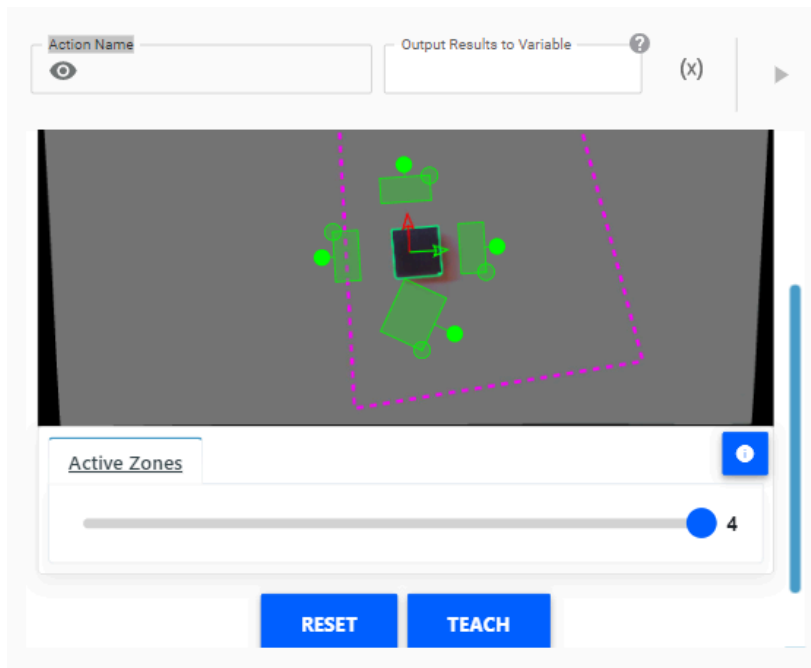


Figure 37: Grasping Configuration - Active Zones

Table 27: Parts of the Fine-tune part detection wizard: Range

Parameter	Description
Slider	Indicate the number of active zones
 Note: The maximum number of active zones at any time is four (4).	

Parameter	Description
	Zone clearance size handle: circle on corner of the clearance zone
	Zone clearance rotation handle: bright green circle extending from middle of one size of the clearance zone
TEACH	Save the size, position, and orientation of each of the clearance zones Proceed to the next step in the Grasping Configuration wizard
RESET	Reset the number of active grasping zones

Part Symmetry

Defining the symmetry to be expected for grasping helps to increase the number of eligible parts to be detected among a bin of many parts.

Cylindrical objects have the highest chance of being selected because there are eight possible gripper orientations. Irregularly-shaped objects have a lower chance of being selected because there can be as few as one way to grasp it safely. By defining the symmetry of the part, the chance of selecting the correct object increases.

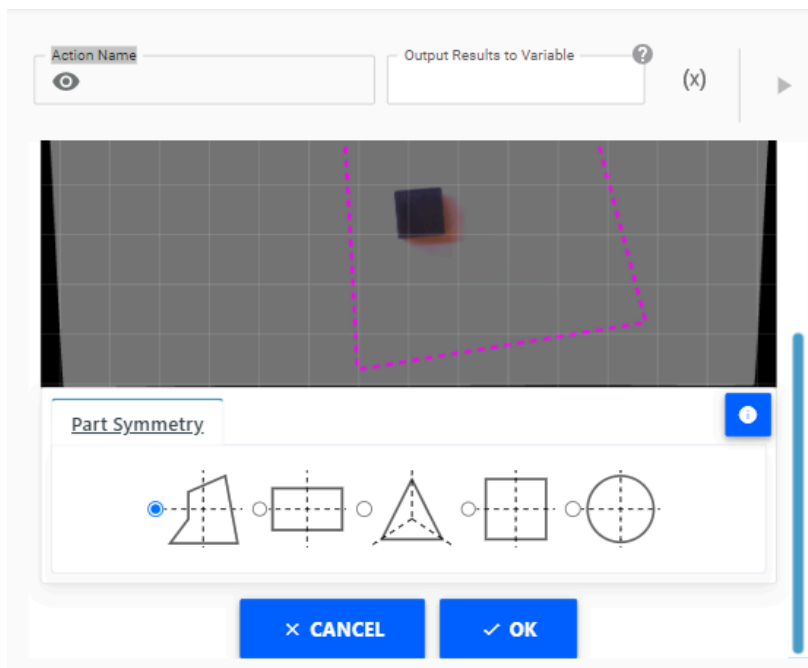


Figure 38: Grasping Configuration wizard - Part Symmetry does not match the shape of the object

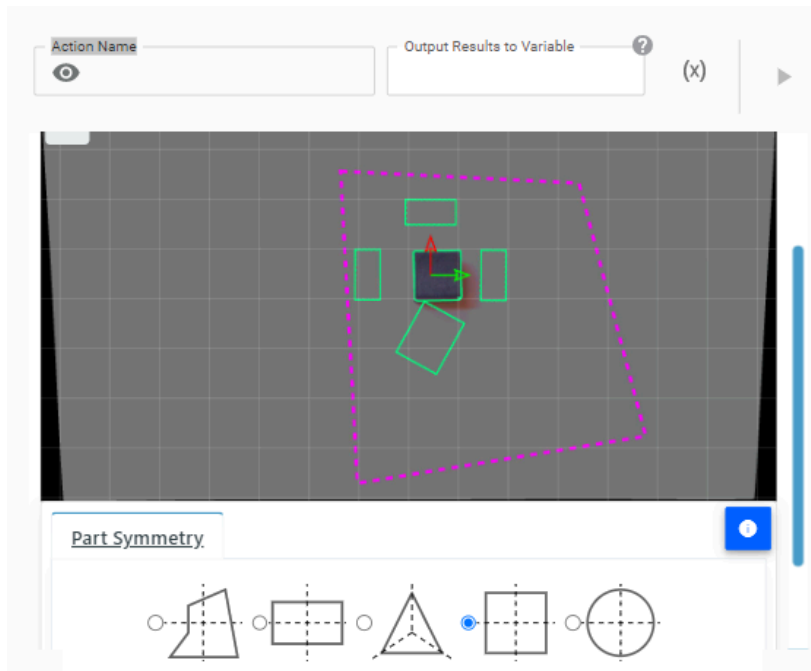
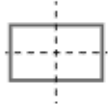
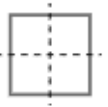
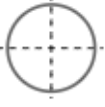


Figure 39: Grasping Configuration wizard - Part Symmetry matches the shape of the object

Table 28: Parts of the Grasping Configuration wizard: Part Symmetry

Parameter	Description
	Clearance zone has an arbitrary shape, such as the letter "L"
	Clearance zone is rectangular
	Clearance zone is triangular
	Clearance zone is square

Parameter	Description
	Clearance zone is circular

Variables

It is possible to create variables that are based on the output values of the actions from the plugin.

Program variables can be one of several types, one of which is **Object**. The **Object** type can take on one of many different schemas related to the pose and angles of the robot, as well as output values coming from the pre-installed Arm plugin. The schema must match the selected action.

In the case of the Vision plugin, the variable can be set to return the data that is found in the data structure that is output by the Vision action, **Vision Job**.

The only action that saves its output in a variable is the **Vision Job**. The **Type** is **Object**. The **Schema** must be **Vision Plugin - Vision Job - Output**.

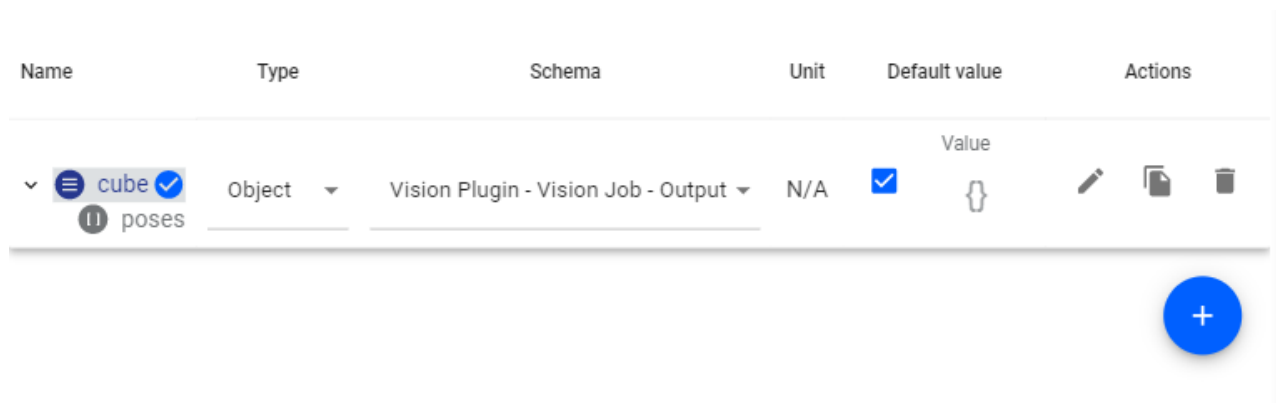


Figure 40: Example of data structure returned by action

Use the output variable of the action when you are programming with the visual programming interface.

View the values in the **JSON Object Editor** that launches after you tap the {} of the variable.

Table 29: Information returned in the Vision Job action

Data element	Description
poses	A list of Cartesian poses, with respect to the base frame, of the object that is detected
	When there is more than one Cartesian pose in the list, use a list indexer to access the pose you want to access.

Related topics

[Creating variables](#) on page 133

Recommended general workflow

Follow a specific sequence of tasks to work with the Vision Module or a camera in your robot programs.

About this task

The workflow describes the steps needed in being able to incorporate the ability to use a camera in other robotic programs.

Each step may contain more steps because of the wizards that are in the Vision Plugin.

Procedure

1. [Install](#) the Vision Module.



Note: If a different camera module is going to be used, it must be a FRAMOS D435e module. Please refer to the manufacturer installation guide.

2. [Install](#) the Vision Plugin.
3. Install the plugins associated with any other tool that is installed on Link 6.
4. Tap **Vision Plugin** from the **Plugins** page.
5. [Register](#) the camera with the Vision Plugin.
6. Tap **Systems** > **Tools** to configure the Vision Module and other tools on the **Tools** page.
7. [Calibrate](#) the camera on the robot.



Note: It is possible to calibrate the camera yourself. However, it is recommended to use the calibration program that comes with the Vision Plugin to calibrate the camera.

8. [Create](#) one or more **Vision Job** actions.
9. [Create](#) a variable for each **Vision Job** action when the output is needed in a bigger program.
10. Incorporate **Vision Job** tasks in other robot programs for Link 6.

Installing the camera

The first step in using the Vision Plugin is to install the camera module.

About this task

Procedure

Choose the type of installation that matches your situation.

- Refer to the installation guide of the manufacturer when you want to install a FRAMOS D435 module instead of the Kinova Vision Module.

- Install only the Vision Module.
- Install the Vision Module and a Robotiq tool.
- Install the Vision Module and an OnRobot tool.

Related topics

[Kinova Vision Module overview](#) on page 6

Mounting the Vision Module on Link 6

The Vision Module is an optional tool that can be installed on the Link 6 end effector.

Before you begin

- Make sure you have all the tools and hardware needed to fasten the Kinova Vision Module to Link 6.
- Make sure the robot is off.

Personnel:

- **Number of Workers:** 1

Supplies

- 5.0 mm hex key
- 4 M6x16 - SHCS screws (KR22003)



Note: Torque: 7-9 N·m

About this task

The Vision Module attaches directly to the wrist of Link 6.

Procedure

1. Remove the end cap from the wrist of Link 6.

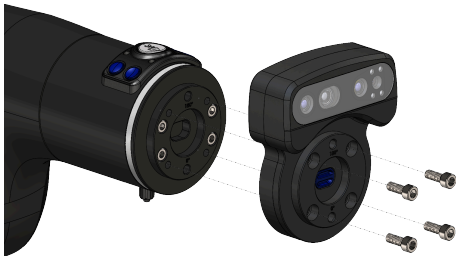


The Vision Module connects to Link 6 using central pogo pin connections.

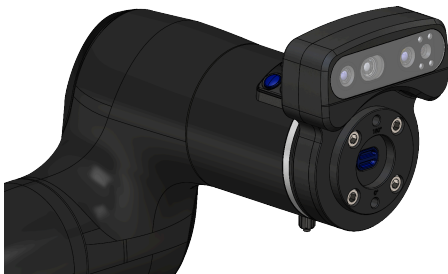
2. Remove the end caps from the Vision Module.



3. Align the four screw holes of the Vision Module with those on the Link 6 flange.



4. Secure the Vision Module with the screws using a fastener torque of 7-9N·m.



Related topics

[Configuring tools](#) on page 80

Mounting the Vision Module on Link 6 with a Robotiq tool

The Vision Module is an optional tool that can be installed on Link 6 with Robotiq tools.

Before you begin

- Make sure you have all the tools and hardware needed to fasten the Kinova Vision Module to Link 6.
- Make sure you have all the tools and hardware needed to fasten the Robotiq tools to Link 6
- Make sure the robot is switched off.

Personnel:

- **Number of Workers:** 1

Supplies

General

- 5.0 mm hex key
- 4 M6x25 - SHCS screws (Kinova part: KR17607)



Note: Torque: 7-9 N·m

- 4 M5x25 - SHCS screws



Note: Torque: 7-9 N·m

Robotiq tools only

- Kinova Robotiq Adapter (only for Robotiq tools)
- O-Ring (Kinova part: KR24183) (only for Robotiq tools)
- Robotiq screws, maximum 8 mm long

About this task

To attach the Vision Module to Link 6 with a Robotiq tool, you must remember to attach the tools in the correct stacking order. The correct stacking order is Link 6, Vision Module, Kinova Robotiq adapter. The Robotiq tool attaches to the Kinova Robotiq adapter.

The Kinova Robotiq adapter has central pogo pins for connections; no external cables are needed.

Procedure

1. Remove the end cap from the wrist of Link 6.



The Vision Module connects to Link 6 using central pogo pin connections.

2. Remove the end caps from the Vision Module.



3. Align the Kinova Robotiq adapter dowel pin to the 0° reference dowel hole on the Vision Module so that the four screw holes align.



The pogo pins on the Kinova Robotiq adapter connect to the central connection on the Vision Module.



Important: Be careful. The Kinova Robotiq adapter and the Vision Module are not secured yet.

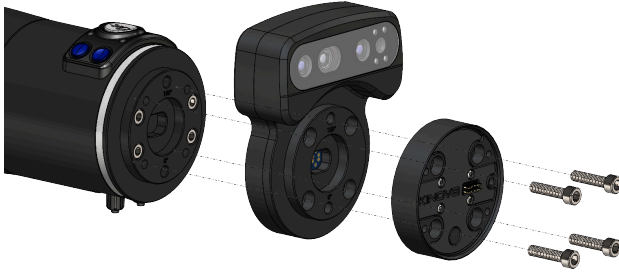
The Vision Module and Kinova Robotiq adapter look like one piece.



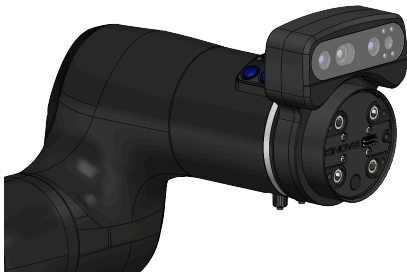
4. Align the four screw holes of the Kinova Robotiq adapter with those on the Link 6 wrist.

When the screw holes of the Kinova Robotiq adapter align with those on the wrist, it implies the screw holes of the Vision Module also align with the holes.

5. Secure the Vision Module with the four M6x25 - SHCS screws using a fastener torque of 7 - 9 N·m.

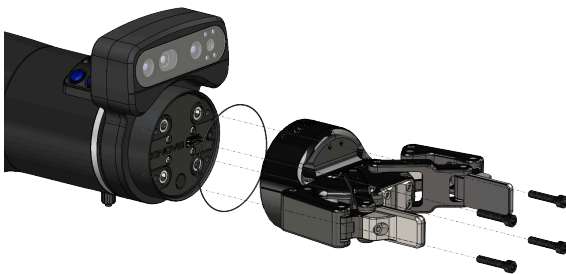


The Link 6, Vision Module, and Kinova Robotiq adapter look like one integrated piece.

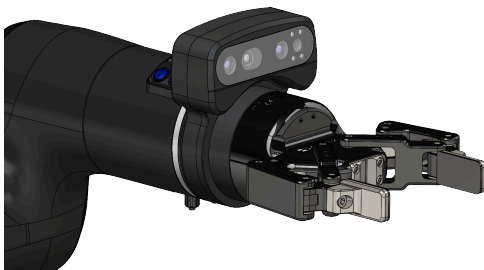


6. Install the Robotiq tool onto the assembly.

! **Important:** To ensure a tight assembly of a Robotiq tool to Link 6 with the Vision Module you must use the O-Ring and the screws that come with the Robotiq tool as long as they are 8 mm long or less.



The Link 6, Vision Module, Kinova Robotiq adapter, and Robotiq tool look like one integrated piece.



Related topics

[Configuring tools](#) on page 80

Mounting the Vision Module on Link 6 with an OnRobot tool

The Vision Module is an optional tool that can be installed on Link 6 with OnRobot tools.

Before you begin

- Make sure you have all the tools and hardware needed to fasten the Kinova Vision Module to Link 6.
- Make sure you have all the tools and hardware needed to fasten the OnRobot tools to Link 6
- Make sure the robot is off.

Personnel:

- **Number of Workers:** 1

Supplies**General**

- 5.0 mm hex key
- 4 M6x25 - Low profile SHCS screws



Note: Torque: 7-9 N·m

OnRobot tools only

- Screws (Kinova part KR26009)

About this task

To attach the Vision Module to Link 6, with a OnRobot tool, you must remember to attach the tools in the correct stacking order. The correct stacking order is Link 6, Vision Module, OnRobot Quick Connect. The OnRobot tool attaches to the OnRobot Quick Connect.

The OnRobot Quick Connect adapter uses external M8 cables to connect.

Procedure

1. Remove the end cap from the wrist of Link 6.



The Vision Module connects to Link 6 using central pogo pin connections.

2. Keep the end cap on the Vision Module.

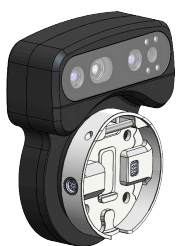


Important: The OnRobot tools connect to Link 6 with an M8 cable; they do not use the central pogo pin connection. To ensure a tight assembly, keep the blue end cap on the Vision Module.

3. Align the OnRobot Quick Connect dowel pin to the 0° reference dowel hole on the Vision Module so that the four screw holes align.

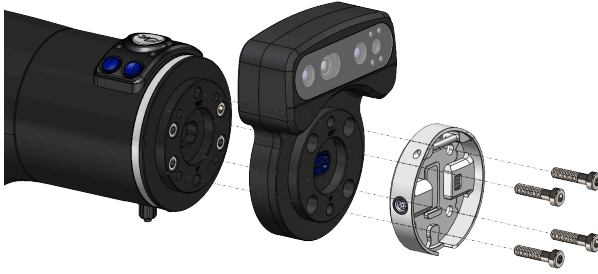


The Vision Module and OnRobot Quick Changer look like one piece.

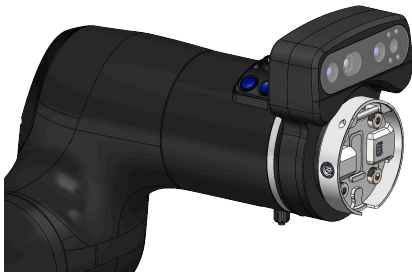


4. Align the four screw holes of the OnRobot Quick Connect with those on the Link 6 wrist.
When the screw holes of the OnRobot Quick Connect align with those on the wrist, it implies the screw holes of the Vision Module also align with the holes.

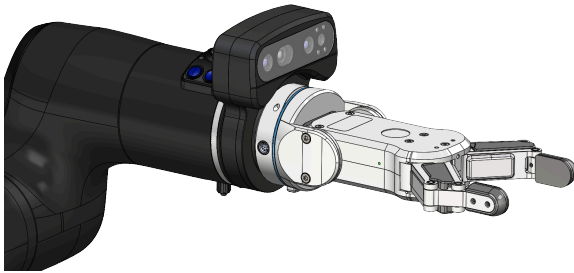
5. Secure the OnRobot tool to the OnRobot Quick Changer with the four Low profile screws, using the 5 mm hex key.



The Link 6, Vision Module, OnRobot Quick Changer, and OnRobot tool look like one integrated piece.



6. Install the OnRobot tool onto the assembly.



Related topics

[Configuring tools](#) on page 80

Getting the plugins for the robot

Upload and installation must be done from the teach pendant and a *USB storage device* connected to the controller or from Kortex Web App running on a computer that has access to the files.

Before you begin

All plugins have dependencies on different aspects of the robot.

Make sure to verify all dependencies before installing the plugin.

About this task

The plugin installation file is named `vision_plugin_<version>.kp`, where `<version>` is the version of the plugin. Contact Kinova to get the appropriate plugin file if you are unsure which files you need.

A computer or *USB storage device* is needed to upload and install the plugin installation file.



Note: Plugins are updated from time to time. Always make sure you have the latest plugin for your installation.



Important: If the plugin is not compatible with the currently running version of Link 6, an error dialog launches.

Procedure

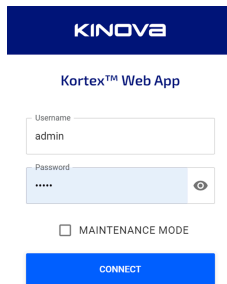
1. Plug the USB storage device on the computer.
2. Download the plugin installation file `vision_plugin_<version>.kp`.
3. Save the plugin installation file in the root directory of the USB storage device.
4. Eject the USB storage device after the transfer of the plugin installation file is complete.
5. Plug the USB storage device on the *controller*.



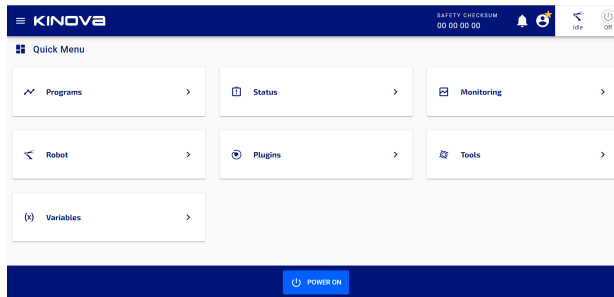
6. Switch on the *teach pendant*.



7. Enter the administrator credentials.



8. Tap **CONNECT**.



9. Tap **POWER ON**.

The arm is switched on.

What to do next

Install the required plugins from the **Plugins** page in *Kortex Web App*.

Related topics

[Installing plugins](#) on page 68

Installing plugins

The Vision Plugin can be installed to work with the Kinova Vision Module or the external Intel RealSense FRAMOS D435e camera.

Before you begin

The plugin files must be on a USB storage device.



Important: The USB must be plugged into the controller when the plugin is being installed on Link 6. Refer to the documentation of other robots for the location of USB connections.

About this task

Access all installed plugins by tapping **Systems > Plugins**.

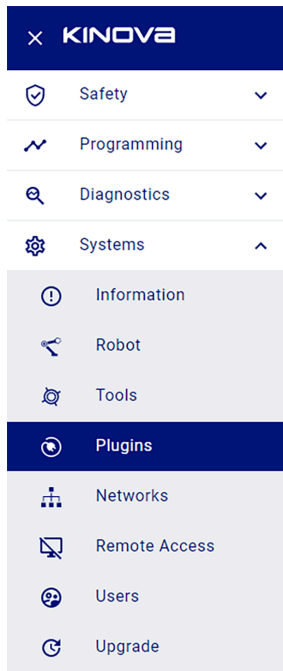
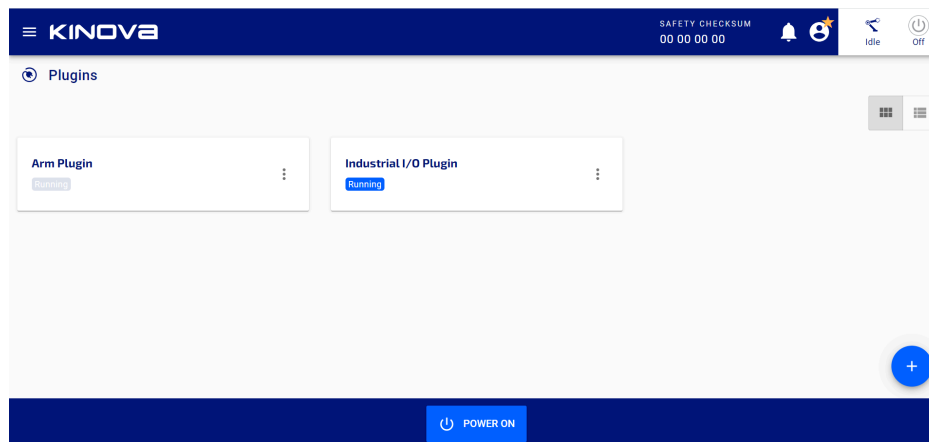


Figure 41: Accessing the plugins

Procedure

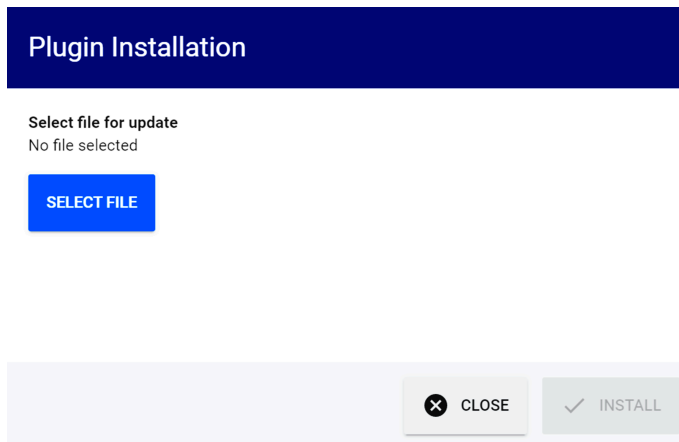
1. Tap **Systems > Plugins**.

The **Plugins** page launches.



2. Tap **+**.

A **Plugin Installation** dialog launches.



3. Tap **SELECT FILE**.

4. Optional: Browse to the plugin installation files.

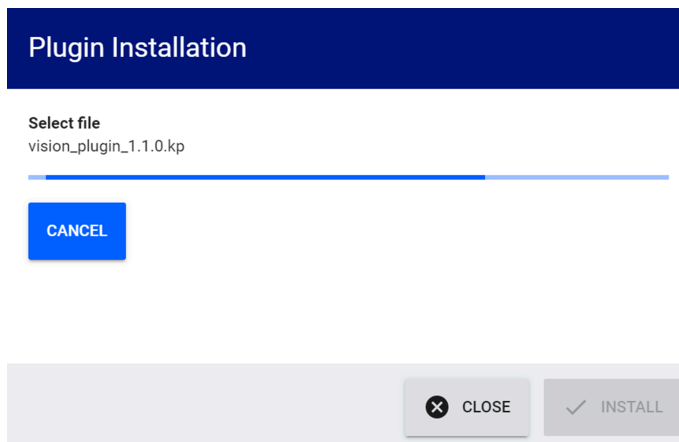
5. Select a plugin installation file.

6. Tap **Open**.

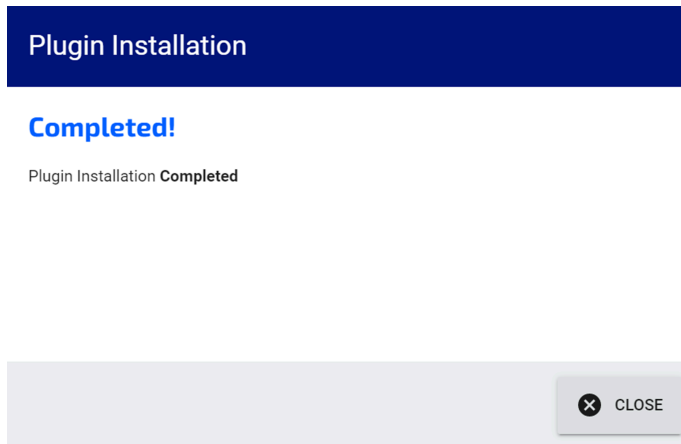
The **Plugin Installation** dialog shows the name of the selected file.

7. Tap **INSTALL**.

The **Plugin Installation** dialog shows that the plugin installation is in progress.

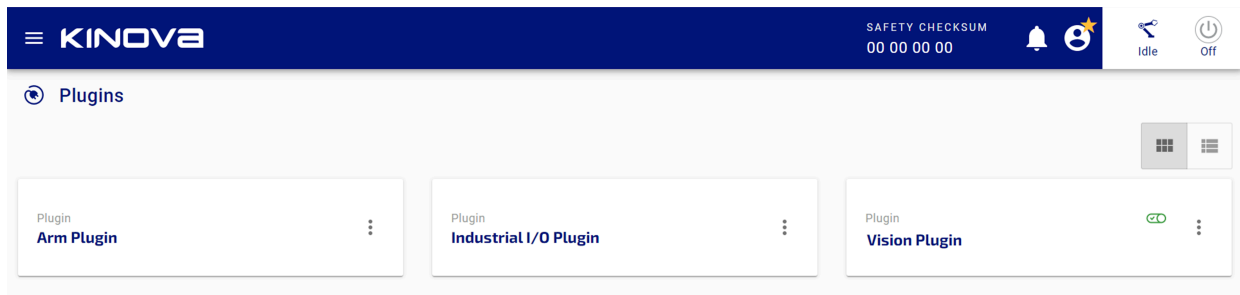


8. Tap **CLOSE** when installation is complete.



Results

The plugin is displayed on the **Plugins** page and is running.

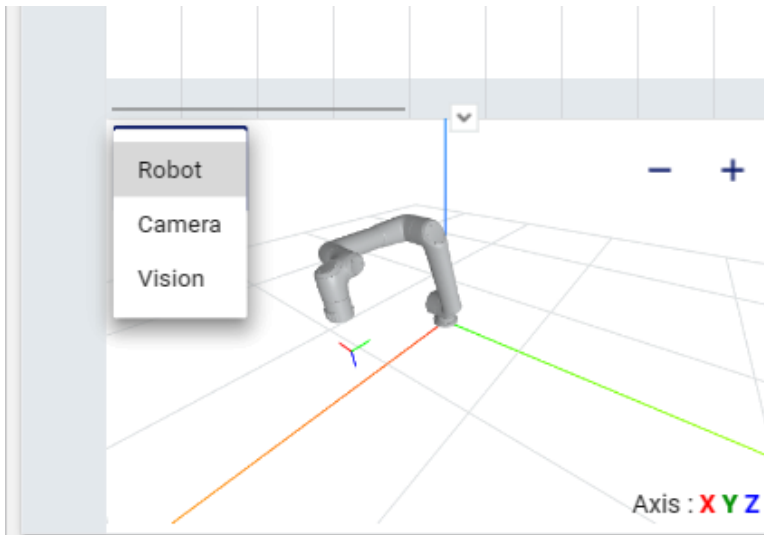


All tools associated with the plugin are added automatically to the **Inactive (drag & drop)** pane on the **Tools** page.

A sample program for calibration is installed automatically on the **Programs** page. Access the **Programs** page by tapping **Programming > Programs**.

The **Visualization** pane on the **Program** page has two more visualization objects available.

- **Camera**
 - Outputs the view from the camera in the **Visualization** pane
- **Vision:**
 - Outputs the view after a vision job action is performed



Related topics

[Getting the plugins for the robot](#) on page 66

[Mounting the Vision Module on Link 6](#) on page 58

[Mounting the Vision Module on Link 6 with a Robotiq tool](#) on page 59

[Mounting the Vision Module on Link 6 with an OnRobot tool](#) on page 63

Updating plugins

Integrate improvements to the plugins by updating them.

Before you begin

Download the latest version of the plugin. Contact Kinova to get the appropriate plugin file if you are unsure which files you need.



CAUTION: Take note of every customized configuration you created with respect to the Vision Plugin; the configuration of the actions and the camera cannot be saved and cannot be restored after an upgrade.

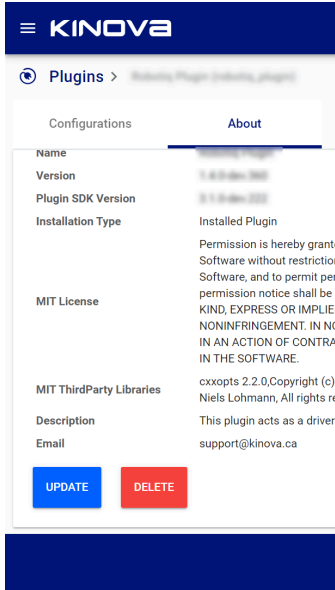
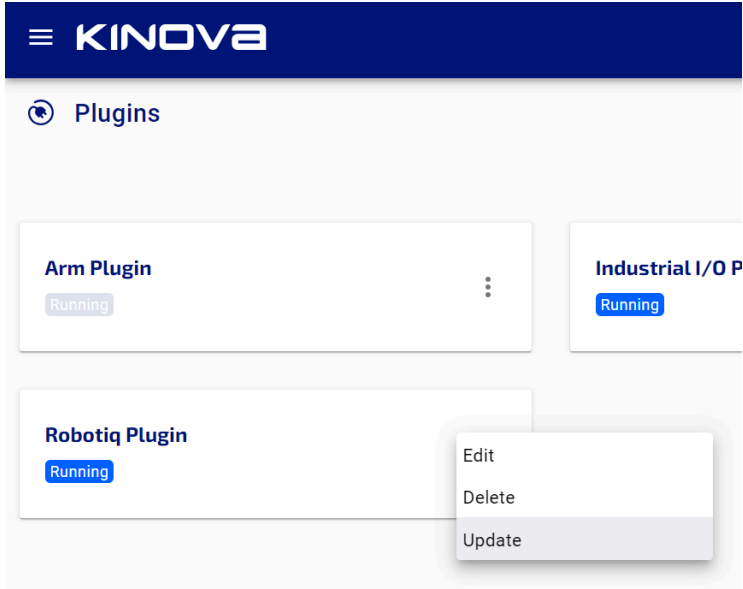
About this task

Use a computer or a [teach pendant](#). Update plugins directly from the **Plugins** page or from the **About** page of the plugin.

Procedure

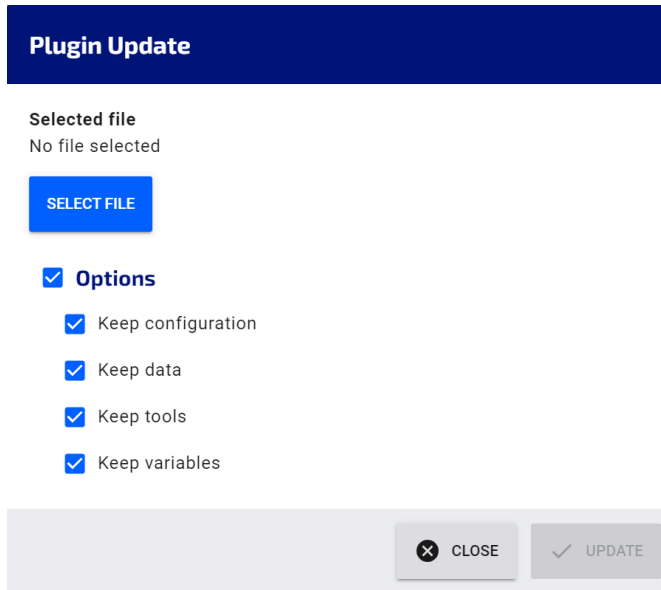
1. Get the latest version of the plugin.
2. Tap **Systems** > **Plugins**.
3. Tap the plugin that you want to update.

4. Access the update dialog in one of two ways.

Option	Description
Update from the About page of the plugin	a. Tap About. The About page launches. 
Update from the Plugins page	a. Navigate back to the Plugins page. b. Tap the <i>kebab menu</i> (⋮) of the plugin that you want to update. 

5. Tap **Update**.

The **Plugin Update** dialog launches.

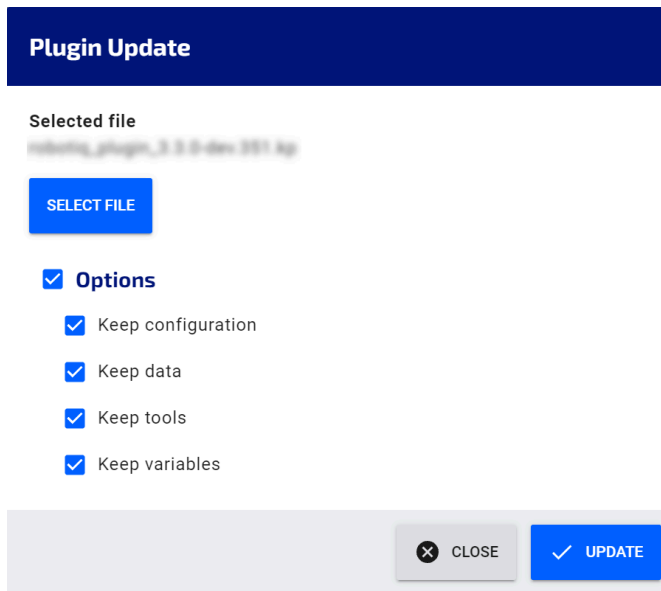


The screenshot shows the 'Plugin Update' dialog. At the top is a dark blue header with the text 'Plugin Update'. Below it, the text 'Selected file' is followed by 'No file selected'. A blue button labeled 'SELECT FILE' is positioned below this. Underneath is a section titled 'Options' with a checked checkbox. Below 'Options' are four items, each with a checked checkbox: 'Keep configuration', 'Keep data', 'Keep tools', and 'Keep variables'. At the bottom right, there are two buttons: 'CLOSE' with a close icon and 'UPDATE' with a checkmark icon.

6. Tap **SELECT FILE**.

7. Select the plugin file.

The name of the file is displayed as the **Selected file**.



This screenshot shows the 'Plugin Update' dialog after a file has been selected. The 'Selected file' section now displays the text 'robotics_plugin_3.3.0-dev 2021.kp'. The 'SELECT FILE' button remains. The 'Options' section and its four checked items are identical to the previous screenshot. In this state, the 'UPDATE' button at the bottom right is highlighted in blue, while the 'CLOSE' button remains grey.

8. Tap **Options**.

By default, all data is selected. Deselect any information you want to ignore. Data that can be saved include the configuration, data, tools, and variables.

9. Select the type of data you want to keep from the current plugin.

10. Tap UPDATE.

The **Plugin Update** indicates that the plugin is updated.

**11. Tap CLOSE.**

The **Plugin Update** dialog closes.

Related topics

[Getting the plugins for the robot](#) on page 66

Activating plugins

When a plugin is installed, but does not appear in the **Action** menu on the **Program** page, the plugin is deactivated. Activate the plugin to use the actions of the plugin.

Before you begin

The plugin must be installed on the robot. The plugin must be deactivated.

About this task

The actions associated with Vision Plugin are available on the **Programs** page only when the plugin is activated.

Procedure

1. Tap **Vision Plugin** on the **Plugins** page.
 - The **Configurations** page of the **Vision Plugin** launches.
 - No **Vision Plugin** actions are in the **Action** menu on the Action **Program** page.
2. Tap **Active** to activate the plugin.

Results

- **Active** is blue.
- **Stop** is available to stop the plugin before deactivating it.



- The status of the **Vision Plugin** changes to **Running** on the **Plugins** page.
- **Vision Plugin** actions appear under **Action** on the **Action Program** page.

What to do next

Create a program with Vision actions.

Deactivating plugins

When the actions associated with a plugin are not needed in the program, deactivate the plugin without uninstalling it.

Before you begin

The plugin must be installed on the robot and must be active.

About this task

The actions associated with Vision Plugin are available on the **Programs** page.

Procedure

1. Tap **Vision Plugin** on the **Plugins** page.
 - The **Configurations** page of the **Vision Plugin** launches.
 - **Vision Plugin** actions appear under the **Action** menu on the **Program** page.
2. Tap **Inactive** to deactivate the plugin.

Results

- The toggle is white and is closest to **Inactive**.
- **Stop** is not available to stop the plugin.



- The **Vision Plugin** button on the **Plugins** page changes its appearance to indicate that the plugin is not active.
- **Vision Plugin** does not appear in the Plugins **Action** menu on the **Program** page.

Registering the camera

Before using the Vision Module or RealSense camera with the Vision Plugin, you must register the camera.

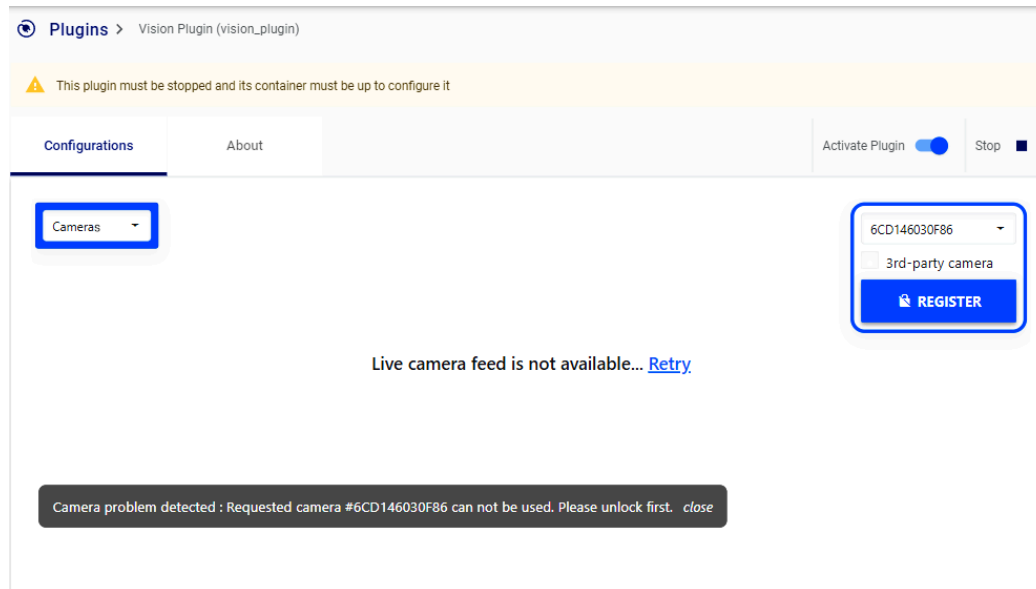
About this task

Camera refers to the RealSense camera as well as the Vision Module.

The camera can be used only after its license is registered. When a camera is registered, it is considered to be *unlocked*. Registration of the installed camera needs to be done only once.

To access the **Configurations** page, tap **Plugins > Vision Plugin**.

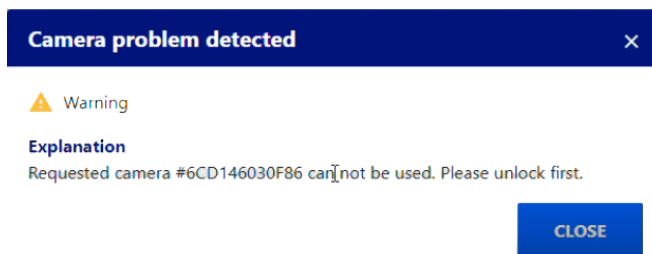
Figure 42: Configurations page of the Vision Plugin



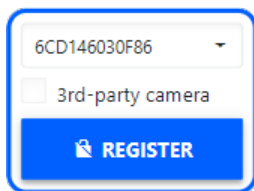
The message **Camera problem detected** is displayed when the camera that is installed is not registered.

Procedure

1. Switch on the camera.
The plugin can detect the camera only when the camera is on.
2. Take note of the MAC address of the Vision Module.
The MAC address is on a label on the Vision Module.
3. Tap **Systems > Plugins > Vision Plugin**.
The **Configurations** page launches.
4. Tap **Cameras**.
5. Select the camera from the list of cameras.
When the selected camera is not yet registered, an error dialog launches.

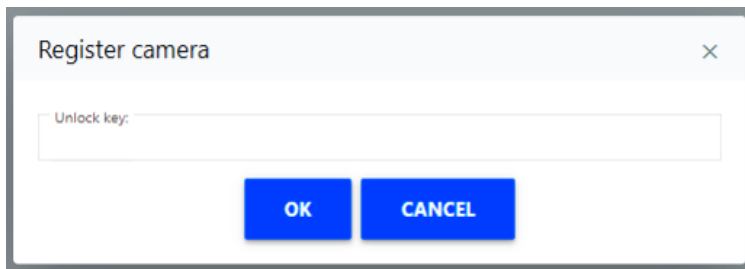


6. Tap **3rd-party camera** when the camera is not a Vision Module.



7. Tap **REGISTER**.

A **Register camera** dialog launches.



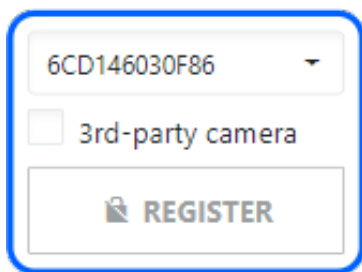
8. Enter the access code you received from Kinova.



Note: If you cannot find your access code or are using a 3rd party camera, contact Kinova support with your MAC address.

9. Tap **OK**.

The **REGISTER** button is grayed out.



The **Action, Message, and Visualization Configuration** area launches the view from the camera.

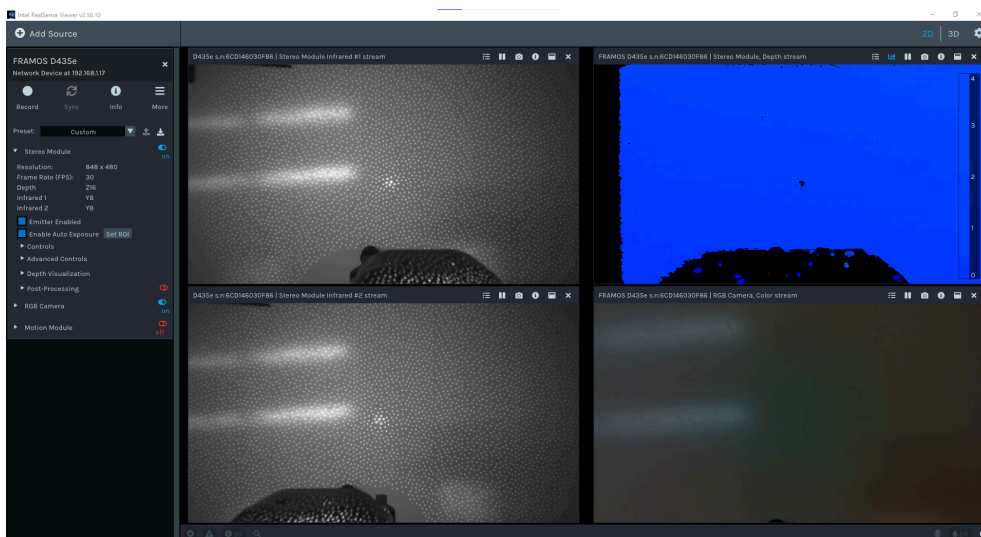


Figure 43: RealSense camera view

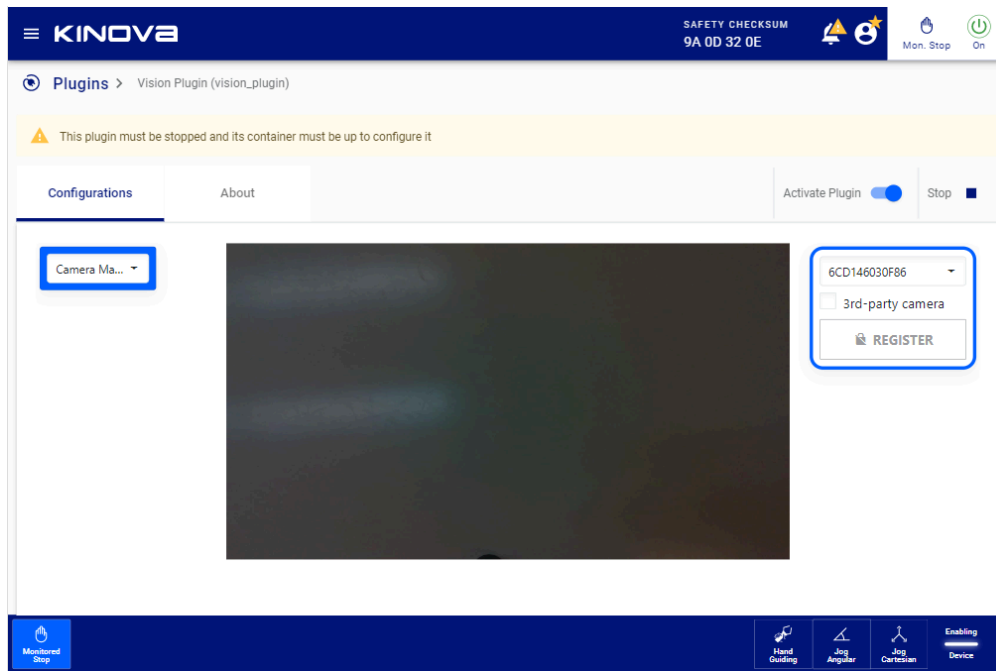


Figure 44: Vision Module camera view

Related topics

[Overview of working with plugins](#) on page 8

Configuring tools

An *end effector* tool that is associated with the *plugin* can be configured even if the corresponding tool is not mounted on the robot, as long as its corresponding plugin is installed.

About this task

A single plugin can communicate with multiple end effector models. Therefore, it is necessary to configure the properties of the tool currently installed on the robot. The associated tool plugin may populate the **Tools** page with tools.



Tip: Before you can edit the active tools, the robot must be switched on and it must be in Monitored Stop.

All tool configuration tasks are accessed by tapping **Systems > Tools**.

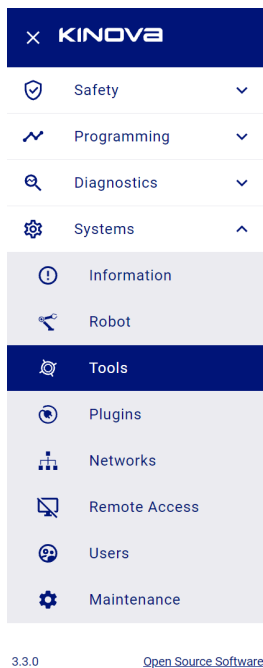
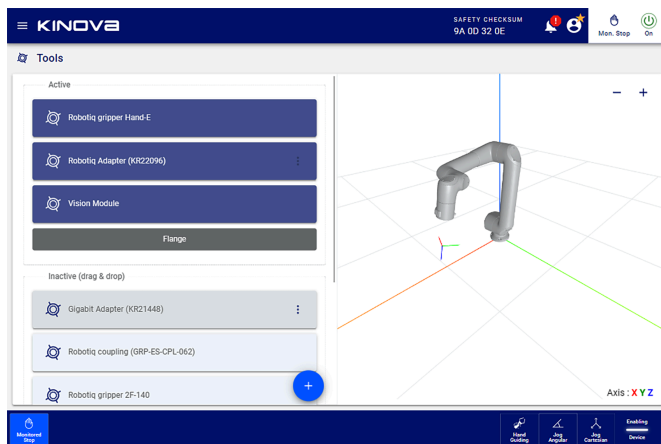


Figure 45: Accessing tool configuration operations

Procedure

1. Tap **Systems > Tools**.

The **Tools** page launches.

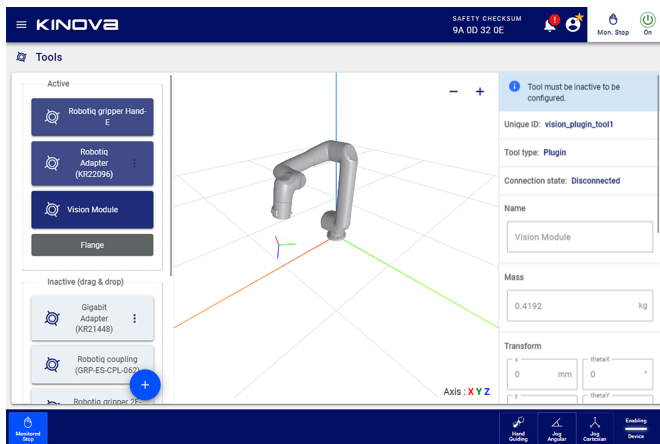


The tools are listed on the left side in two groupings: **Active** and **Inactive (drag & drop)**. The **flange** is always listed in the **Active** tools list because all tools are attached to it.

The center is a 3D view of the arm that can be moved around to help you visualize the tool reference frame. Tap **+** or **-** to zoom in or out. Hold and move the view around to have different viewpoints of the robot.

2. Select a tool in the **Inactive (drag & drop)** pane.

The properties of the selected tool are displayed on the right.



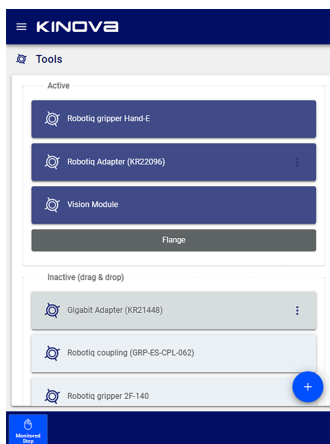
3. Modify the values in the **Properties** panel.



Note: Configure the tools only when they are still in the **Inactive (drag & drop)** pane.

4. Drag each tool in the order they are assembled onto the flange of the *wrist*.

Example: The Kinova Vision Module or FRAMOS D435e module is already on the wrist. Drag the Vision Module or camera from the **Inactive (drag & drop)** pane to the **Active** pane, placing it directly above the flange. Place additional tools on top of the camera module in the same order they are physically installed.



Related topics

[Tool configuration fields](#) on page 10

Camera calibrations

Tasks that require vision work well only when the camera installed on Link 6 is calibrated.

There are a few approaches to calibrating the camera.

- Use the **Robot-Camera Calibration** program that comes with the Vision Plugin.
- Create your own **Robot-Camera Calibration** program.

Calibrating the camera with the default program

The fastest way to get the camera calibrated with the Link 6 is to use the program **Robot-Camera Calibration** that comes with the Vision Plugin.

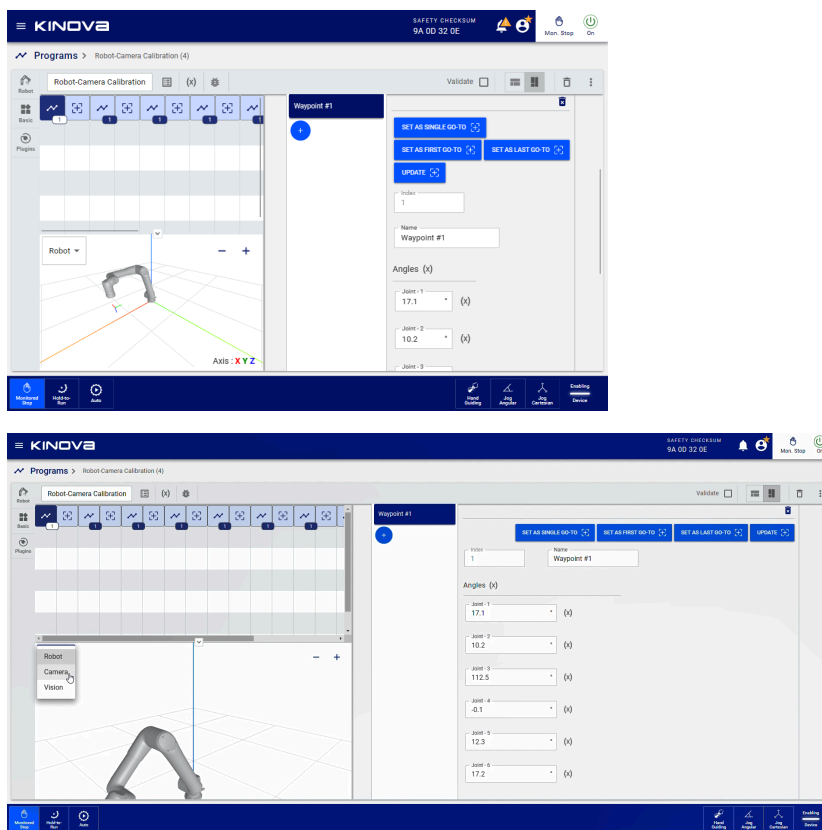
About this task

The default calibration program that comes with the plugin is a sequence of nine waypoint actions. In between each waypoint action a **Calibration Snapshot** action is used to take a picture. The final action is **Robot-Camera Calibration**.

Procedure

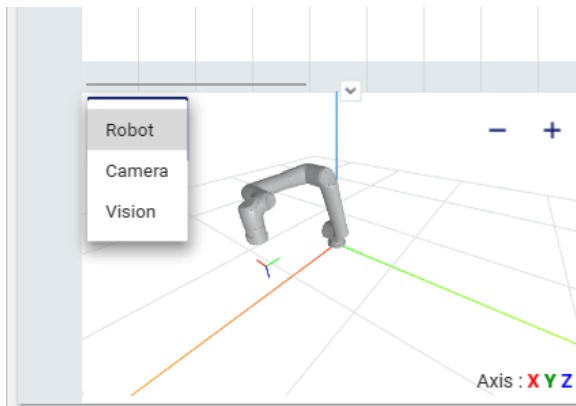
1. Place the calibration plate on the surface where the object is going to be located.
2. Tap **Programming > Programs > Robot-Camera Calibration**.

The **Program** page launches with the **Robot-Camera Calibration** program. The actions required for the calibration are in the **Sequence editor**.

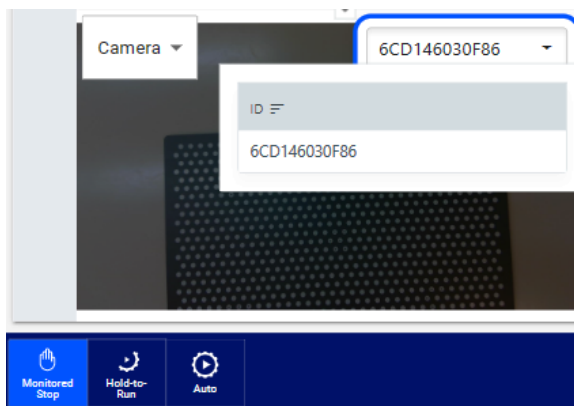


Note: The program is made of the **Calibration Snapshot** action taken on nine different waypoints. It ends with **Robot-Camera Calibration** action.

3. Select **Camera** from the list of visualization objects in the **Visualization** pane.

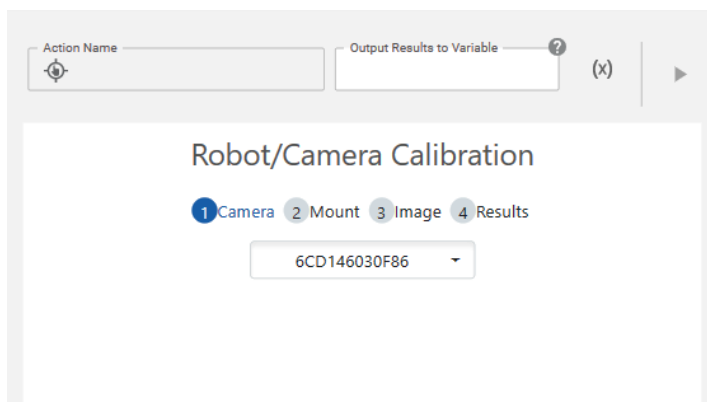


4. Select the camera that is installed on Link 6.
A live feed coming from the selected camera is displayed in the **Visualization** pane.



Tip: It is recommended to make sure that the calibration plate is completely visible in the **Visualization** pane; when the plate is completely visible, there are fewer problems calibrating the camera.

5. Scroll to the end of the program and tap the **Robot-Camera Calibration**.
The **Robot/Camera Calibration** launches in the **Tile configuration** pane.

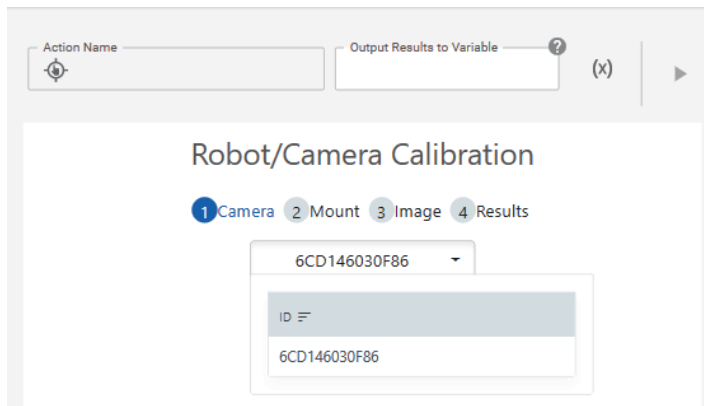


Tip: If the camera is not registered, a message launches in the **Robot/Camera Calibration** wizard.

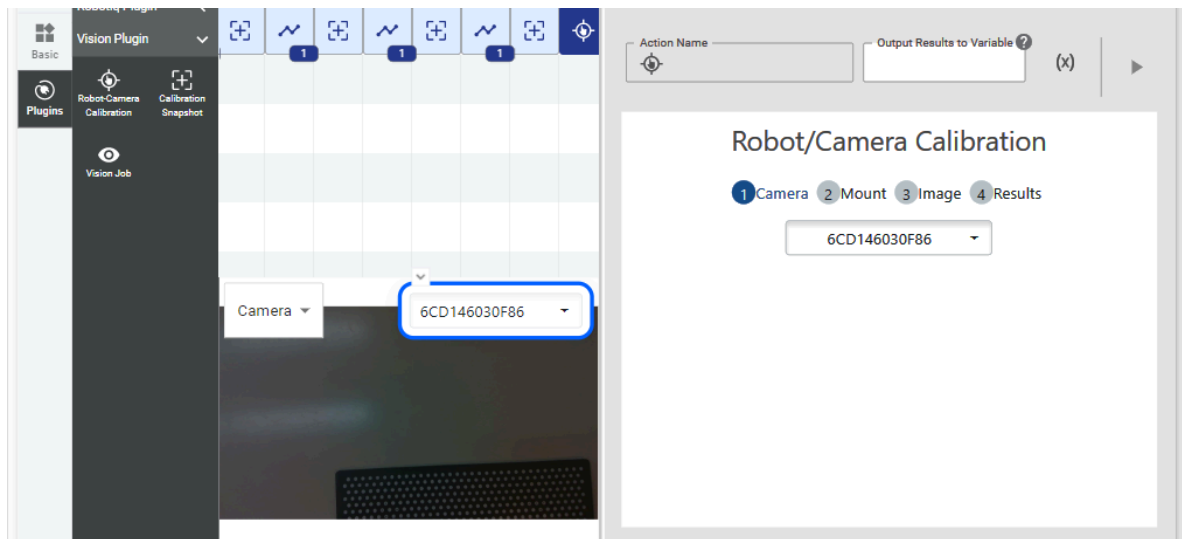
Please unlock and register your camera.

Go to the **Configurations** page and register the camera.

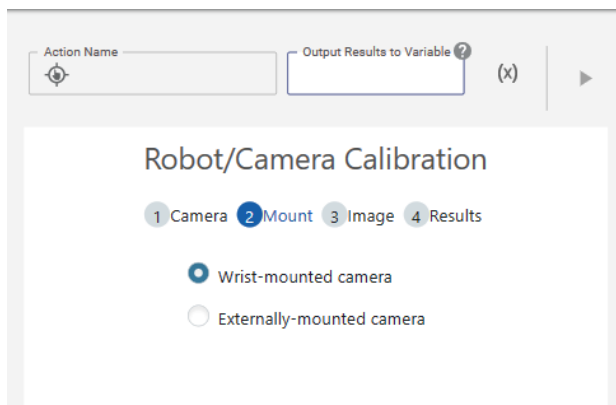
6. Select the camera that has the same identification as the one installed on the robot.



The camera listed in the **Visualization** pane is the same as the camera that is selected.



7. Tap **Mount**.

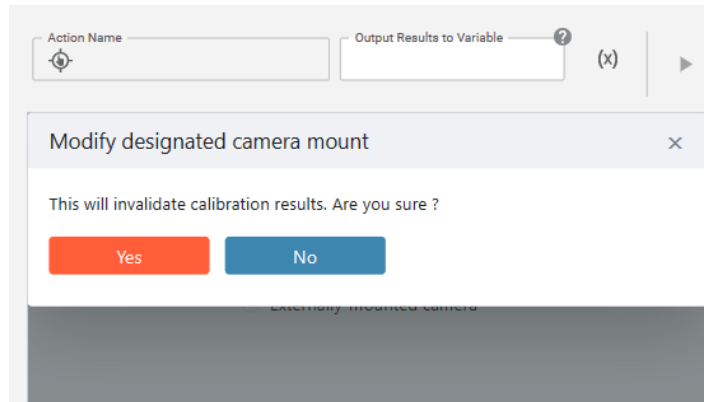


8. Select how the camera is installed.

- **Wrist-mounted camera**
- **Externally-mounted camera**



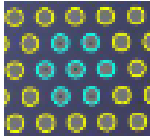
Important: When the camera mount is changed from the previous value, a warning dialog launches; the camera must be recalibrated.



9. Tap **Image**.

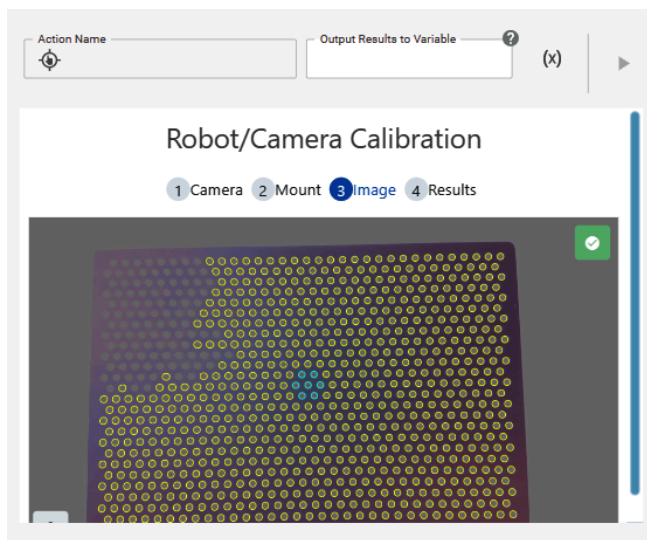
The cluster of five blue circles can be in any of the corners or in the center of the **Camera viewer**. The blue circles are visual guidelines for the camera and are called anchor points.

The Vision Module uses one of these clusters to determine the orientation of the calibration plate so the module can be calibrated.

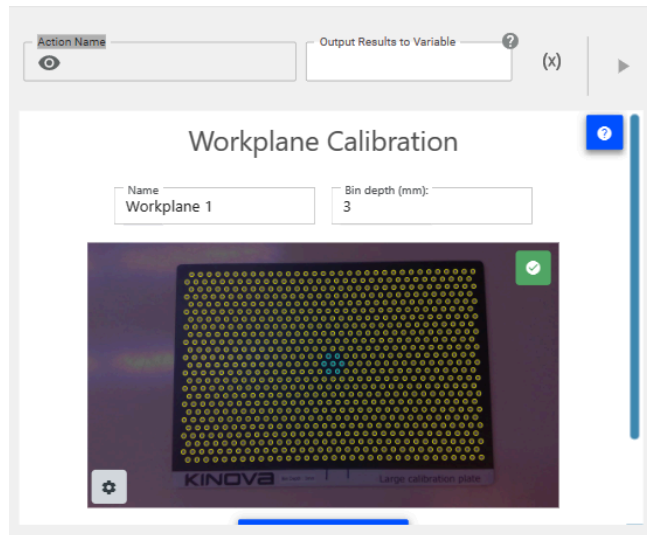


When no cluster of blue dots are detected, there is a significant number of missing yellow dots; the camera parameters must be adjusted.

When there is at least one cluster of blue circles in the **Camera viewer** and a section of the calibration is blurred out, or missing a significant number of yellow dots, adjust the camera parameters to improve the vision of the camera.



Tip: Try to have no blurry sections of the calibration plate in the **Camera viewer** for best results.

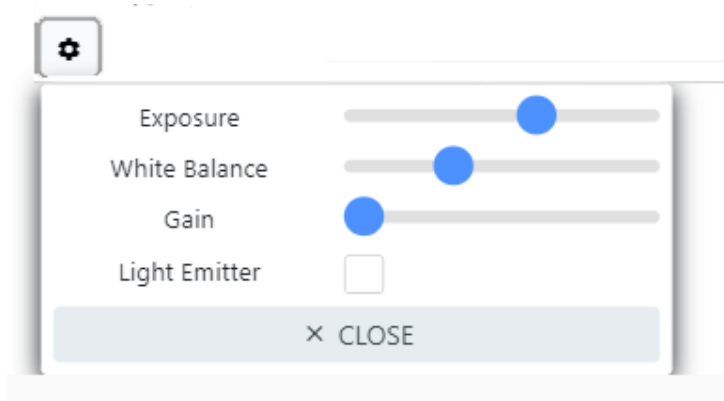


10. Tap the cog (⚙️) to make sure the calibration plate has the proper exposure by adjusting the camera parameters.



Note: Proper exposure implies the pattern visibility is near 100% and there are no significant blurs in the image.

A dialog launches with the modifiable camera parameters.



11. Enable **Light Emitter** when the environment is dark and detection requires the camera to emit light.
12. Adjust the **Exposure**, **White Balance**, **Gain** until the image is as clear as it can be in the **Camera viewer**.
13. Tap Hold-to-Run.
The Program play area launches.
14. Tap **Play** (▶️).
The program runs and tries to calibrate the camera.
15. Tap the **Robot-Camera Calibration** action tile at the end of the program.

16. Tap **Results** to view the success of the calibration.



Tip: When the default program is used for calibration, **Status** is always a check mark and **Number of Samples** is always 0.

Example: Failed calibration

1 Camera 2 Mount 3 Image 4 Results	
Status	✓
Number of Samples	0
Camera Calibration Error	0.37
Translation RMS Error	0.35 mm
Rotation RMS Error	0.07 degrees
Maximum Translation Error	0.54 mm
Maximum Rotation Error	0.10 degrees
Marks distribution score	0 %
Tilt angles score	0 %

Example: Successful calibration

1 Camera 2 Mount 3 Image 4 Results	
Status	✓
Number of Samples	9
Camera Calibration Error	0.34
Translation RMS Error	0.20 mm
Rotation RMS Error	0.07 degrees
Maximum Translation Error	0.33 mm
Maximum Rotation Error	0.11 degrees
Marks distribution score	100 %
Tilt angles score	100 %

17. Adjust the camera calibration if you do not have the desired results.



Important: Pay close attention to the calibration values listed. **Marks distribution score** must be at least 80%.

Results

The camera is calibrated with the robot.

Related topics

[Robot-Camera Calibration program](#) on page 14

Calibrating the camera with your own calibration program

Cameras that are not the default camera must be calibrated to work with Link 6.

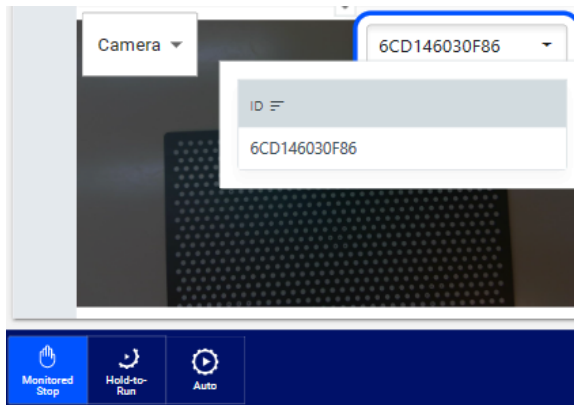
About this task

Use the **Robot-Camera Calibration** and **Calibration Snapshot** actions to calibrate a camera.

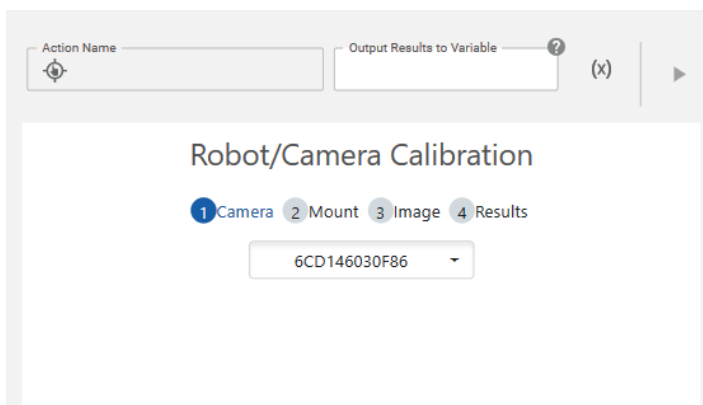
Procedure

1. Select **Camera** in the **Visualization** pane.
2. Select the camera that is installed on Link 6 and is in the camera listing in the **Visualization** pane.

A live feed coming from the selected camera is displayed in the **Visualization** pane.



3. Drag the **Robot-Camera Calibration** action into the **Sequence editor**.
The **Robot/Camera Calibration** launches in the **Tile configuration** pane.



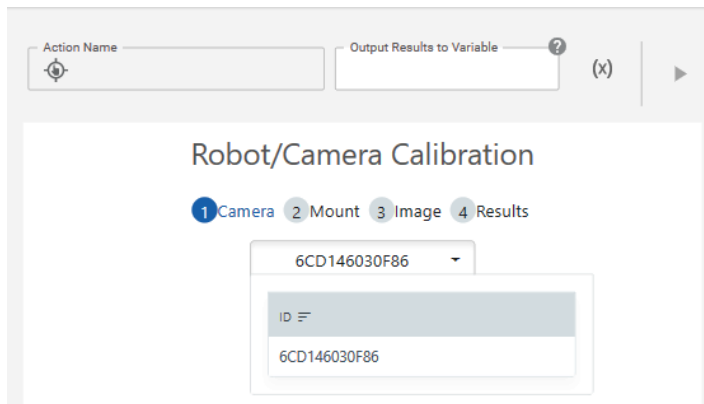
Tip: If the camera is not registered, a message launches in the **Robot/Camera Calibration** wizard.

Please unlock and register your camera.

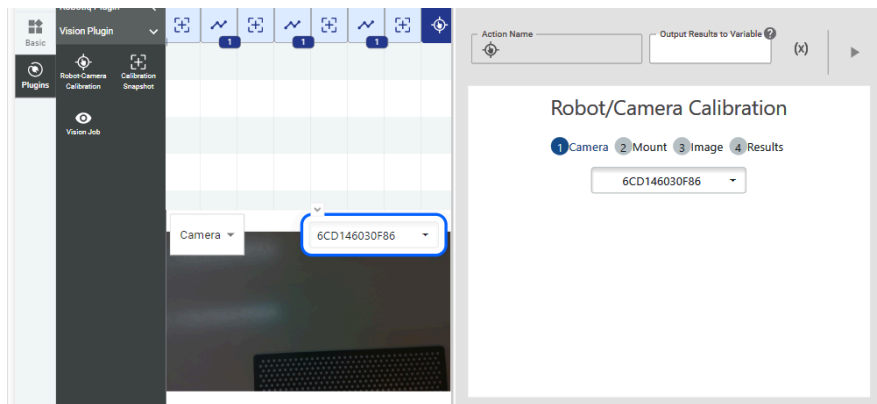
Go to the **Configurations** page and register the camera.

4. Select the camera that is installed on Link 6 in the **Robot/Camera Calibration** wizard.

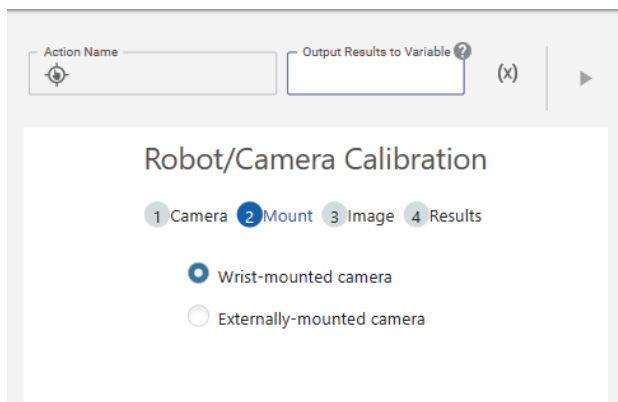
The camera must have the same identification as the one installed on the robot.



The camera listed in the **Visualization** pane is the same as the camera that is selected.



5. Tap **Mount**.

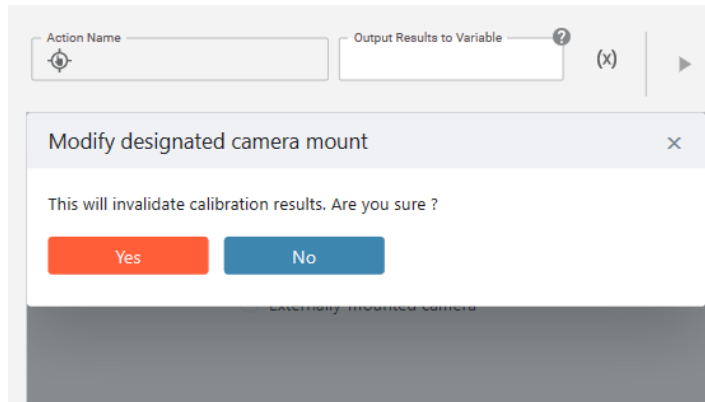


6. Select how the camera is installed.

- **Wrist-mounted camera**
- **Externally-mounted camera**



Important: When the camera mount is changed from the previous value, a warning dialog launches; the camera must be recalibrated.

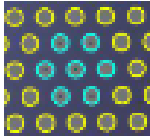


7. Place a calibration plate on the workplane.

8. Tap **Image**.

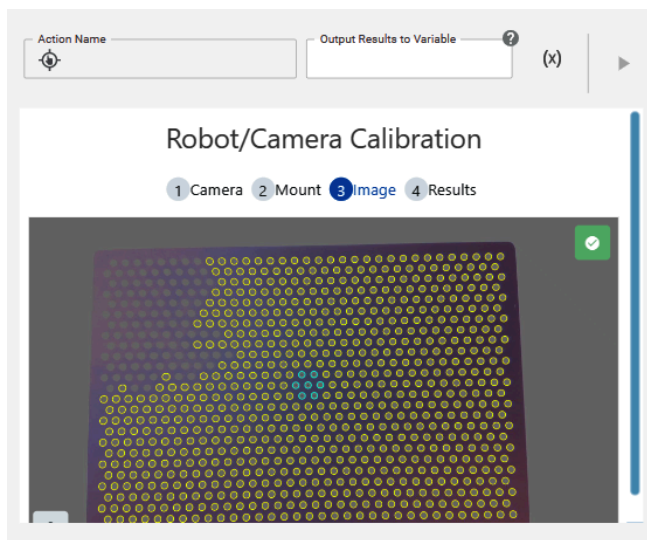
The cluster of five blue circles can be in any of the corners or in the center of the **Camera viewer**. The blue circles are visual guidelines for the camera and are called anchor points.

The Vision Module uses one of these clusters to determine the orientation of the calibration plate so the module can be calibrated.

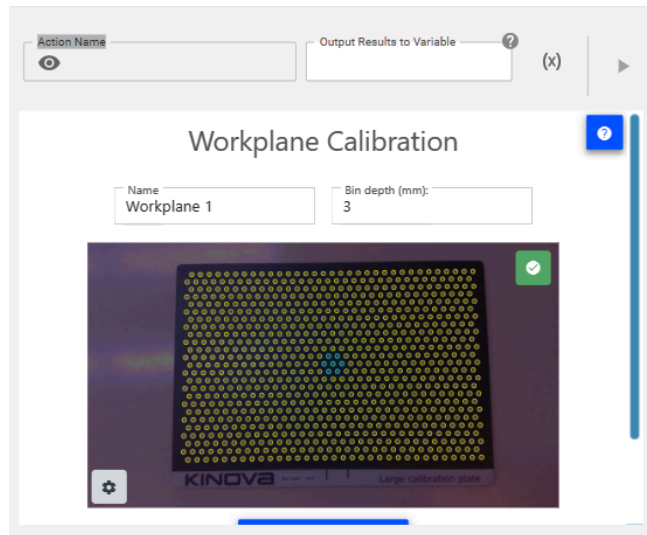


When no cluster of blue dots are detected, there is a significant number of missing yellow dots; the camera parameters must be adjusted.

When there is at least one cluster of blue circles in the **Camera viewer** and a section of the calibration is blurred out, or missing a significant number of yellow dots, adjust the camera parameters to improve the vision of the camera.



Tip: Try to have no blurry sections of the calibration plate in the **Camera viewer** for best results.



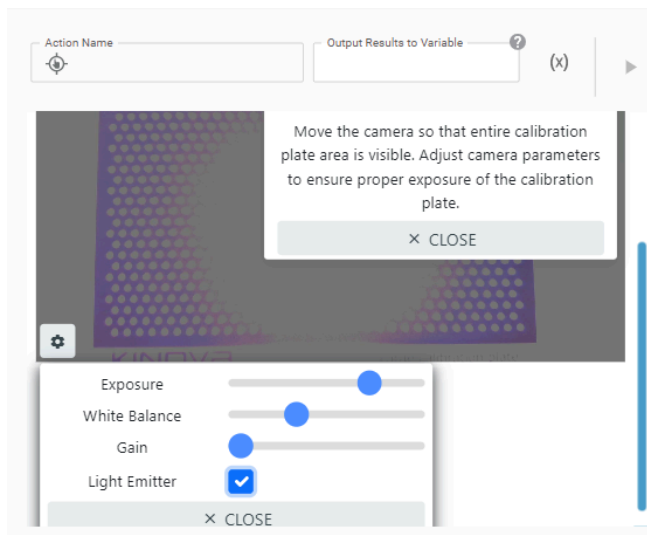
9. Move the camera to capture the entire calibration plate in the **Camera viewer**.



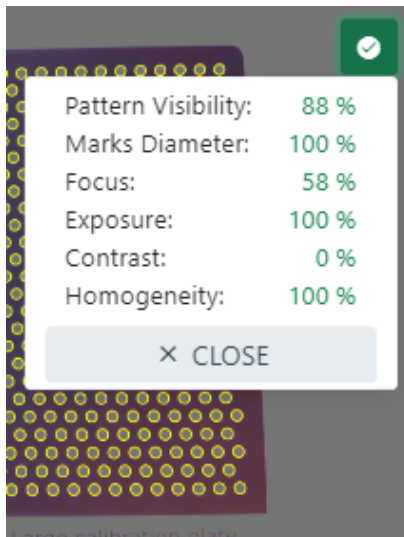
Important: The entire calibration plate must be visible to the camera to have an accurate camera calibration.



Note: An error dialog launches when the calibration plate is not completely visible.



10. Tap the camera calibration results icon (📌) to view the current camera calibrations.

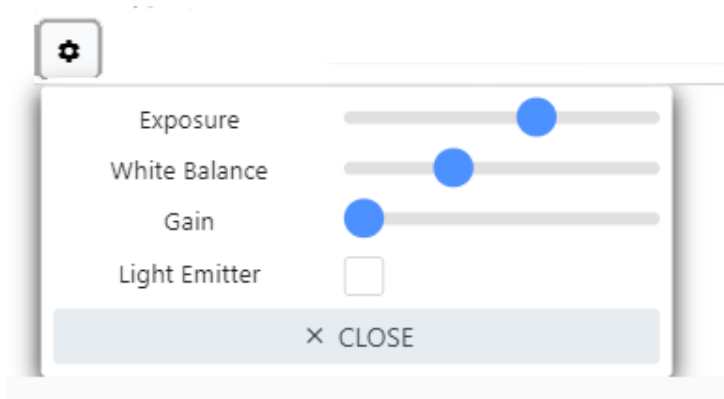


11. Tap the cog (⚙️) to make sure the calibration plate has the proper exposure by adjusting the camera parameters.



Note: Proper exposure implies the pattern visibility is near 100% and there are no significant blurs in the image.

A dialog launches with the modifiable camera parameters.



12. Enable **Light Emitter** when the environment is dark and detection requires the camera to emit light.
13. Adjust the **Exposure**, **White Balance**, **Gain** until the image is as clear as it can be in the **Camera viewer**.
14. Tap Hold-to-Run.
The Program play area launches.
15. Tap **Play** (▶️).
The program runs and tries to calibrate the camera.

16. Drag the **Calibration Snapshot** action into the **Sequence editor** along with waypoints between each **Calibration Snapshot**.

The last action must be the **Calibration Snapshot**.

17. Tap **Results** to view the success of the calibration.

Example: Failed calibration

Robot/Camera Calibration	
1 Camera 2 Mount 3 Image 4 Results	
Status	❌
Number of Samples	9
Camera Calibration Error	0.00
Translation RMS Error	0.00 mm
Rotation RMS Error	0.00 degrees
Maximum Translation Error	0.00 mm
Maximum Rotation Error	0.00 degrees
Marks distribution score	70 %
Tilt angles score	100 %

Example: Successful calibration

Action Name	Output Results to Variable	?	(x)	▶
1 Camera 2 Mount 3 Image 4 Results				
Status	✅			
Number of Samples	9			
Camera Calibration Error	0.34			
Translation RMS Error	0.20 mm			
Rotation RMS Error	0.07 degrees			
Maximum Translation Error	0.33 mm			
Maximum Rotation Error	0.11 degrees			
Marks distribution score	100 %			
Tilt angles score	100 %			

18. Adjust the camera calibration if you do not have the desired results.



Important: Pay close attention to the calibration values listed. **Number of Samples** must be at least 5. **Marks distribution score** must be at least 80%.

Creating a Vision Job

A Vision Job is used for detecting objects.

About this task

When the **Vision Job** is dragged into the **Sequence editor**, its parameters are launched in the **Tile configuration** pane as a series of wizards. Each wizard is divided into subsequent steps visible through breadcrumbs.

There is one exception: **Working Zone**. It can be thought of as a wizard of one breadcrumb.

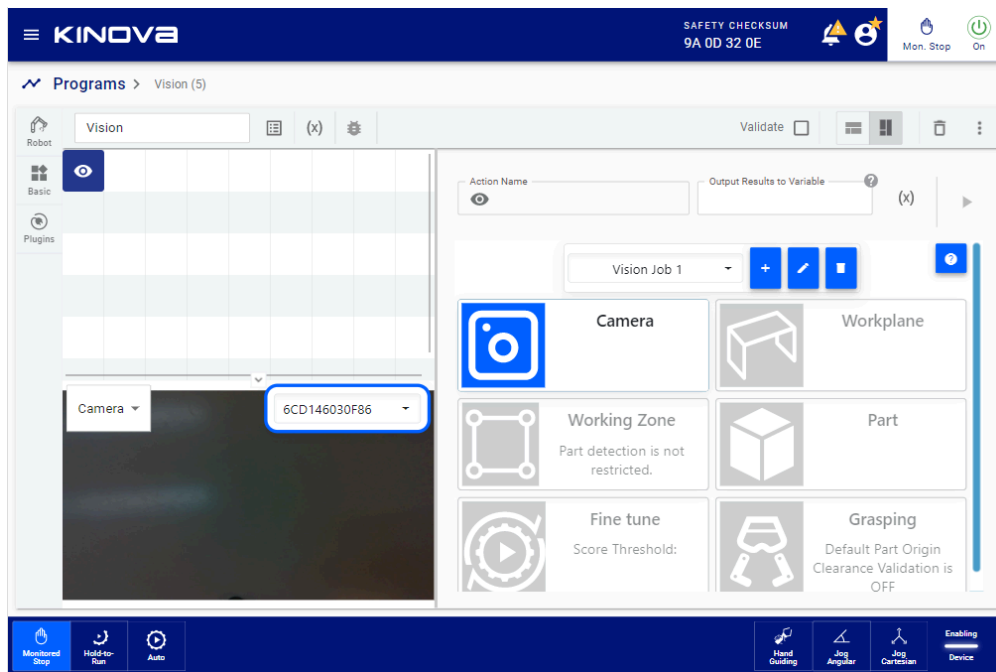


Figure 46: Initial view of the Vision Job parameters when the action is dragged into the Sequence editor

i **Tip:** After selecting or configuring a set of **Vision Job** parameters, tap **OK** to return to the list of general parameters of the **Vision Job** action. The next wizard to use becomes available for selection.

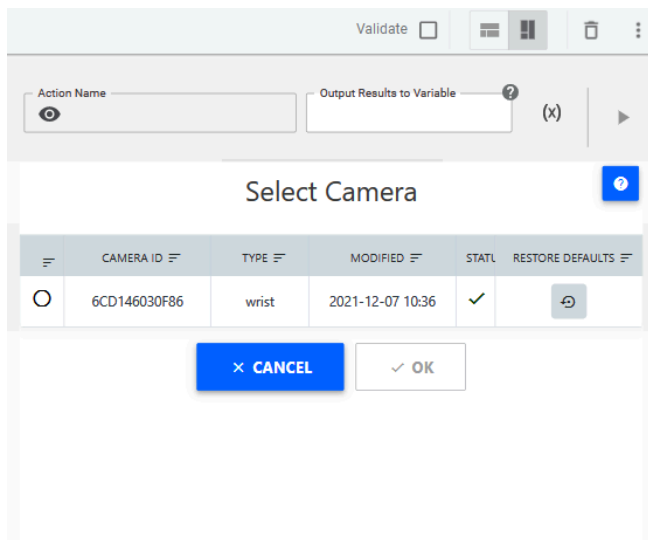
Procedure

1. Tap **Create** (👉) to create a vision job.

i **Tip:** By default, each **Vision Job** is named sequentially as Vision Job 1, Vision Job 2, and so on. Tap **Modify** (✎) to change the name of the Vision Job to something more meaningful.

2. Tap **Camera**.

Select Camera launches in the **Tile configuration** pane.



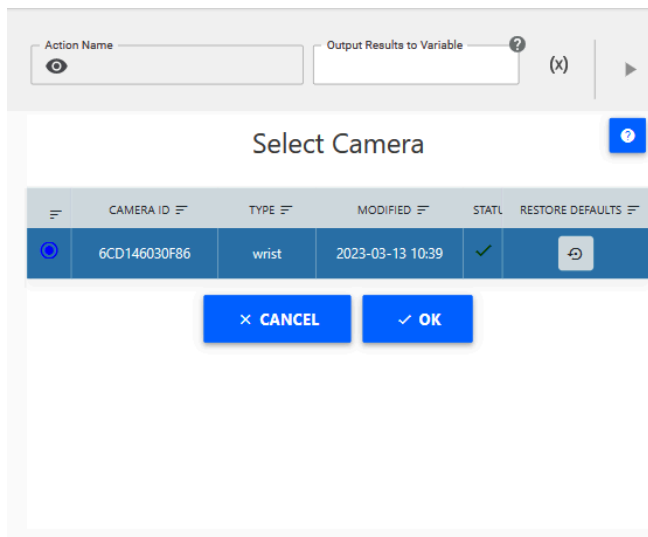
3. Select the camera that is going to be used for the **Vision Job** action.



Tip: Choose a camera that is installed and calibrated.

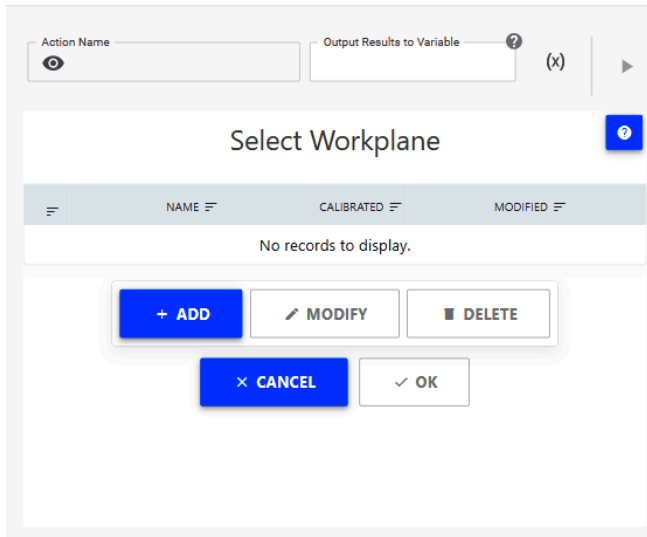


Tip: If the installed camera is not calibrated, calibrate the camera.



4. Tap **Workplane**.

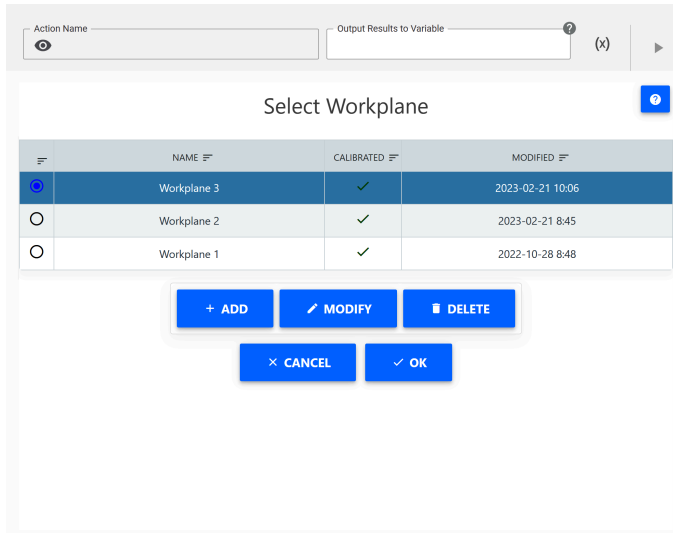
The **Select Workplane** wizard launches **Tile configuration** pane.



Tip: If there are no workplanes listed, create a workplane.

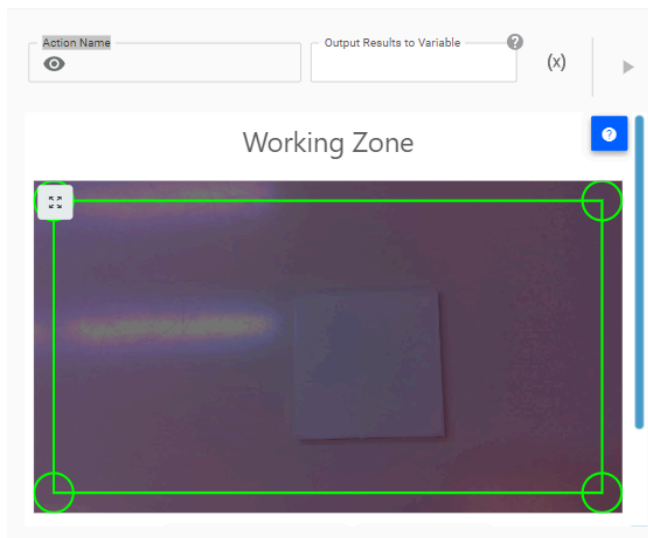
5. Select the workplane.

The **Select Workplane** wizard launches in the **Tile configuration** pane.



6. Optional: Tap **Working Zone**.

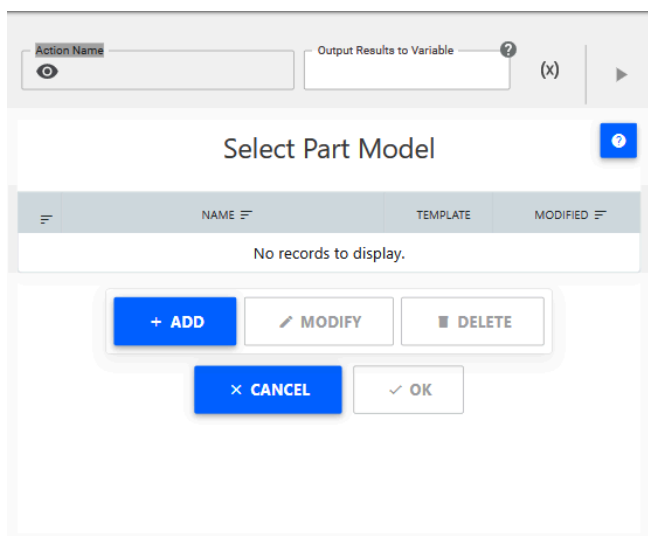
The **Working Zone** wizard launches in the **Tile configuration** pane.



7. Optional: Define the *working zone* by dragging the crop marks handles.

8. Tap **Part**.

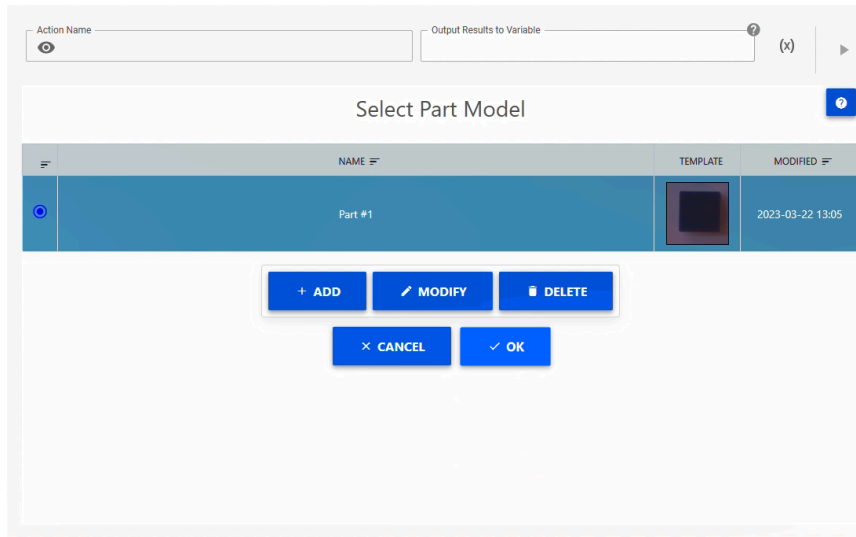
The **Select Part** wizard launches in the **Tile configuration** pane.



Tip: If there are no part models listed, create a part model.

9. Select a part model.

The **Select Part Model** wizard launches in the **Tile configuration** pane.



10. Tap **Fine tune**.

The **Fine-Tune Part Detection** wizards launches in the **Tile configuration** pane.



11. Fine-tune the amount, overlap, and deformation parameters until you reach the optimal detection of the object.
12. Optional: Tap **Grasping** to define a clearance zone around the defined part for the gripper.
The **Grasping Configuration** wizard launches in the **Tile configuration** pane.

Results

The **Vision Job** action is configured.

Selecting a camera

The **Vision Job** action depends on having a calibrated camera.

Before you begin

A camera is installed on the robot, is switched on, and is registered.

About this task

Only calibrated cameras can be used in a Vision job.

Access the **Vision Job** wizard from one of two locations.

- **Systems > Plugins > Vision Plugin > Vision Jobs**
- **Vision Job** action tile dragged into the **Sequence editor** in a program.

Procedure

1. Tap **Camera** from the **Vision Job** wizard.

Select Camera launches.

CAMERA ID	TYPE	MODIFIED	STATUS	RESTORE DEFAULTS
6CD146030F86	wrist	2021-12-07 10:36	✓	↺

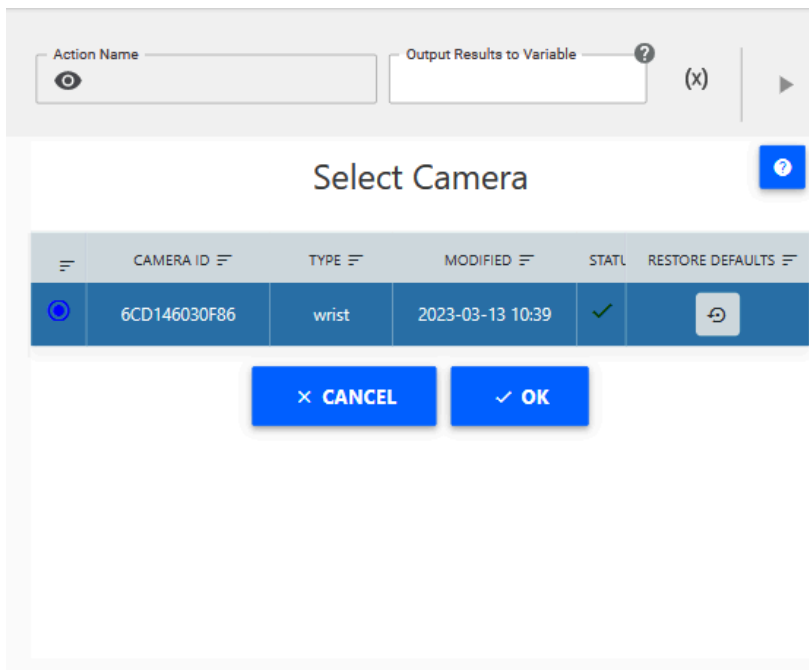
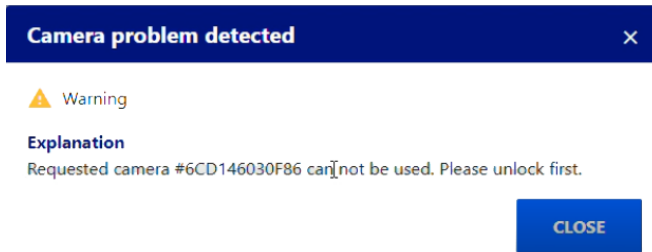
2. Select the camera that is available and registered.



Note: If the list is empty, use the **Robot-Camera Calibration** action to calibrate a camera that can be used.



Note: If the selected camera is not registered, an error dialog launches. Unlock the camera by registering it.



3. Tap **OK** () to return to the **Vision Job** main configuration parameters.

Selecting a workplane

To detect an object, you must first select a workplane that can be used in relation to the object.

About this task

You can select a workplane only when one or more workplanes have already been defined.

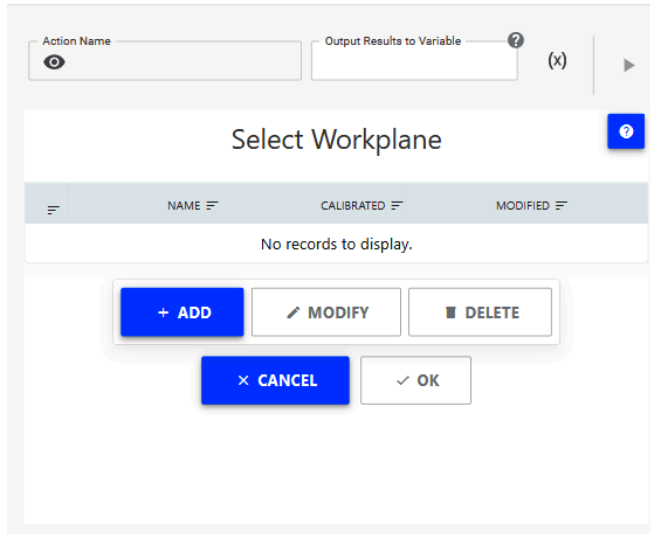
Access the **Vision Job** wizard from one of two locations.

- **Systems > Plugins > Vision Plugin > Vision Jobs**

- **Vision Job** action tile dragged into the **Sequence editor** in a program.

Procedure

1. Tap **Workplane** from the **Vision Job** wizard.
Select Workplane launches in the **Tile configuration** pane.



2. Select a workplane from the list in **Select Workplane**.
If the list is empty, create a workplane by tapping **ADD**.
3. Tap **OK** () to return to the **Vision Job** main configuration parameters.

Calibrating a workplane

To detect an object, you must first have a workplane that can be used in relation to the object.

Before you begin

You must have already selected a calibrated camera.

About this task

Define a workplane by creating one or by modifying an existing one. Refer to the **Visualization** pane to ensure the new workplane is calibrated with the selected camera.

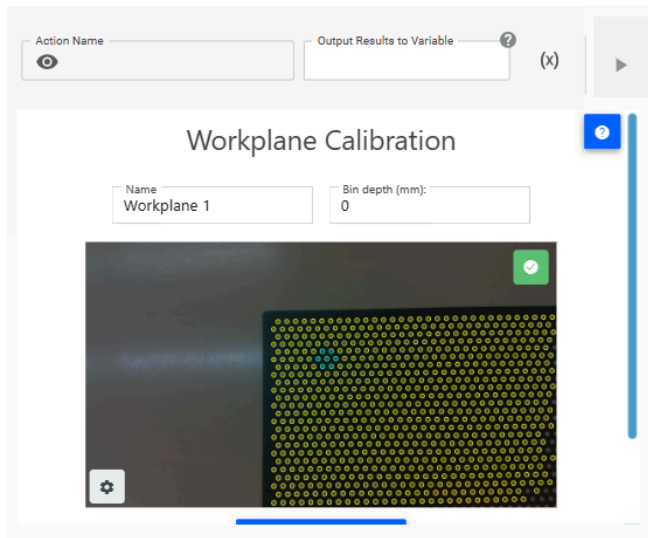
Access the **Vision Job** wizard from one of two locations.

- **Systems > Plugins > Vision Plugin > Vision Jobs**
- **Vision Job** action tile dragged into the **Sequence editor** in a program.

Procedure

1. Tap **Workplane** () from the **Vision Job** wizard.

2. Tap **ADD** () or **MODIFY** ()
Workplane Calibration launches.



3. Make sure the entire Kinova Calibration plate is visible in the view of the camera.
4. Enter the **Name** of the workplane.
5. Enter the **Bin depth (mm)**.

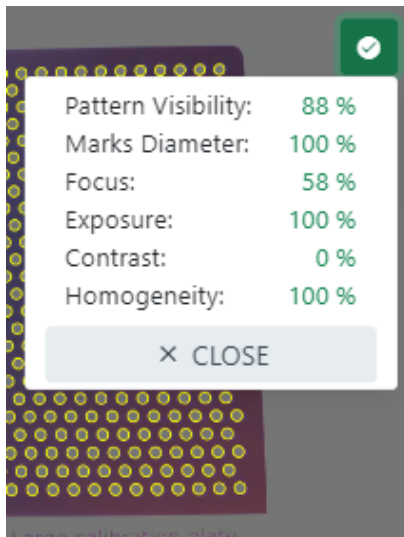


Note: Bin refers to the container from which the object is to be retrieved. The calibration plate is placed on top of the bin or in the bin. Bin depth is the distance between the workplane and the surface the parts are on. With the bin depth, a **Vision Job** can return the position of the part that lays on the workplane.

Enter a number greater than 0 when the calibration plate is on top of the bin, and not in the bin.

Enter 0 as the bin depth when the calibration plate is inside the bin.

6. Tap the camera calibration results icon (📊) to view the current camera calibrations.

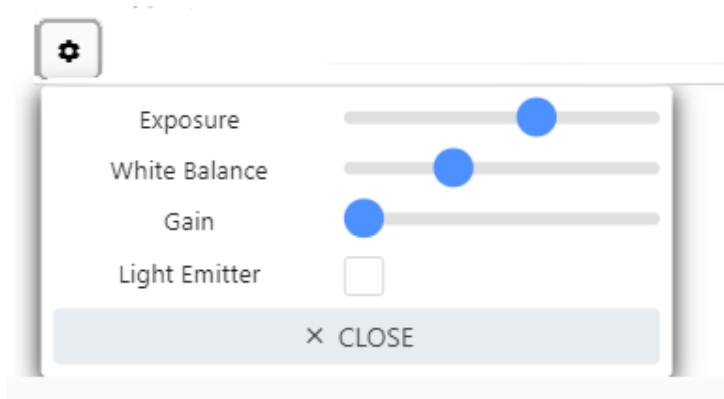


7. Tap the cog (⚙️) to make sure the calibration plate has the proper exposure by adjusting the camera parameters.



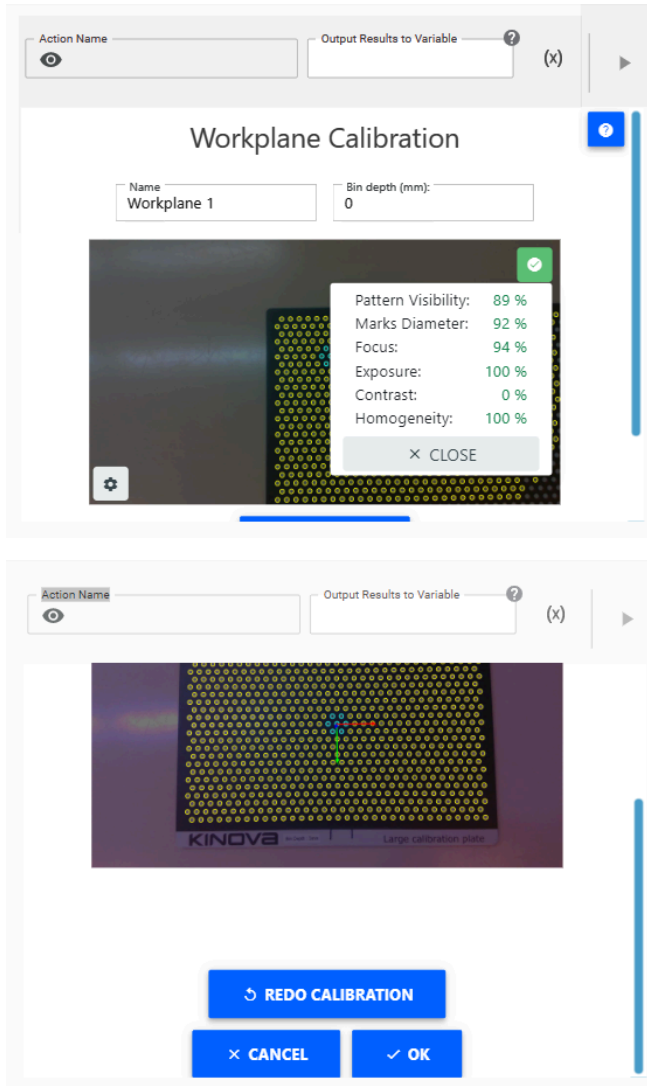
Note: Proper exposure implies the pattern visibility is near 100% and there are no significant blurs in the image.

A dialog launches with the modifiable camera parameters.



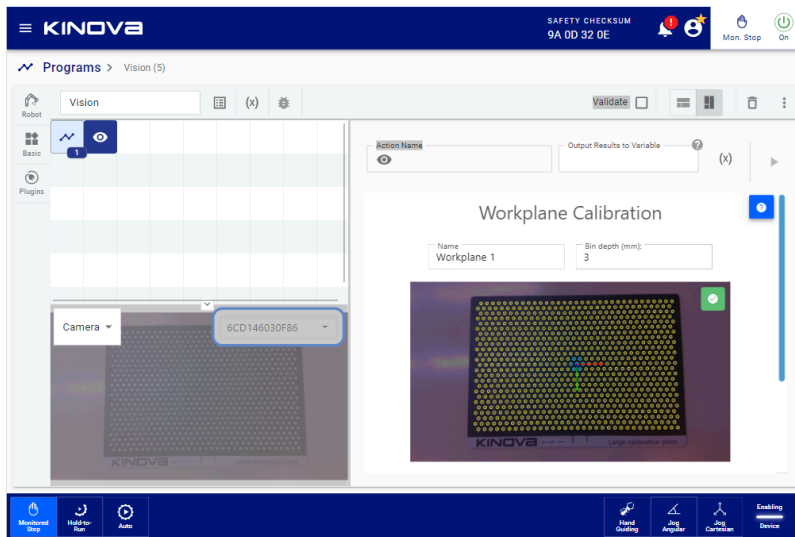
8. Enable **Light Emitter** when the environment is dark and detection requires the camera to emit light.
9. Adjust the **Exposure**, **White Balance**, **Gain** until the image is as clear as it can be in the **Camera viewer**.

10. Tap **CALIBRATE** () to calibrate the workplane with the camera automatically. The results of the calibration launches in the **Camera viewer**.



Workplane Calibration changes to include the possibility to **REDO CALIBRATION**.

When the object view in the **Visualization** pane is **Camera**, a live stream of what is actually coming from the camera is visible.



11. Tap **OK** () to return to the **Vision Job** main configuration parameters.

Related topics

[Camera settings](#) on page 26

Creating the working zone

The working zone is the physical area in which the camera can find the object.

Before you begin

The camera must be installed, switched on, registered, and calibrated.

About this task

The robot locates the objects within the working zone of the working plane.



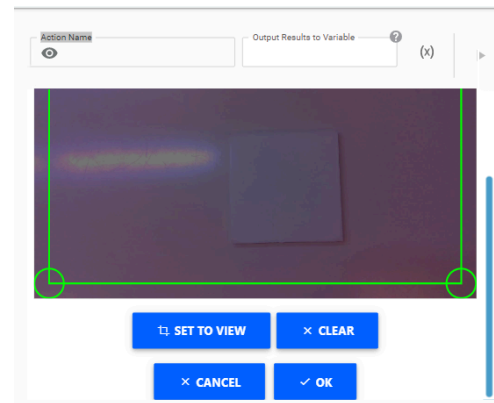
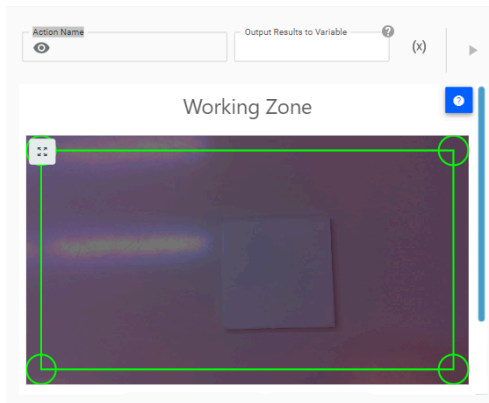
Important: Working zones are optional; they are not mandatory for the operation of any **Vision Job** action.

Access the **Vision Job** wizard from one of two locations.

- **Systems > Plugins > Vision Plugin > Vision Jobs**
- **Vision Job** action tile dragged into the **Sequence editor** in a program.

Procedure

1. Tap **Working Zone** (📐) in the **Vision Job** wizard.
The **Working Zone** wizard launches.



2. Tap the **Magnifier** (🔍).

Use the **Magnifier** slider to zoom into the **Camera viewer**.

i Tip: Launching the **Magnifier** slider makes the **Crop mark handle** (●) more accessible.

3. Drag each **Crop mark handle** until the crop marks outline the acceptable area in which the robot must stay within.
4. Optional: Tap **SET TO VIEW** to reset the crop marks to contain the entire field of view.
5. Optional: Tap **CLEAR** to remove all crop marks.
There is no working zone.

Selecting a part for the Vision Job to detect

To detect an object easily, select an important aspect or part of the object.

About this task

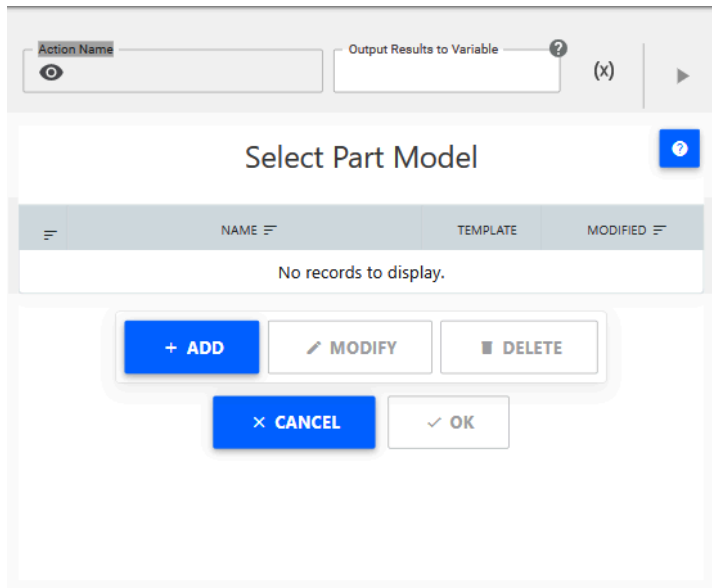
You can select a part only when one or more parts have already been defined.

Access the **Vision Job** wizard from one of two locations.

- **Systems > Plugins > Vision Plugin > Vision Jobs**
- **Vision Job** action tile dragged into the **Sequence editor** in a program.

Procedure

1. Tap **Part** (📦) from the **Vision Job** wizard.
Select Part launches.



2. Select a part from the list in **Select Part Model**.
If the list is empty, create a part model by tapping **ADD**.
3. Tap **OK** (✓ OK) to return to the **Vision Job** main configuration parameters.

Creating a part for the Vision Job to detect

The part model is a part of the object that is to be detected.

About this task

Create a part using the **Create Part Model** is a wizard, accessed from the **ADD** button in **Select Part Model**.

Procedure

1. Tap **Part** (📁) from the **Vision Job** wizard.
Select Part launches.

2. Tap **ADD**.
The **Create Part Model** wizard launches.

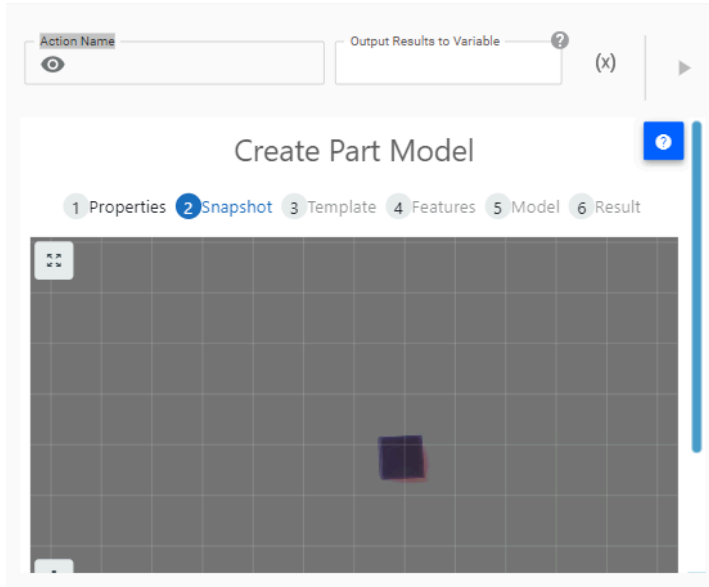
3. Use the wizard to define the part.



Tip: Use the wizard breadcrumbs to rework any part of part creation in the wizard.

4. Enter the **Name** for the part.
5. Enter the **Part height (mm)** for the part.
6. Tap **CONTINUE**.
Create Part Model advances to **Snapshot**.

7. Place the part roughly in the center of the camera view.



8. Tap the cog to access the camera parameters.
9. Adjust the camera parameters.
10. Tap **RECORD TRAINING IMAGE**.
The recorded image is used to train the vision model of the part.
11. Tap **OK**.
Create Part Model advances to **Template**.
12. Define a template for the part by dragging the green square selector over the part.
Reposition and resize the square to include all desired features of the part.
13. Tap **REGISTER PART TEMPLATE**.
14. Tap **NEXT**.
Create Part Model advances to **Features**.
15. Sharpen the image and define, using the paintbrush, which features of the part must be detected.
If you have a cube with a symbol on top, define the features of the part in one of three ways.
 - Choose the feature to be only the cubic shape.
 - Choose the feature to be only the symbol.
 - Choose the feature to be the symbol and the cube at the same time.
16. Tap **REGISTER SELECTED FEATURES**.
17. Tap **NEXT**.
Create Part Model advances to **Model**.

Defining properties of the part model

The same object may have different identifiable parts to be used in different programs. To identify each part model accurately, their properties must be defined.

About this task

The part model has two properties to help identify it.

- **Name**
- **Part height (mm)**



Note: **Properties** breadcrumb is highlighted.

Figure 47: Step 1 in defining a model of the part: properties

Procedure

1. Enter a unique and descriptive **Name** of the part model.
2. Enter the **Part height (mm)**.

Part height (mm) is the height of the detected features of the object. Knowing the height of the detected feature helps to be precise even when the perspective, or view, changes.

3. Tap **CONTINUE**.

The **Create Part Model** wizard advances to the next step in defining the part model.

Related topics

[Properties of the part model](#) on page 32

Taking a snapshot of the part model

The **Vision Job** action works with pattern matching. A picture of the part model is an important part of pattern matching.

About this task

The object that needs to be detected must be used to take the snapshot. It is a reference for rest of the modeling needed for the robot to find the correct part.



Note: **Snapshot** breadcrumb is highlighted.

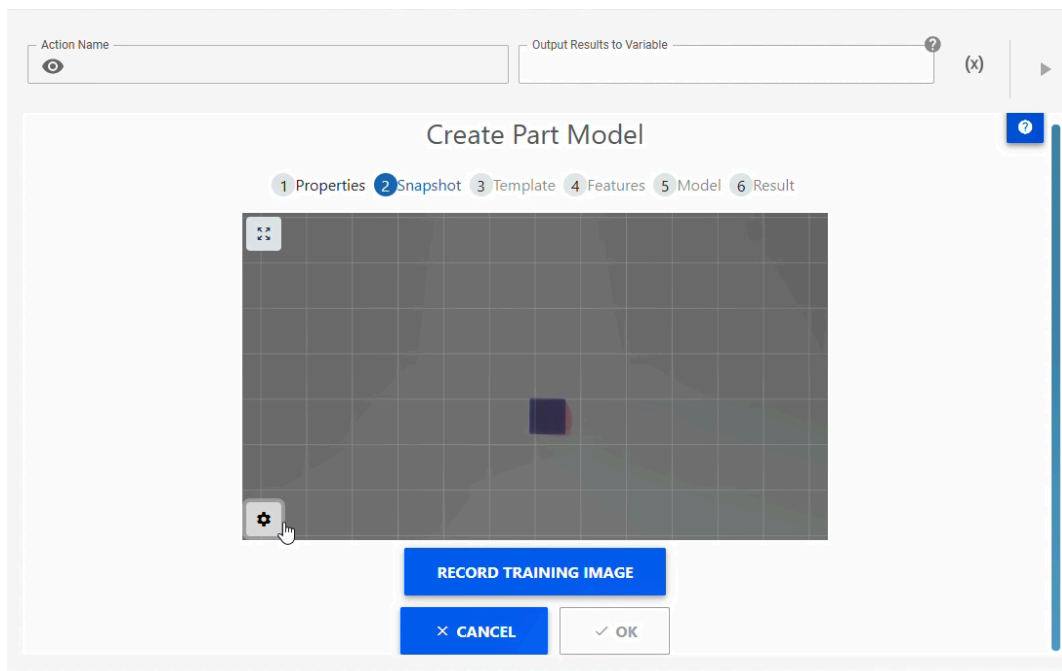


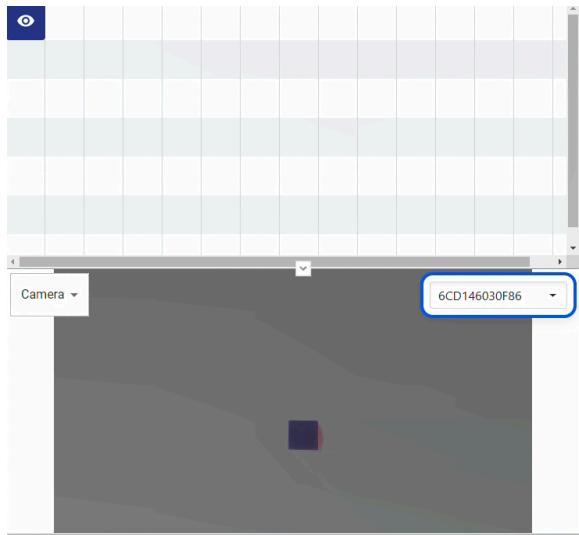
Figure 48: Step 2 in defining a model of the part: snapshot

Procedure

1. Place the sample object in the center of the camera view.



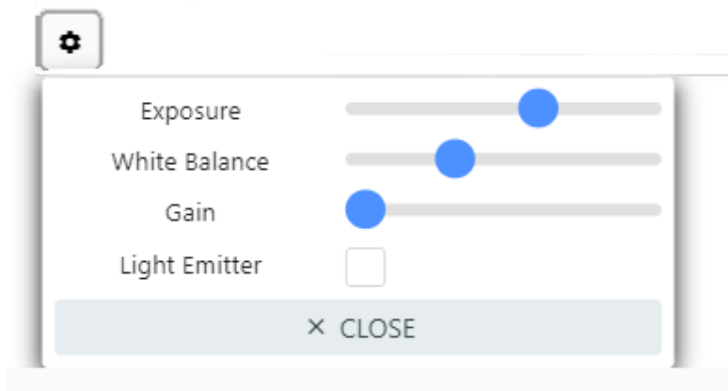
Tip: For best results, use the **Camera** object in the **Visualization** pane for the live feedback of what the camera sees in addition to the **Camera viewer** in the wizard.



2. Optional: Tap **Magnifier** (🔍) to zoom into the part in the **Camera viewer**

3. Tap the cog (⚙️).

A dialog launches with the modifiable camera parameters.



4. Enable **Light Emitter** when the environment is dark and detection requires the camera to emit light.

5. Adjust the **Exposure**, **White Balance**, **Gain** until the image is as clear as it can be in the **Camera viewer**.

6. Tap **RECORD TRAINING IMAGE** to save a picture of the part that needs to be detected in a **Vision Job**.

7. Tap **OK** (✓ OK).

The **Create Part Model** wizard advances to the next step in defining the part model.

Related topics

[Snapshot of the part model](#) on page 33

Creating a template for the part model

Having a template simplifies pattern matching by focusing on a specific portion or aspect of the part for the pattern matching in the **Vision Job** action.

About this task

The template can be the entire snapshot or a section of the snapshot.



Note: **Template** breadcrumb is highlighted.

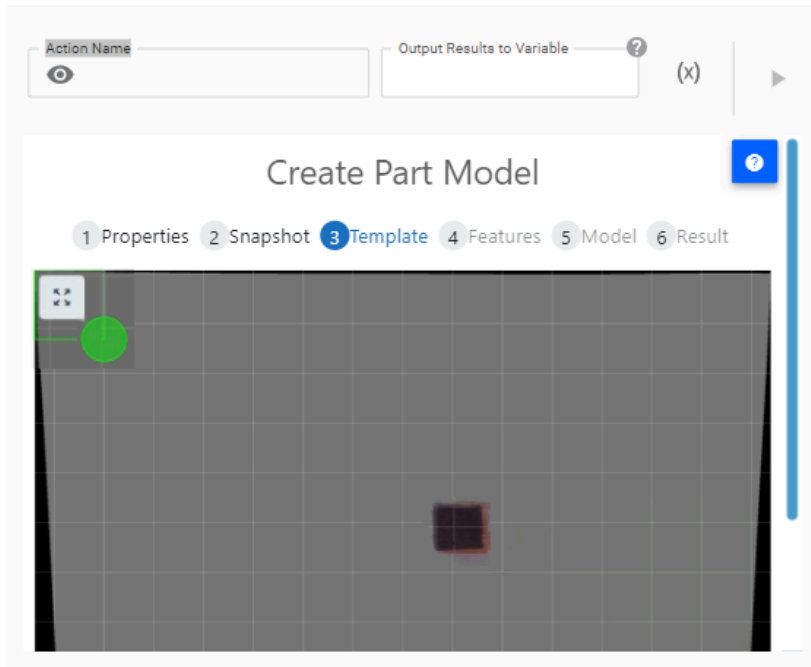
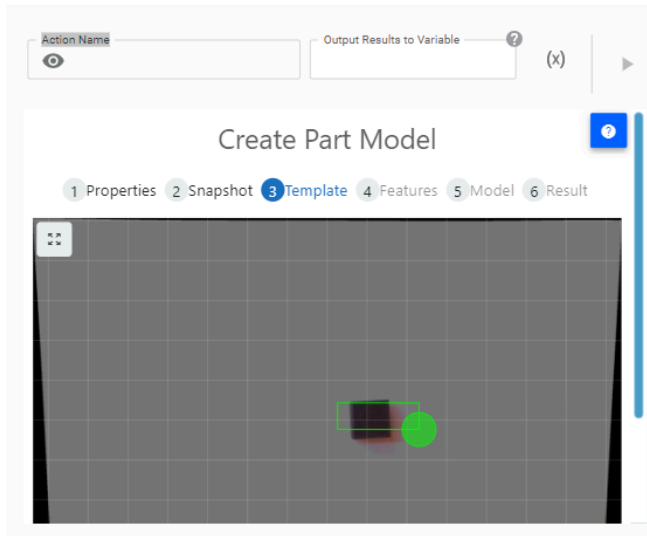


Figure 49: Step 3 in defining a model of the part: template

Procedure

1. Drag the green square selector over the part.



2. Optional: Use the **Magnifier** (🔍) to zoom into the object whenever it is necessary to get a closer look at the object.
3. Adjust position and size of the green square until it includes all the features needed for recognizing the part.
4. Tap **REGISTER PART TEMPLATE**.
5. Tap **OK** (✓ OK).

The **Create Part Model** wizard advances to the next step in defining the part model.

Related topics

[Template of the part model](#) on page 34

Defining features

Pattern matching can be improved by defining the specific features of the part. The more specific the pattern, the easier it is to recognize the part.

About this task

Features are defined by painting over the object in the **Camera viewer**.



Note: **Features** breadcrumb is highlighted.

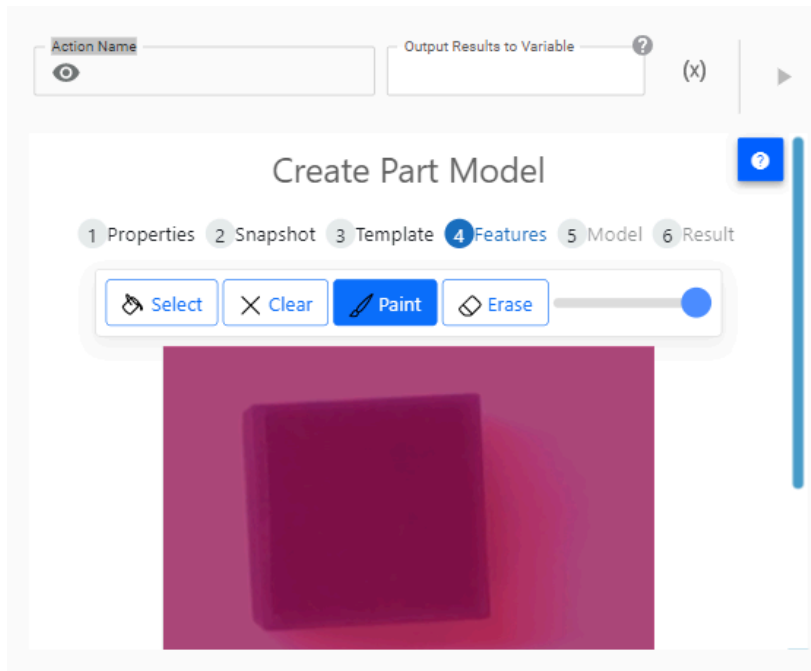


Figure 50: Step 4 in defining a model of the part: features

Table 30: Tasks to define features

Task	Description
Select	Select the entire image
Clear	Unselect the image
Paint	Paint the desired features
Erase	Erase undesired portions of the features
Slider	Drag the slider to the desired size for the brush

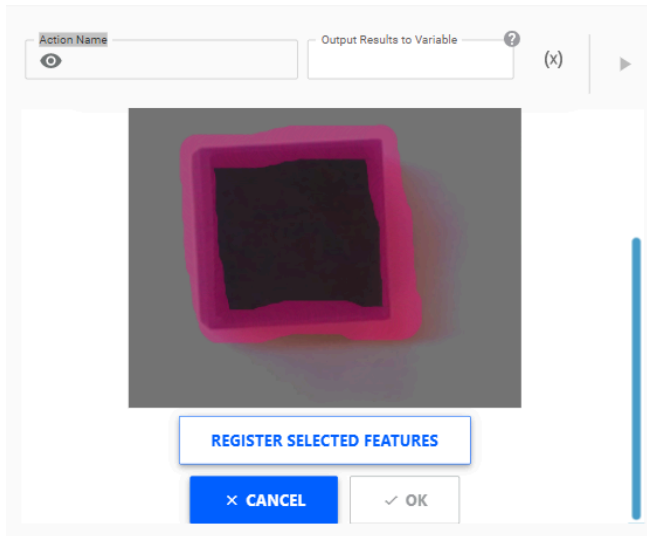


Important: Defining features is subjective and is different for each model you are creating for part recognition. Use any and all feature tasks that are available to make detecting the part easier.

Procedure

1. Start one of two ways.
 - Tap **Clear** to remove all paint on the object in the **Camera viewer**
 - Tap **Erase** to erase portions of the painted features.
2. Tap **Paint**.
3. Drag the slider until you have the correct size for the brush.
4. Drag the brush along the area that you want to define as a feature of the object.

5. Repeat until the feature is defined.



6. Tap **REGISTER SELECTED FEATURES** to save the features.

7. Tap **OK** ().

The **Create Part Model** wizard advances to the next step in defining the part model.

Related topics

[Features of the part model](#) on page 35

Defining the model

The model is defined with more specific information for the pattern matching process.

About this task

At this point, the part model is almost complete. However, a few more properties can help identify the part more accurately.



Note: **Model** breadcrumb is highlighted.

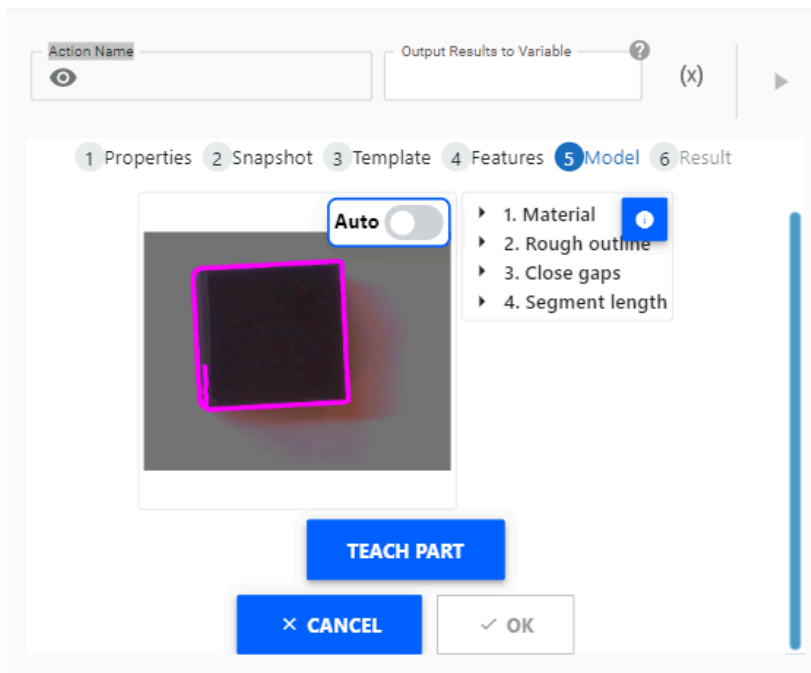
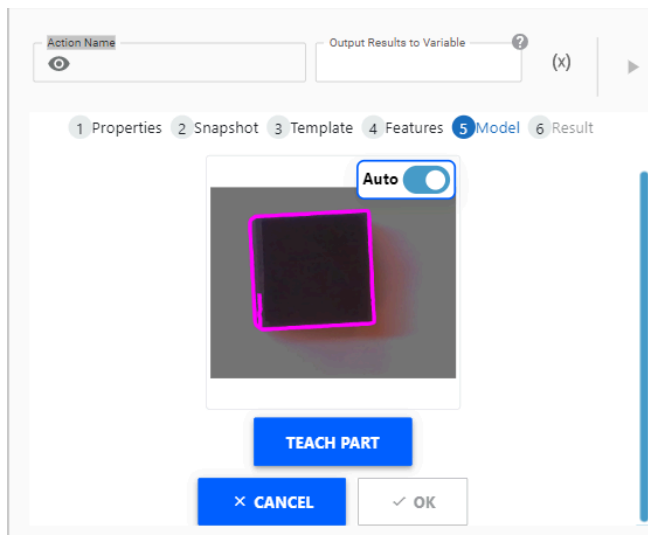


Figure 51: Step 5 in defining a model of the part: model

Procedure

Defining the model automatically

1. Toggle **Auto** on.



2. Tap **TEACH PART**.
3. Tap **OK** (✓ OK).

The **Create Part Model** wizard advances to the next step in defining the part model.

Defining the model with more information

4. Expand **1. Material**.

5. Select the best match type of the material of your part.

Option	Description
Normal	Generic type; works for most parts
Reflective	Metallic type; works for metallic parts
Mixed Color	Color variations; works for parts with a variance of color

6. Expand **2. Rough outline** to define sharp edges.
7. Drag the slider until all major part features are outlined and all undesired part features are excluded.
Some small gaps may be in the final shape.
8. Expand **3. Close gaps**.
9. Drag the slider until the shape does not have gaps and all undesired features are excluded.
10. Expand **4. Segment length**.
11. Drag the slider to remove undesired segments from the outline of the part.
12. Tap **TEACH PART**.
13. Tap **OK** ().
- The **Create Part Model** wizard advances to the next step in defining the part model.

Related topics

[Model of the part](#) on page 37

Accepting or rejecting the model of the part

The final step in creating a part model involves viewing the well-defined outline of the features, and either accepting or rejecting it.

About this task

Do not skip or view the result. It is vital to the success of the pattern matching process.



Note: **Result** breadcrumb is highlighted.

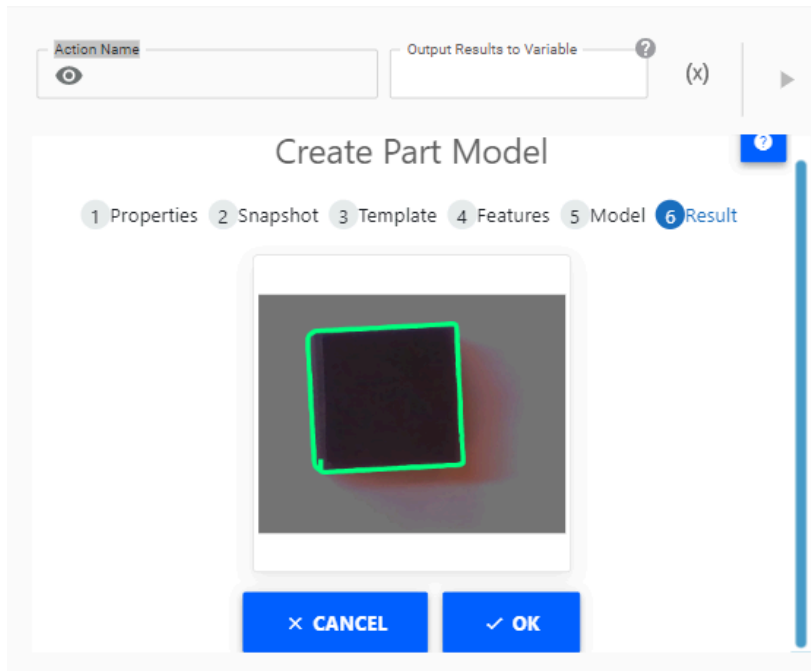


Figure 52: Step 6 in defining a model of the part: result

Procedure

1. View the highlighted outline of the features of the part that is to be used for object detection.
2. Take one of two actions.
 - Tap **CANCEL** to readjust any aspect of the part model wizard.
 - Tap **OK** () to return to **Select Part Model**.

Related topics

[Result of the part model](#) on page 38

Fine-tuning the part

Fine-tuning serves to define the part to be detected in greater detail to make it easier for the robot to located the object.

About this task

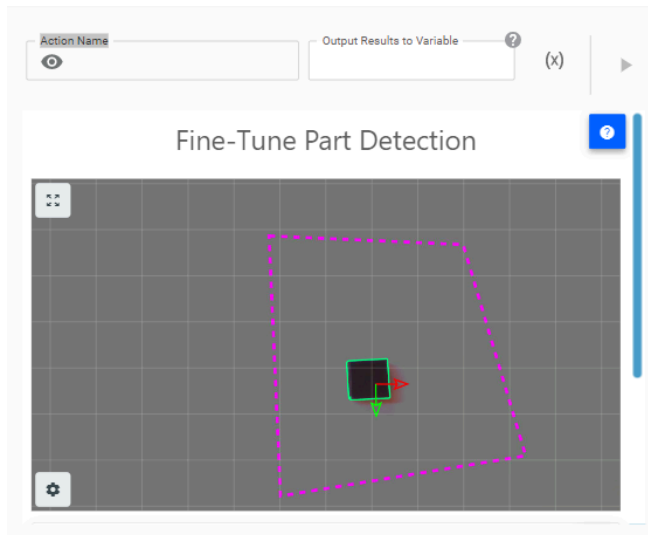
The final mandatory step in defining a **Vision Job** is to fine-tune the capabilities of the camera to detect the correct object.

Access the **Vision Job** wizard from one of two locations.

- **Systems > Plugins > Vision Plugin > Vision Jobs**
- **Vision Job** action tile dragged into the **Sequence editor** in a program.

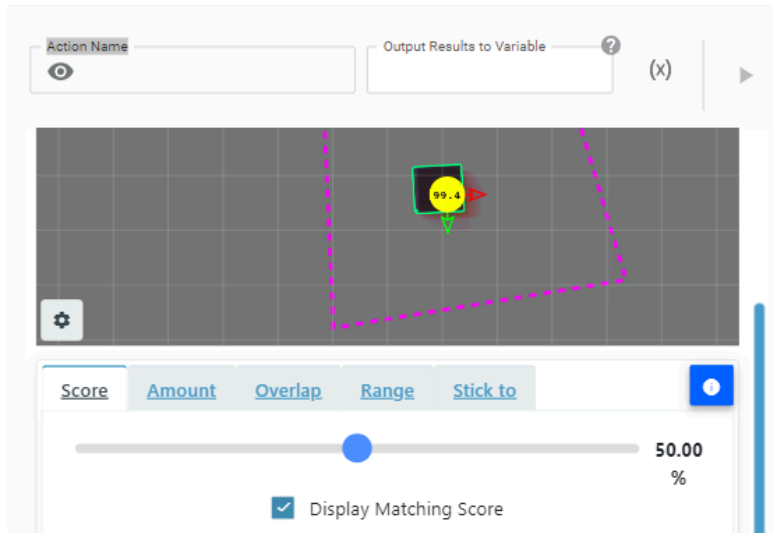
Procedure

1. Tap **Fine tune** (🔍) from the **Vision Job** wizard.
The **Fine-Tune Part Detection** wizard launches.



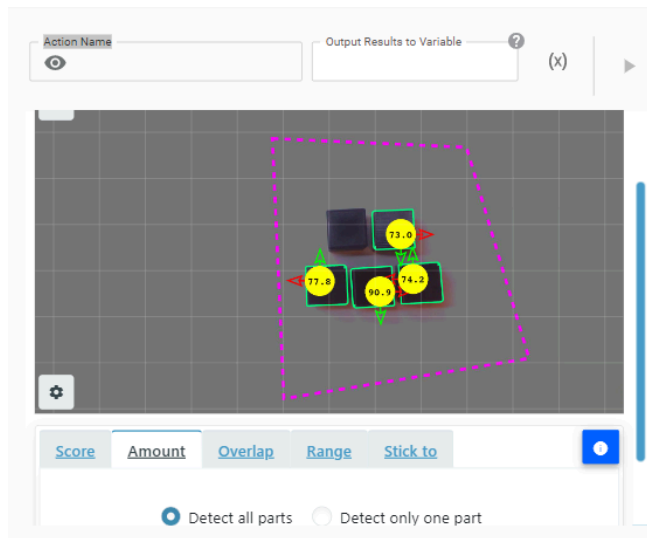
The object is in the **Camera viewer** with a defined working zone. Its default **Score** is 50%.

2. Tap **Display Matching Score** to see the score directly on the object.

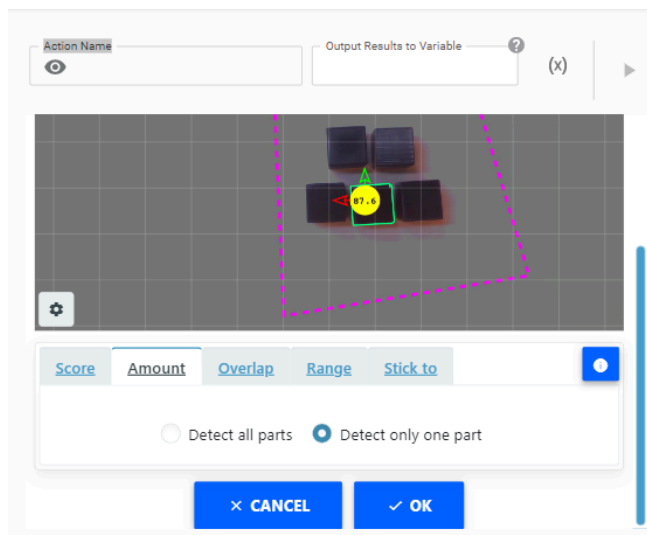


3. Tap **Amount** and select how many objects you want to detect.

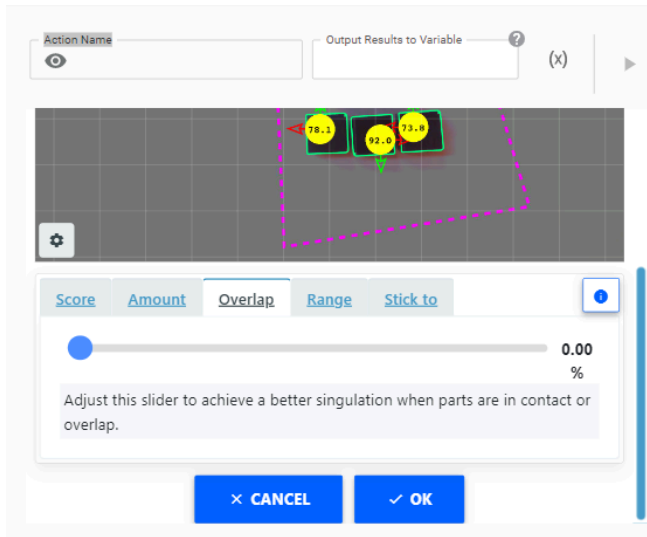
- **Detect all parts**



- **Detect only one part**

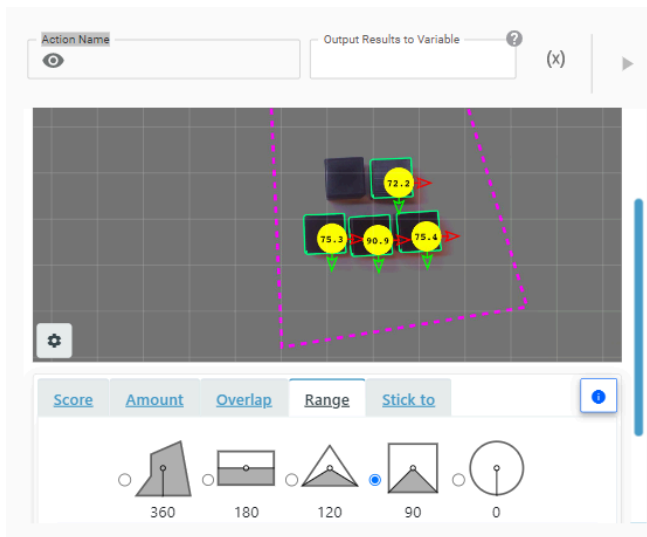


4. Tap **Overlap** and move the slider to determine the most that several objects can overlap before they can be detected.



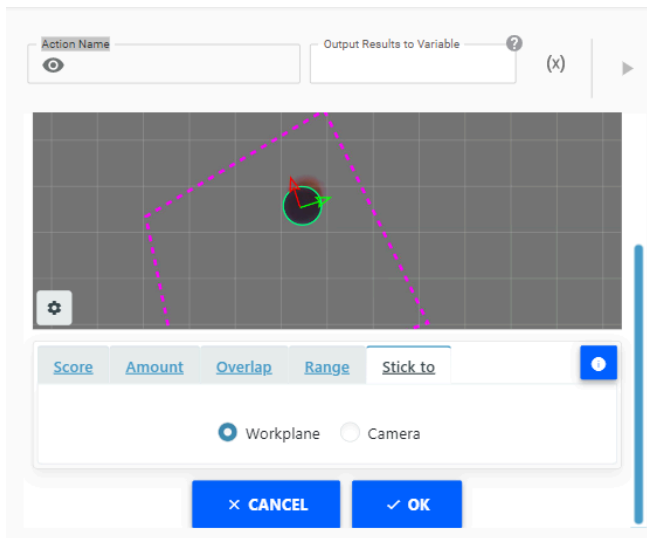
i Tip: Overlap refers to the template zone of the part; it does not refer to the detected features. The template zone of the part is always rectangular. When an object is shaped like the letter "L", overlap must be set to 50% to detect parts that are close to each other.

5. Tap **Range** to define the search range of an object based on the part model symmetry.

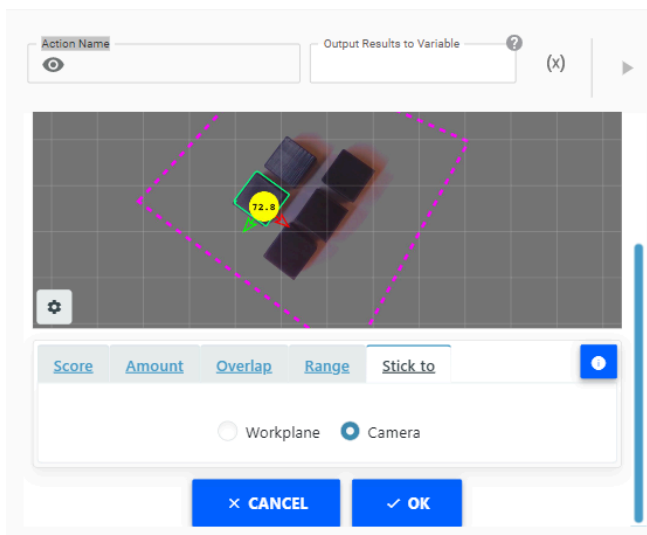


6. Tap **Stick to** to define whether the origin of the part follows the workplane or the camera.

- **Workplane**



- **Camera**



7. Tap **OK** () to return to the **Vision Job** main configuration parameters.

Grasping configuration

Configure where the tool can grasp the detected object.

About this task

Use the **Grasping Configuration** wizard to complete all steps for configuring the grasp of the object.

Access the **Vision Job** wizard from one of two locations.

- **Systems > Plugins > Vision Plugin > Vision Jobs**
- **Vision Job** action tile dragged into the **Sequence editor** in a program.



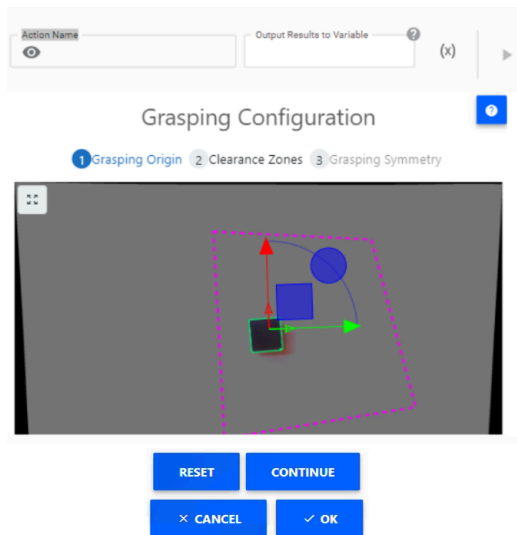
Important: Grasping is optional.



Note: **Grasping Origin** breadcrumb is highlighted.

Procedure

1. Tap **Grasping** (🤖) from the **Vision Job** wizard.
The **Grasping Configuration** wizard launches.



2. Define the grasping origins.
3. Define the clearance zones for the gripper.
4. Define the grasping symmetry for the gripper.
5. Tap **CONTINUE** to continue to the next step in the wizard.

Defining the Grasping Origin

Grasping origin dictates the way the robot grasps the object.

About this task

By default, the grasping origin is defined to be the center of the object. The center of the object may not be the optimal grasping origin.



Note: **Grasping Origin** breadcrumb is highlighted.

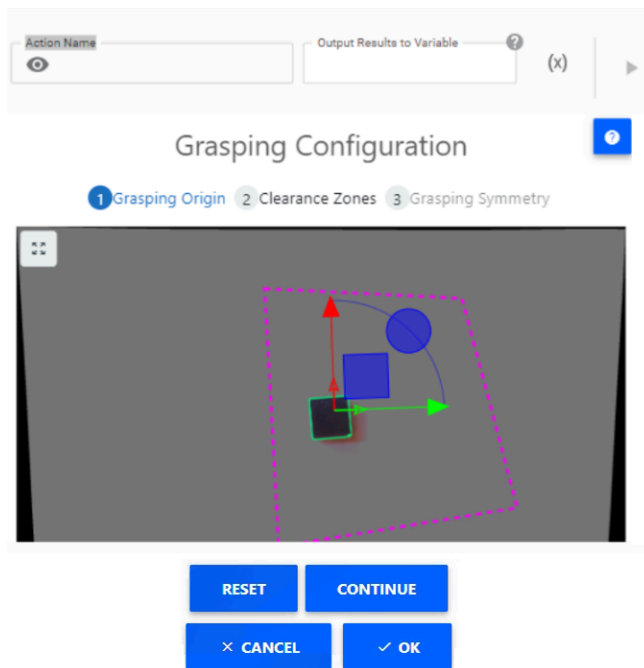
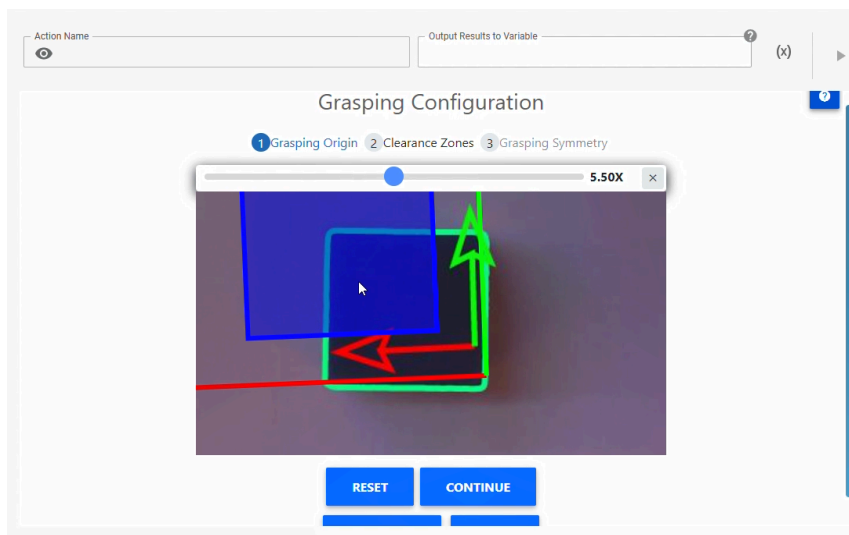


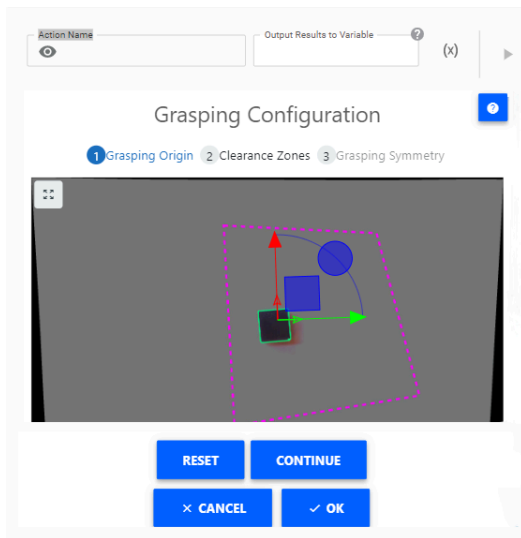
Figure 53: Grasping origins in the Configuration wizard

Procedure

1. Optional: Use the **Magnifier** (🔍) to zoom into the **Camera viewer** to get a better view of the part and the origins.
2. Drag the square over the object to define the origin of the object.



3. Drag the circle to define the angle of origin of the object.



4. Optional: Tap **RESET** to put the origin and angle of the grasp back to the default.
5. Tap **CONTINUE** to proceed to the next step in the **Grasping Configuration** wizard.

Defining clearance zones for grasping configuration

The clearance zone is the area in which the tool is guaranteed to have cleared around the detected object.

About this task

Clearance is defined in the **Grasping Configuration** wizard.



Note: **Clearance Zones** breadcrumb is highlighted.

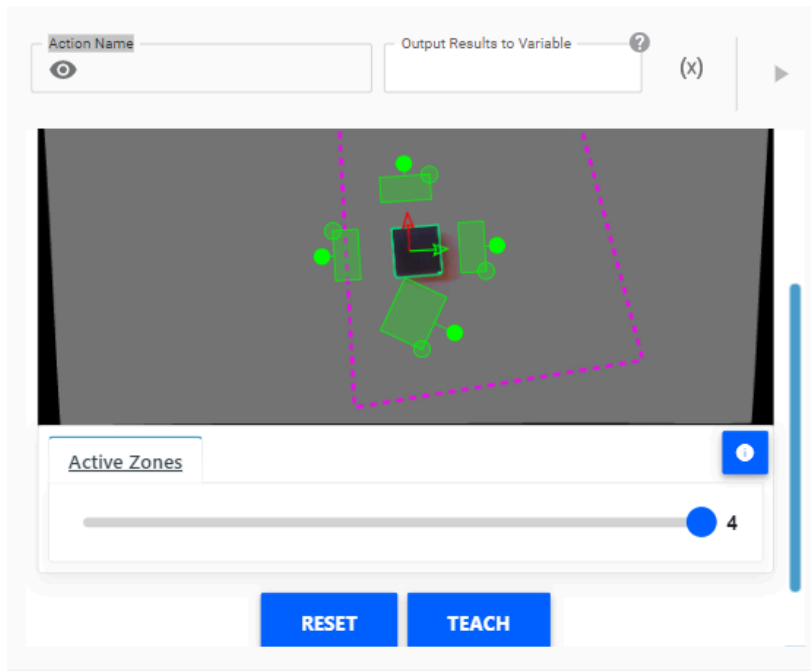


Figure 54: Clearance zones in the Grasping Configuration wizard

Procedure

1. Drag the slider to define the number of active clearance zones are available for the grasping tool.



Important: A maximum of four active clearance zones can be defined.

2. Use the resizer handle () to change the size of the active grasping zone.
3. Use the repositioner handle () to change the position of the active grasping zone.
4. Tap **CONTINUE** to proceed to the next step in the **Grasping Configuration** wizard.

Defining the grasping symmetry

Symmetry for grasping an object is closely related to the shape of the object which may be different of the shape of the part model.

About this task

For objects with grasping symmetry, it is important to center the grasping origin with the part symmetry of the object.

Grasping symmetry is defined in the **Grasping Configuration** wizard.



Note: Grasping Symmetry breadcrumb is highlighted.

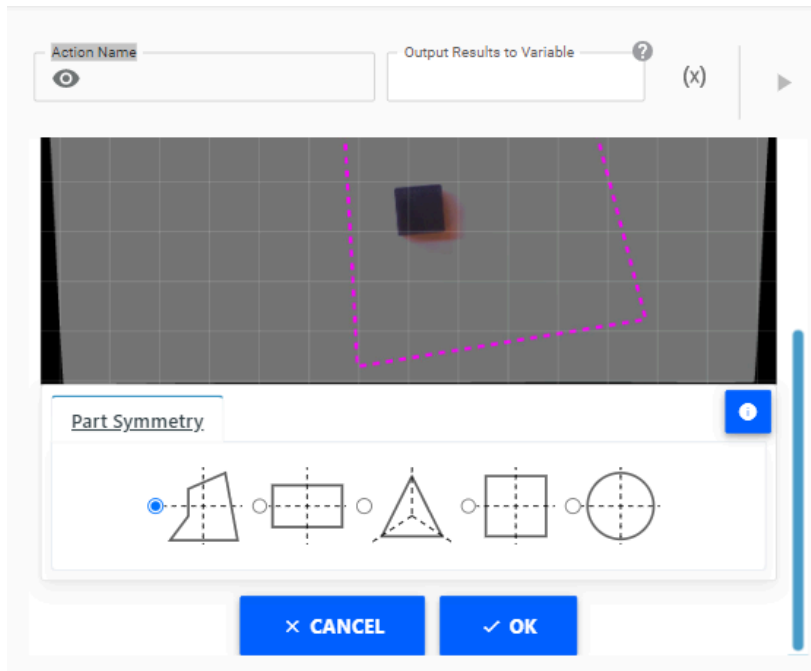
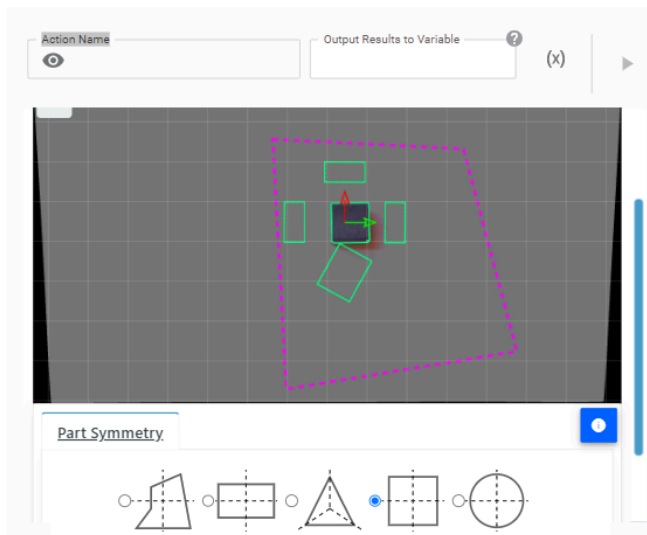


Figure 55: Part Symmetry in the Grasping Configuration wizard

Procedure

1. Select the symmetry of the part.

When the correct part symmetry is selected, the active grasping zones are outlined in the **Camera viewer**.



2. Tap **OK** () to return to the **Vision Job** main configuration parameters.

Creating variables

Each **Vision Job** action has an output. The output is of the pose of the object. The pose can be saved and used to program some waypoints.

Before you begin

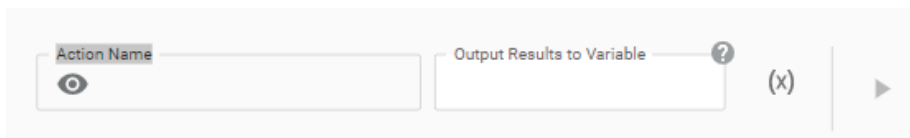
The camera is calibrated, the workplane is configured, the part model is configured. A **Vision Job** is created.

About this task

The output of the **Vision Job** is specific to the detection of an object and its features. The best place to create a variable to hold the **Vision Job** action is directly from the **Vision Job** action.

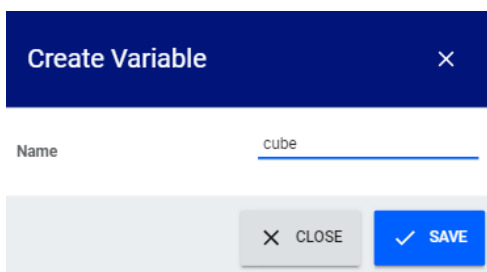
Procedure

1. Drag the **Vision Job** action into the **Sequence editor**.
2. Tap (X) beside **Output Results to Variable**.



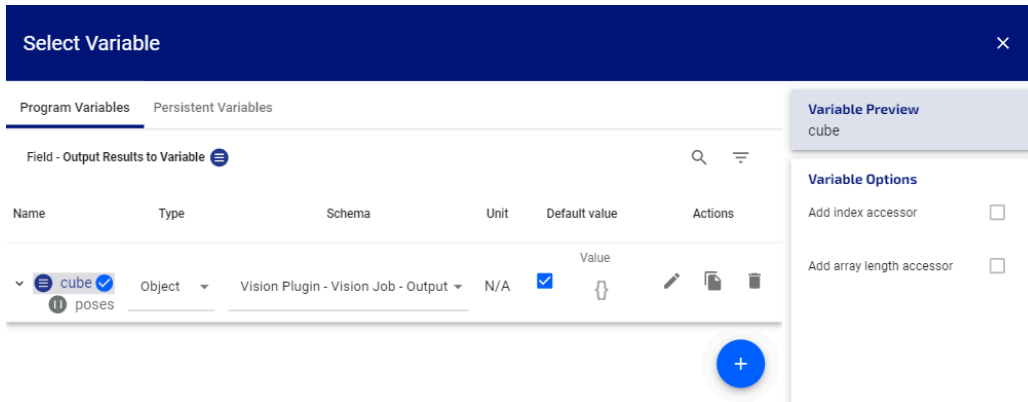
Select Variable launches.

3. Tap the type of variable you want to create.
 - Use **Program Variables** to keep the **Vision Job** output available only to the current program.
 - ⚠ **Important:** A program variable is not persistent; it cannot be consulted after the program runs and it is not accessible to other programs.
 - Use **Persistent Variables** to use the **Vision Job** output in multiple programs.
4. Tap **Add (+)**.
The **Create Variable** dialog launches.
5. Enter the name of the variable.



6. Tap **SAVE**.

A variable of **Type Object** and **Schema Vision Plugin - Vision Job - Output** is available.



The output of the **Vision Job** action is **poses** and can be used in other programs.

Related topics

[Variables](#) on page 55

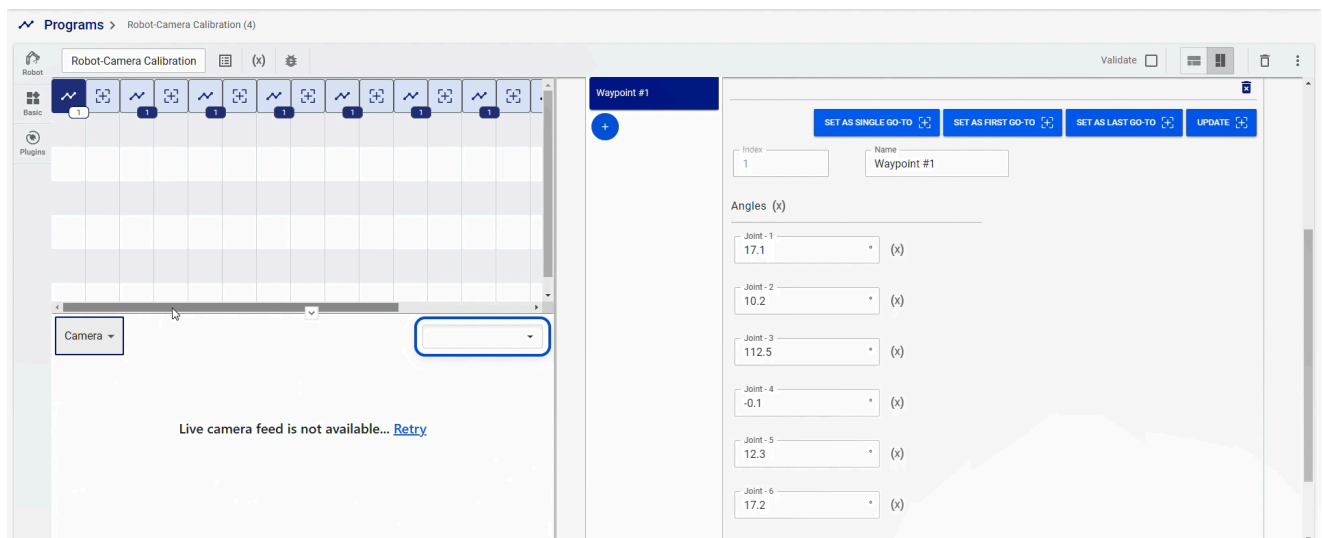
Troubleshooting

Examples of issues related to the Vision Module and the Vision Plugin include camera-robot calibrations, lack of grasping clearance zones, and so on.

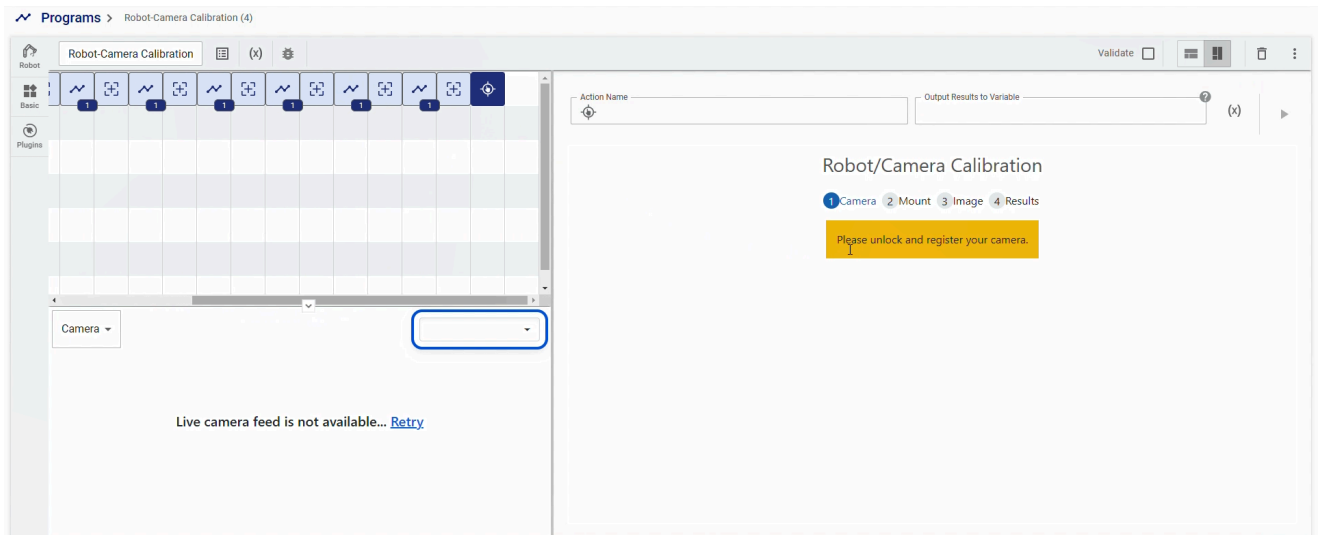
Why are there no cameras listed in the Visualization pane when the Camera visualization object is selected?

Condition

The current program is the default program called **Robot-Camera Calibration**. The selected visualization object in the **Visualization** pane is **Camera**. Nothing is in the camera listing in the **Visualization**.



An orange message is in the **Tile configuration** pane when the **Robot-Camera Calibration** action is selected.



Cause

The camera must be registered.

Remedy

Procedure

1. Tap **Systems > Plugins > Vision Plugin**.
2. Register the camera.

Why are there 0 samples in the camera calibration results?

Condition

The number of samples listed on the **Results** pane of the **Robot/Camera Calibration** wizard is zero (0).

Action Name

Output Results to Variable

?

(x)

1 Camera

2 Mount

3 Image

4 Results

Status	✓
Number of Samples	0
Camera Calibration Error	0.37
Translation RMS Error	0.35 mm
Rotation RMS Error	0.07 degrees
Maximum Translation Error	0.54 mm
Maximum Rotation Error	0.10 degrees
Marks distribution score	0 %
Tilt angles score	0 %

Tapping the number of samples listed launches an error dialog with an explanation of the situation and a suggestion to overcome the issue.

Unable to record robot-camera calibration snapshot

Severity	Timestamp	Code
! ERROR	2023-03-13 14:37:19.326Z	N/A

Explanation

timeout: never received response from
 topic:kortex_vision_plugin/trigger_calibration_snapshot

Suggestion

See detailed explanation in the vision action visualizer.

×

CLOSE

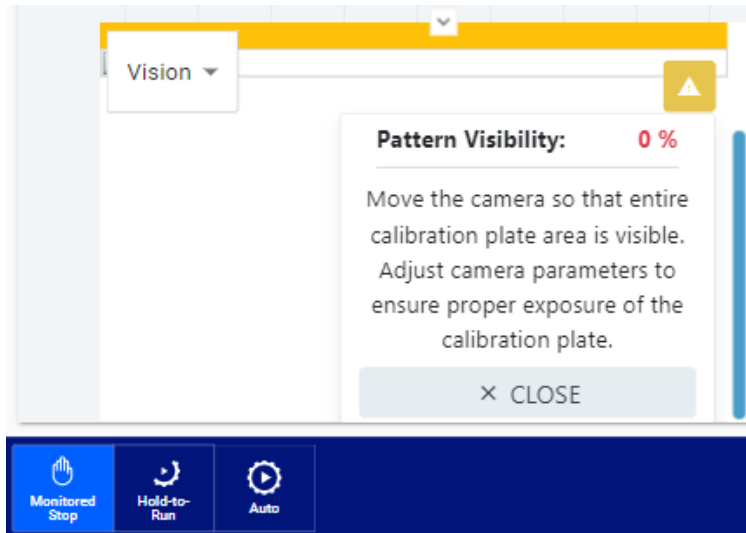
Cause

Part of the calibration plate is not visible.

Remedy

Procedure

1. Select **Vision** in the **Visualization** pane.
2. Read the instructions in the **Visualization**.



3. Tap **CLOSE**.
4. Move the camera so that the entire calibration plate is visible to the camera.
5. Adjust the camera parameters.
6. Calibrate the camera.
The number of samples is greater than zero (0) and the scores are larger than 0%.

Why can I not teach the gripper clearance zone?

Condition

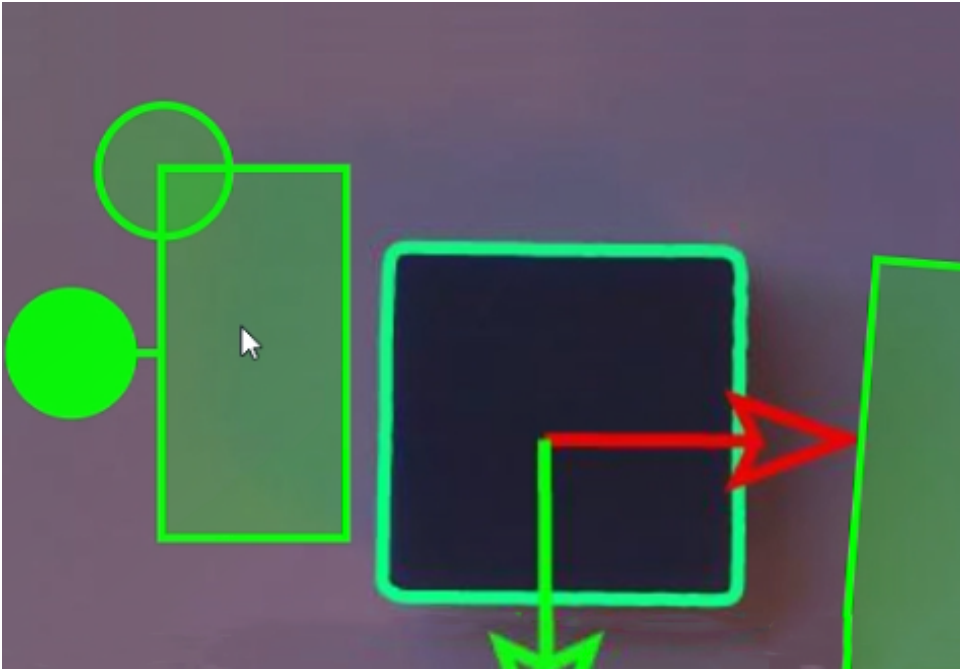
The gripper clearance zone is created for a **Vision Job** action, but tapping **TEACH** launches an error dialog.

Cause #1

Something is blocking the gripper clearance zone or the clearance zone is not touching the object.

Message:

Unable to teach gripper clearance. Clearance zone is obstructed.



Remedy #1

Procedure

Redefine the gripper clearance zone with no places that can block the gripper.



Cause #2

The gripper clearance zone is invalid. Two or more clearance zones overlap.

Message:

Unable to teach gripper clearance. Clearance Region is invalid.



Remedy #2

Procedure

Move the gripper clearance zones to surround the object instead of being on top of each other.



Changes since the last release

Modifications were made from the previous version to the current version.

Changes made in version 1.2.0

Version 1.2.0 of the Vision Plugin is compatible with the latest Kortex v3.3.0.

Glossary

C

controller

the part of the robot from where the software operates

E

end effector

device specifically designed for attachment to the flange of the wrist

F

flange

a mechanical interface used for attaching another object

FOV

associated with cameras and optical devices, it is the angular scope of vision

field of view (FOV)

G

GUI

a way of interacting with a program of a computer that involves windows, dialogs, icons, and menus

Graphical User Interface (*GUI*)

synonym: *HMI*

K

kebab menu

three vertical dots that, when tapped, expose a menu of actions or tasks from which the user can choose; usually used for contextual menus

⋮

synonym: contextual menu, menu options, options, menu

Kortex Web App

the *GUI* that runs on a web server on the *controller* and is accessed on the *teach pendant* or on an external computer

synonym: Web App

N

namespace

a way in computer science of grouping together all objects that work together such that each object has a unique name

non-blocking

the ability for a robotic program to proceed to its next step even when the current action is not finished

synonym: synchronous operation

P

pendant

a device used to configure and control the movements of a robot

synonym: *teach pendant*

plugin

software that is added to an pre-existing base software so as to give the application additional capabilities

T

TCP

the position and orientation of the tool

Tool Center Point (*TCP*)

teach pendant

a device used to configure and control the movements of a robot

synonym: pendant

U

USB device

industry computer bus standard that makes it easier to transfer data between devices

Universal Serial Bus (*USB*)

W

wrist

the part found at the end of the robot arm to which end effectors may be attached

TOGETHER IN ROBOTICS



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📍 QUEBEC, CANADA

EN-UG-024-r1.1-202311

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