



Introduction to Robot Image Recognition Software

Robot Engineering Department, Control Division,
TOSHIBA MACHINE CO., LTD.



Software package that facilitates use of high-end 3D image recognition technology.

Strong support of “automated bin picking” using robot and 3D image recognition

■ Easy setup

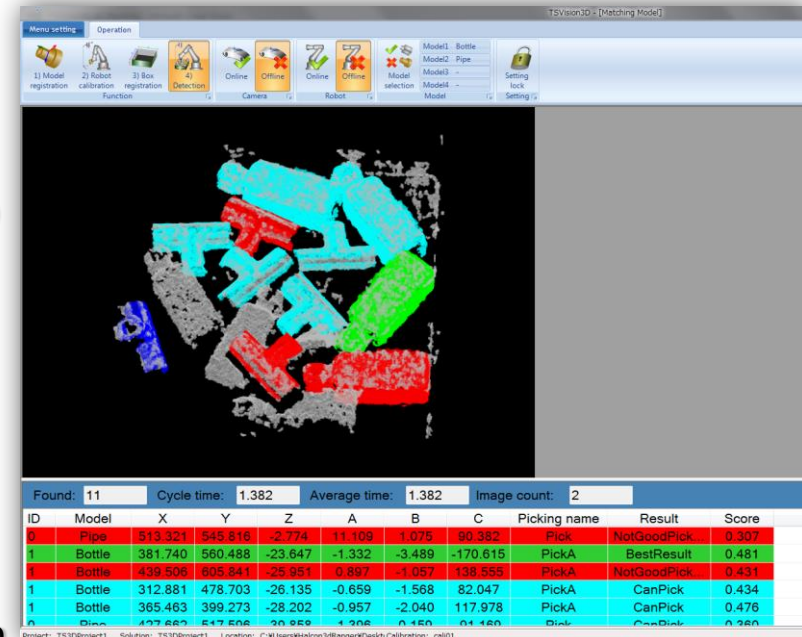
- Easy model registration:
3D-CAD data not required!
- Easy calibration and box detection function
(Box size and height are automatically detected.)

■ Error prevention

- “Box interference avoidance function” that prevents interference with box
- Arm motion reach check function

■ Improved recognition rate

- Multiple-model registration and detection function
- Mask function





Robot Image Recognition Software

SYSTEM CONFIGURATION

System Configuration

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Stereo vision system

3D
image
acquisition

Lens distortion
correction
Calibrated
camera

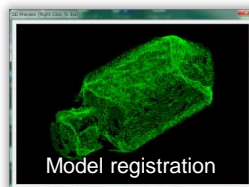
Disparity
calculation
(height
information)



Initial setting

Coordinate
system
calibration

Model
registration



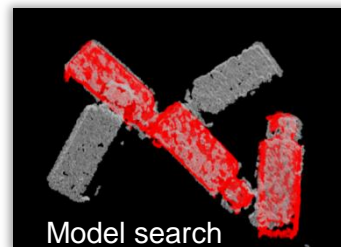
Model
search

Filtering
Box interference &
motion reach check

Data
transmission

Picking
operation

Robot
control



Stereovision system

LED light

Stereo camera

GigE

Ethernet Hub

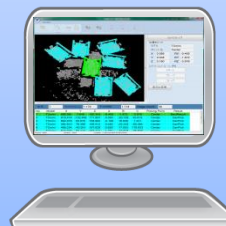
GigE

robot
program
for Picking

Robot controller



Recommended PC spec
PC contains Windows7
32/64bit, Intel Corei5-
equivalent CPU, and
4.00 GB RAM
Multilanguage
Japanese, English, Chinese
and Thai

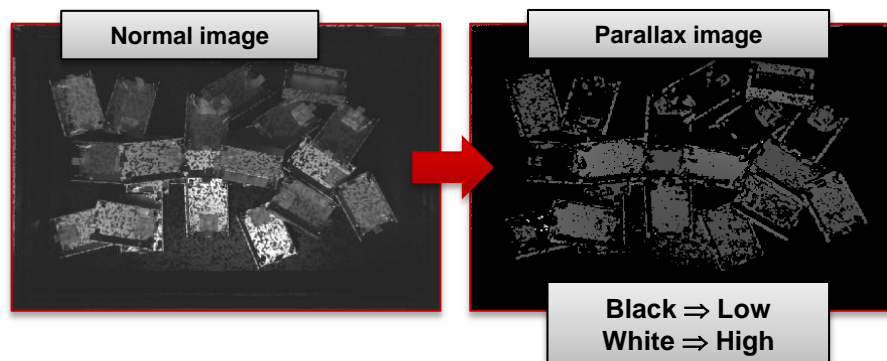


Stereo camera capable of high-speed 3D measurement

- Stereo camera capable of that enables real-time 3D measurement

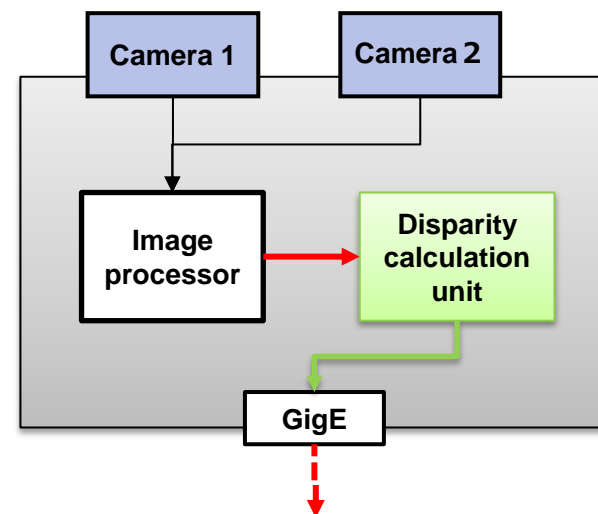
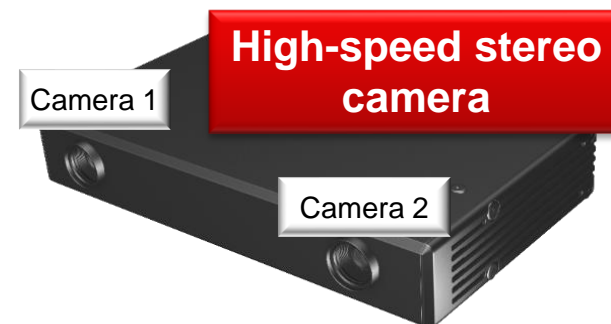
- Capturing, image processing and parallax operation are performed inside the camera.

⇒ **Continuous high-speed 3D measurement is possible**
⇒ **30 fps (30 times per second)**



- Stereo camera that is high-speed, highly accurate and easy to use

- Accuracy (at measurement height of 1 m): ± 1 mm
- **Measurement field: 500 mm \times 400 mm**
- **work pieces distance: 800 mm to 1200 mm**
- Calibrated camera
- Lightweight, compact: 232 (W) \times 40 (H) \times 140 (D) mm, 1140 g



Improved object recognition accuracy based on random pattern projection system

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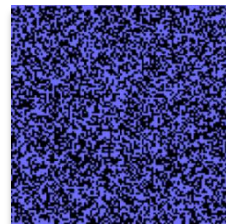
Under normal lighting, only
outline shape can be acquired.
(Surface information cannot be acquired.)



— — — — — An optimum random pattern is projected to acquire **surface data** of the object. — — — — —

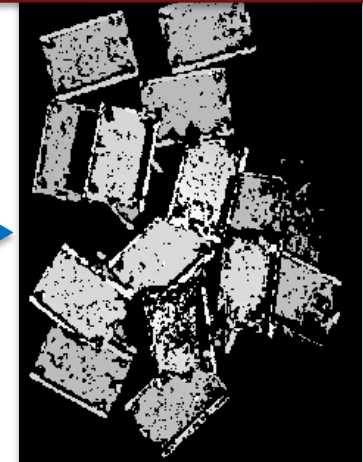


+



Blue random
pattern radiation

Improved object position and orientation detection accuracy





Robot Image Recognition Software

DESCRIPTION OF SOFTWARE FUNCTION

Intuitive operation. Support of bin picking by robot

Functional operation icon

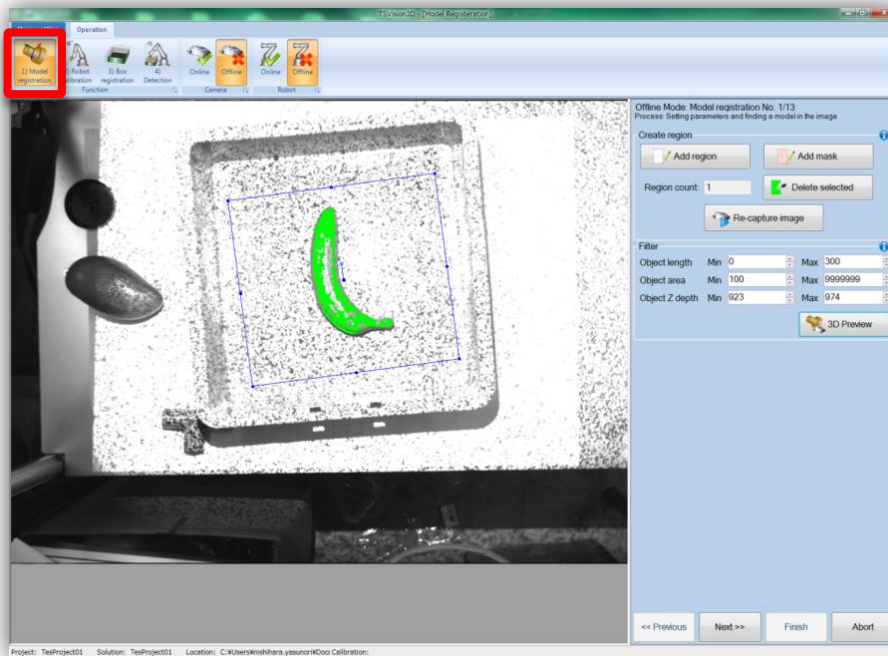
Parameter setting

**Operation in the order of icon
Intuitive and easy to use!**

Detection result display

ID	Model	X	Y	Z	A	B	C	Picking name	Result	Score
0	Pipe	513.321	545.816	-2.774	11.109	1.075	90.382	Pick	NotGoodPick	0.307
1	Bottle	381.740	560.488	-23.647	-1.332	-3.489	-170.615	PickA	BestResult	0.481
1	Bottle	439.508	605.841	-25.951	0.897	-1.057	138.555	PickA	NotGoodPick	0.431
1	Bottle	312.881	478.703	-26.135	-0.659	-1.568	82.047	PickA	CanPick	0.434
1	Bottle	365.463	399.273	-28.202	-0.957	-2.040	117.978	PickA	CanPick	0.476
0	Pipe	427.889	647.508	-20.889	4.308	0.450	64.460	Pick	CanPick	0.380

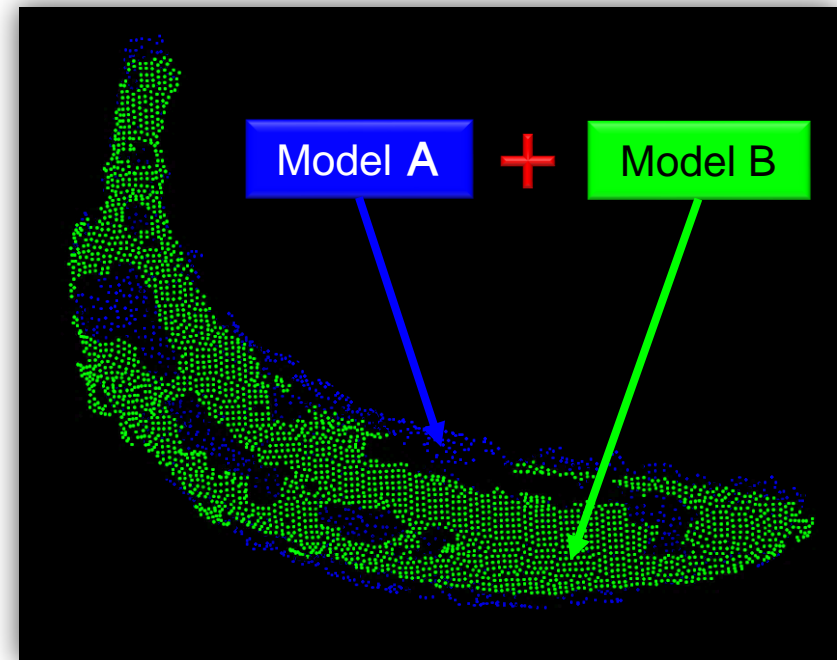
No CAD data required. Easy model registration



A model is registered by enclosing a sample work piece with mouse.

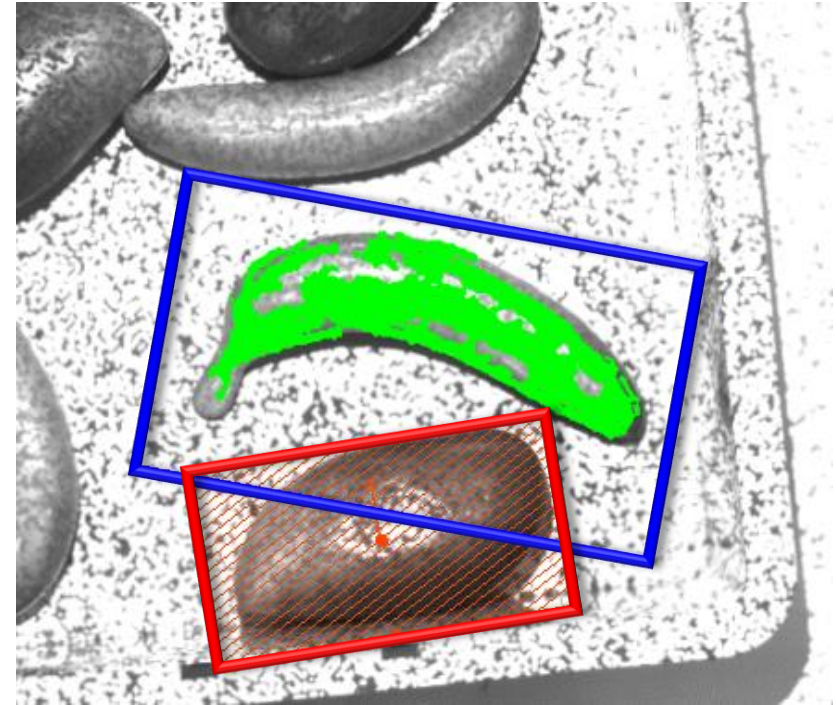
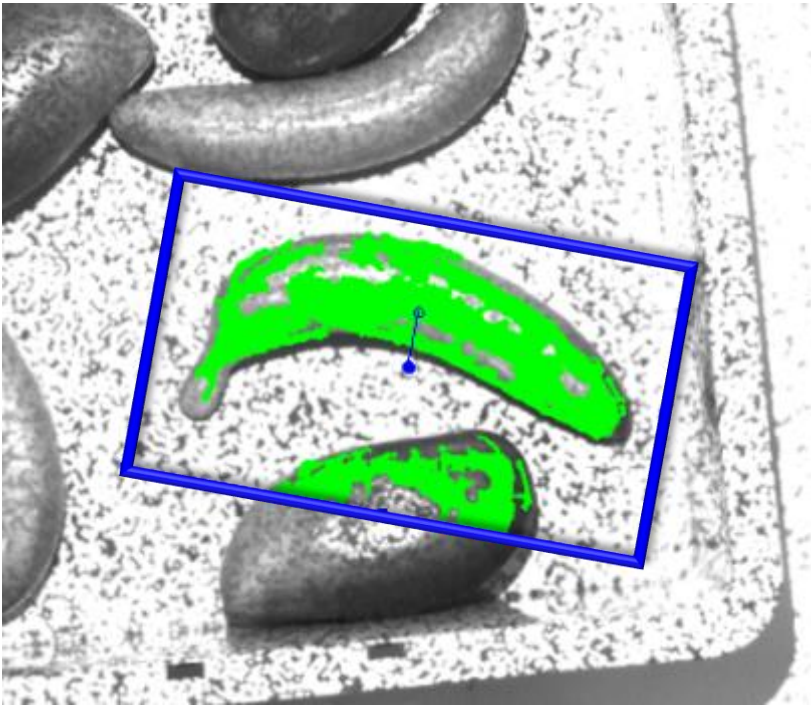


Register banana as model



After capturing the sample work pieces multiple times in different positions and orientations, smooth composite model data is generated automatically.

Model mask function

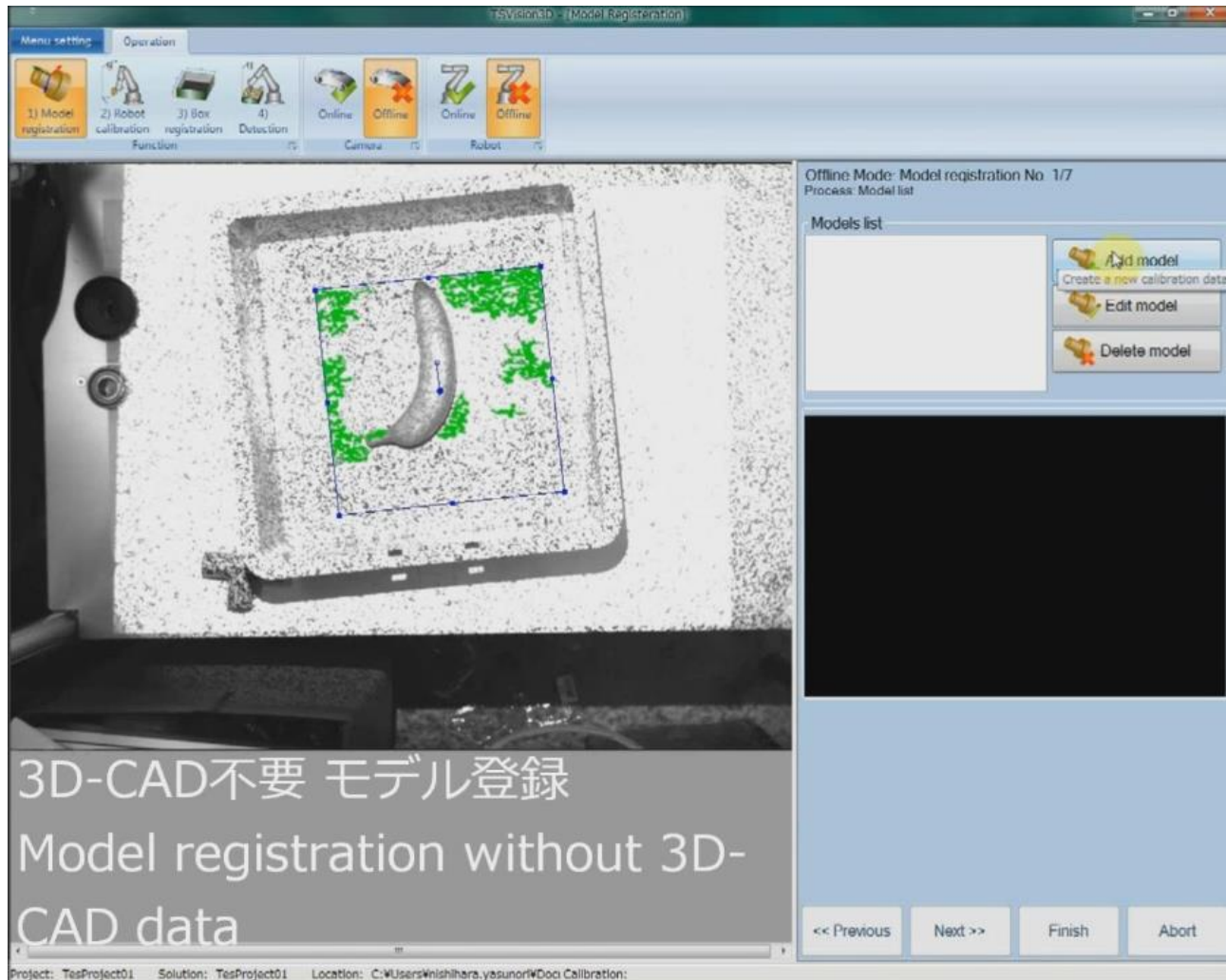


An unnecessary part is excluded from the model.

The area to be inspected can be narrowed down to improve the recognition rate.

(Same usability as 2D vision sensor)

No CAD data required. Easy model registration



Model mask function

The screenshot displays the 'Easy Model Registration' software interface. The main window is titled 'Model Registration' and shows a live camera feed of a green, curved object on a white surface. A yellow rectangular region is drawn around the object, and a green mask is applied to it. The interface includes a menu bar with 'Menu setting' and 'Operation'. The 'Operation' menu is open, showing options for '1) Model registration', '2) Robot calibration', '3) Box registration', '4) Detection', 'Online', 'Offline', 'Online', and 'Offline'. The 'Offline' mode is selected. The 'Create region' section has buttons for 'Add region', 'Add mask', 'Delete selected', and 'Re-capture image'. The 'Filter' section has input fields for 'Object length', 'Object area', and 'Object Z depth', each with 'Min' and 'Max' values. The '3D Preview' button is also visible. The status bar at the bottom shows 'Project: TesProject01', 'Solution: TesProject01', and 'Location: C:\Users\Yasunori\Documents\Calibration:'.

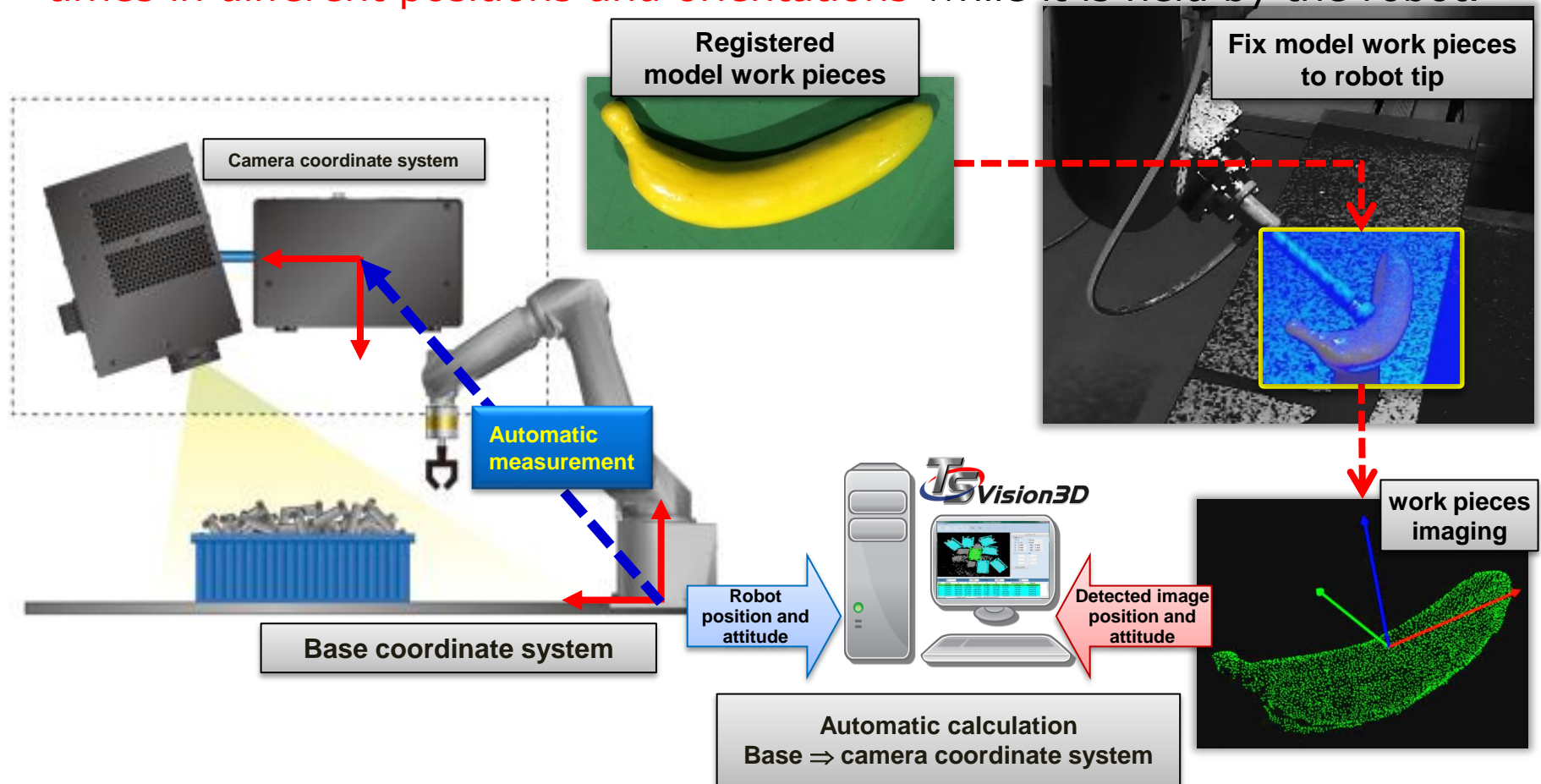
不要な部位をマスキングして認識率改善する事も可能。
Recognition rate can be improved by masking unnecessary part.

<< Previous Next >> Finish Abort

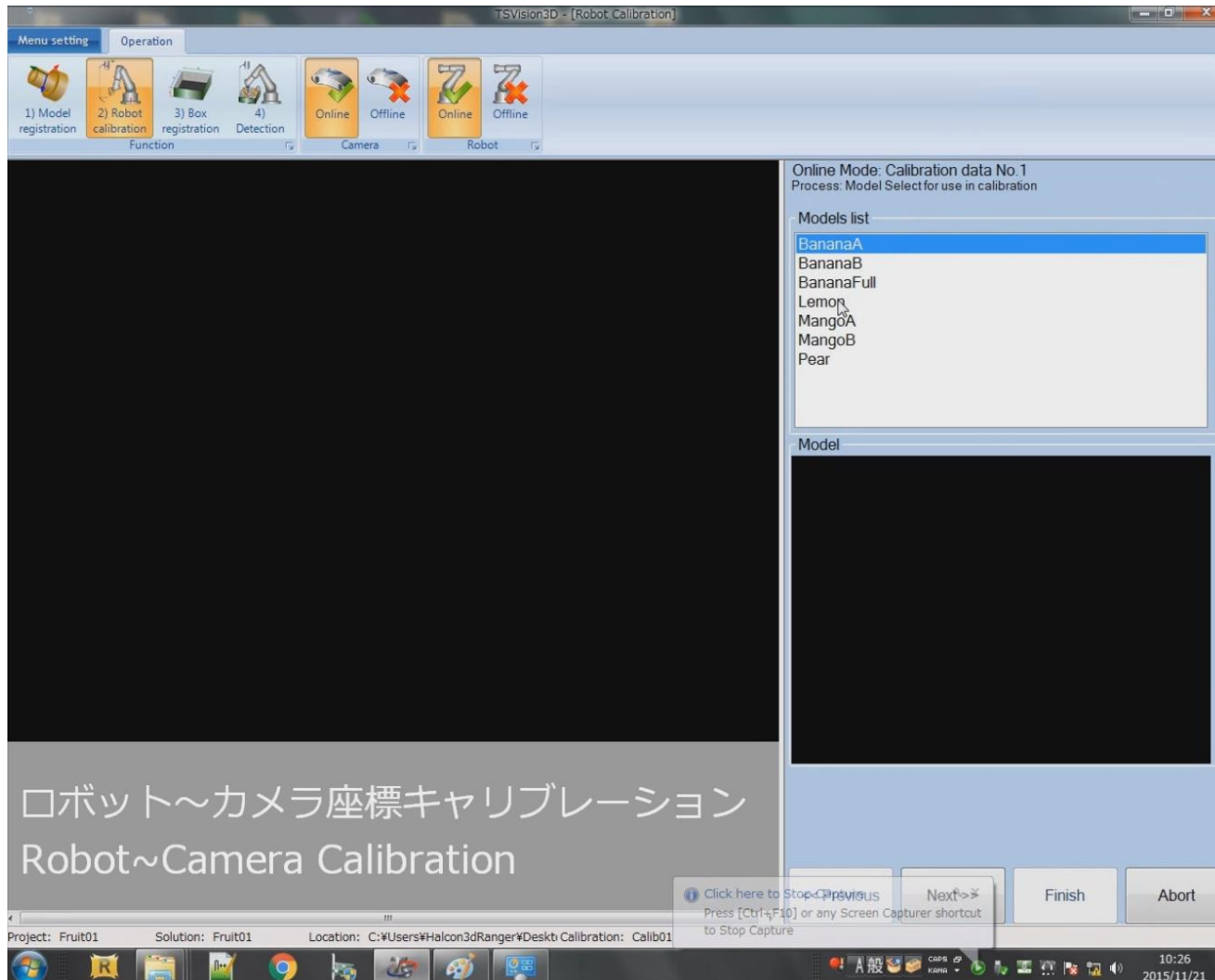
Project: TesProject01 Solution: TesProject01 Location: C:\Users\Yasunori\Documents\Calibration:

Camera and robot coordinate system calibration

The position and orientation of the camera coordinate system in relation to the robot base coordinate system is automatically calculated **just by capturing a sample work piece of previously-registered model multiple times in different positions and orientations** while it is held by the robot.



Camera and robot coordinate system calibration

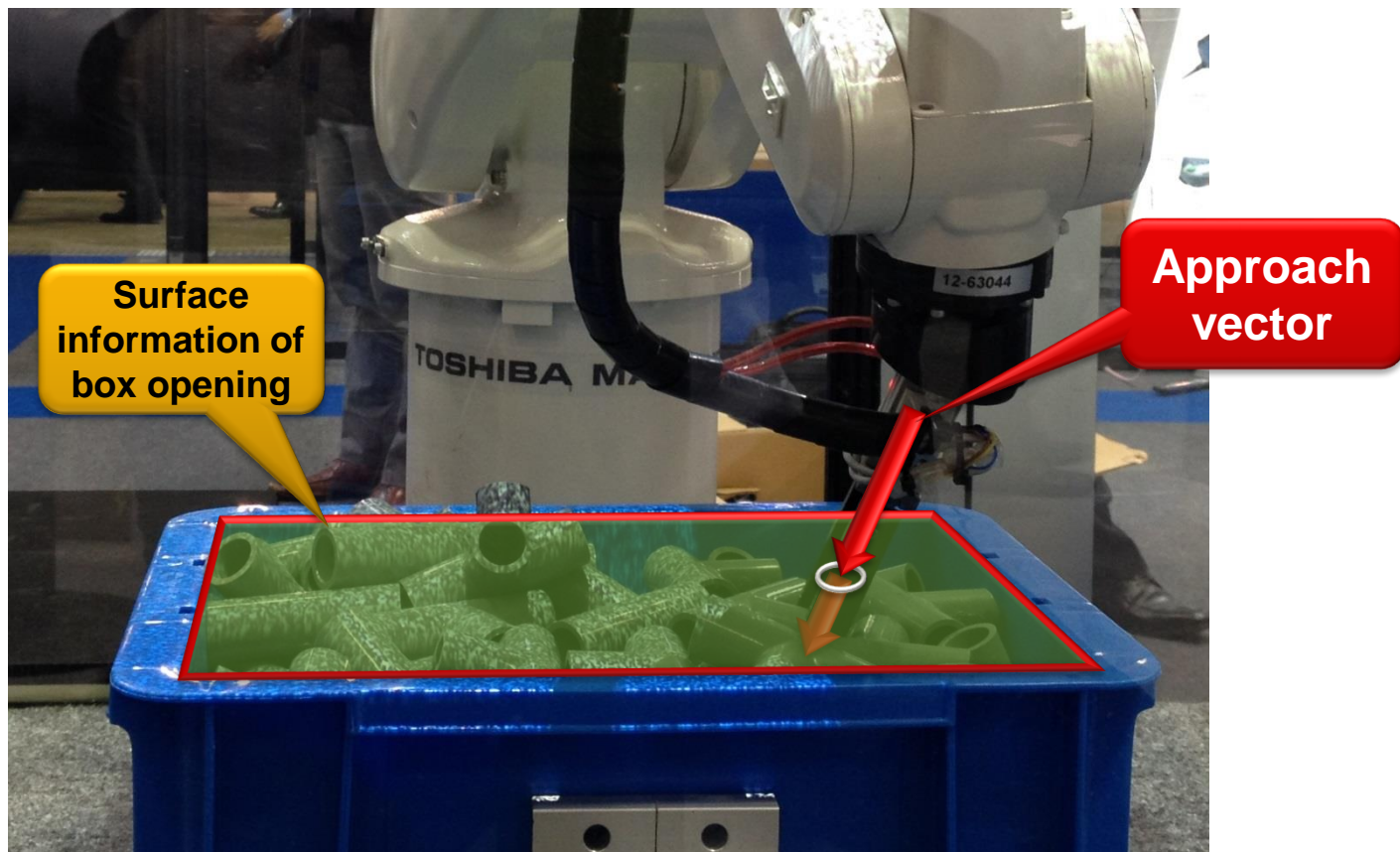


Box Interference Avoidance Function

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The positional relationship between the box opening and gripper during approach is calculated.

Only work pieces that does not interfere with the box is picked.



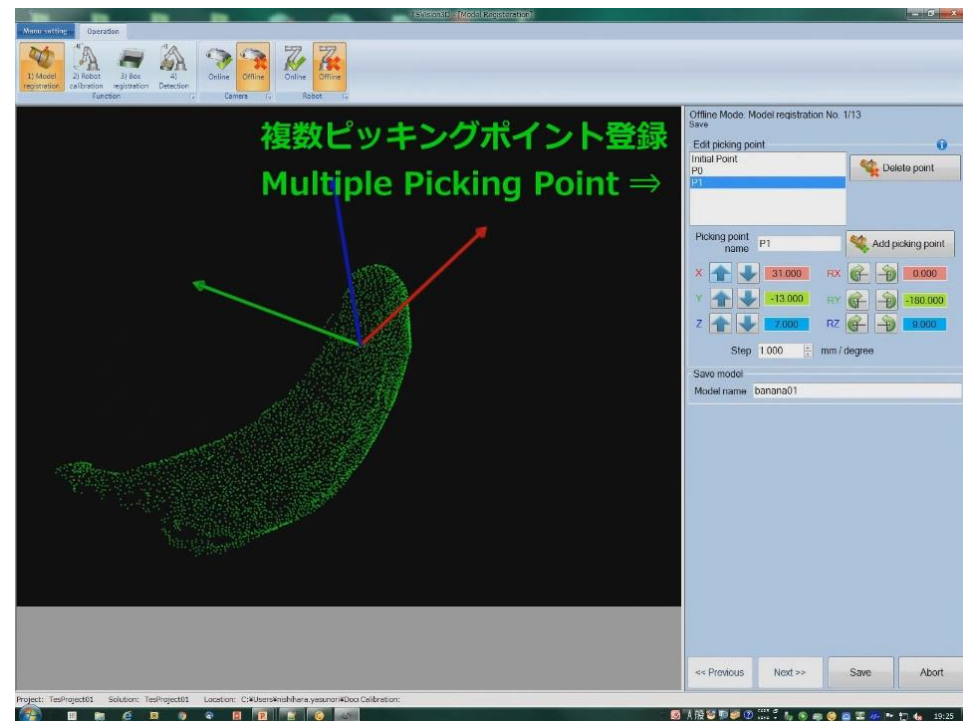
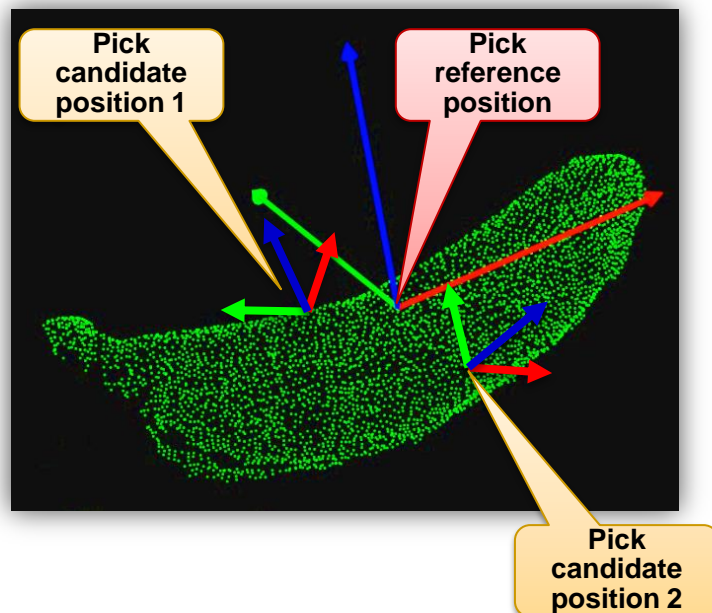
Box position and height \Rightarrow Measured automatically with box enclosed by the mouse.



An optimum picking point is selected.

- ① Arm reach check
- ② Box interference check

If the above conditions are not satisfied,
other candidate pick position is
Automatically selected.



Multiple models can be registered and detected.

Parameters are also easily adjusted!

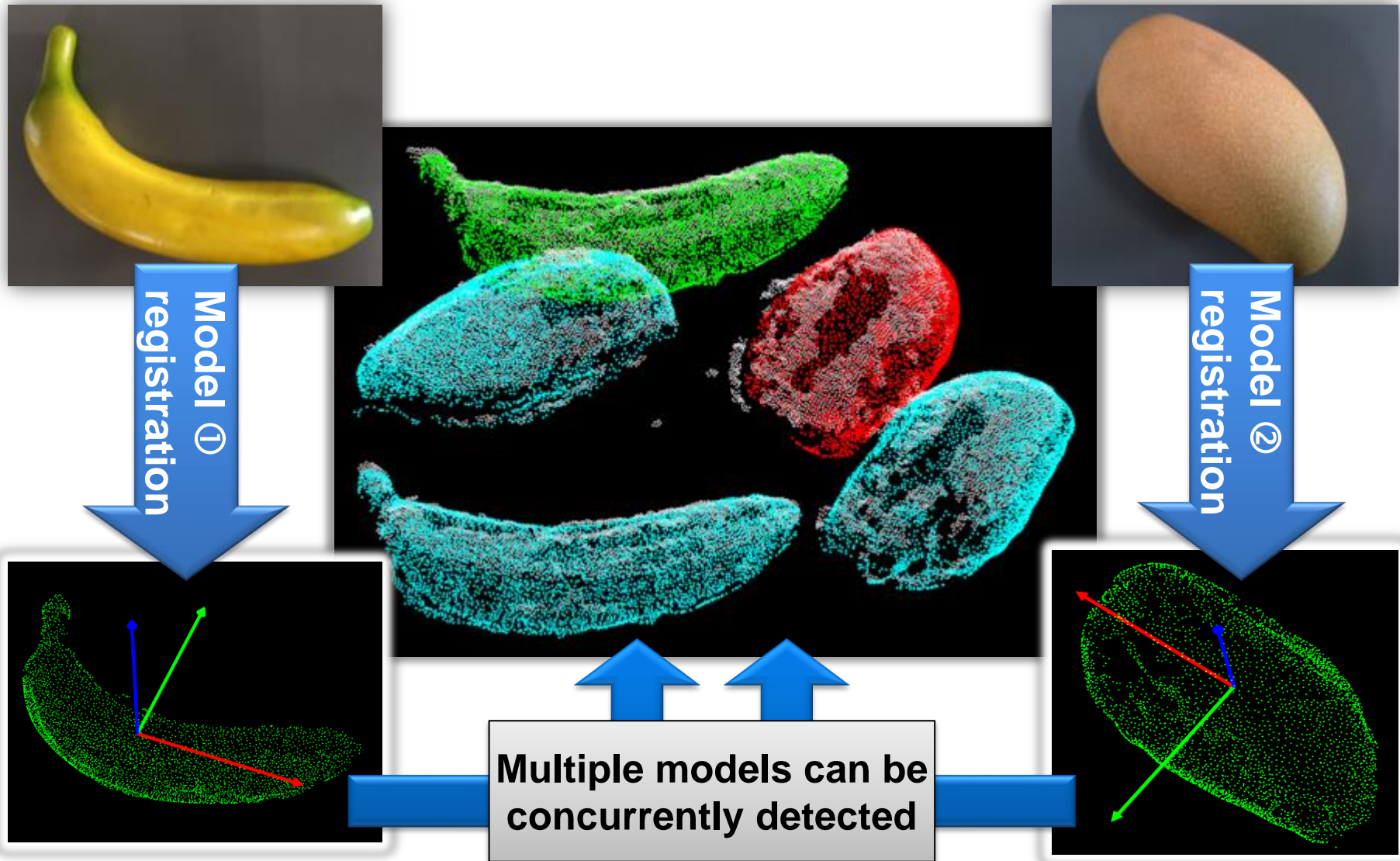
The screenshot displays the TS-Vision3D software interface. The main window shows a 3D point cloud of several objects, including what appear to be bananas and mangoes, rendered in different colors (red, green, blue, and grey). The interface includes a top menu bar with options like 'Menu setting', 'Operation', 'Camera', 'Robot', and 'Setting'. A right-hand panel contains controls for '1 Shot capture image', 'Camera start', 'Picking position' (with fields for ID, Model, Picking name, and coordinates X, Y, Z, RX, RY, RZ), and 'Robot communication' (with buttons for 'Serve on', 'Start', and 'Reset'). At the bottom, a status bar shows 'Found: 5', 'Cycle time: 0.585', 'Average time: 0.585', and 'Image count: 8'. Below this is a table of detection results.

ID	Model	X	Y	Z	A	B	C	Picking name	Result	Score
1	banana01	-79.000	-10.464	939.105	-23.444	1.631	-133.029	Initial Point	BestResult	0.417
0	Mango	13.425	0.018	937.531	171.051	-18.203	41.834	Initial Point	NotGoodPick	0.335
0	Mango	-53.569	-153.721	936.104	153.202	-5.531	-154.307	Initial Point	NotGoodPick	0.324
1	banana01	66.831	-69.362	934.126	-24.217	2.359	-127.583	Initial Point	CanPick	0.504
0	Mango	-48.694	-52.522	861.666	154.723	-24.971	38.857	Initial Point	NotGo	

Project: TesProject01 Solution: TesProject01 Location: C:\Users\yoshihara.yesunori\Doca Calibration:

Multiple models can be registered and concurrently detected

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Easy to use software

- Easier to use
- Easy to use by any beginners



Extended Scope of Application

- Accommodation of irregular-size work pieces
- Improvement of reflective work pieces recognition rate
- Interface to connect with other maker's robot



Thank you

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**In closing,
I thank you very much for your attention.**