Color Inspection and Sorting

SensorApp

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COLOR INSPECTION & SORTING
CONTENTS

About this document

Information on the operating instructions

- These operating instructions provide important information on how to use products from SICK AG. Prerequisites for safe work are:

  ▸ Compliance with all safety notes and handling instructions supplied.

  ▸ Compliance with local work safety regulations and general safety regulations for product applications .

  The operating instructions are intended to be used by qualified personnel.

NOTE

Read these operating instructions carefully before starting any work, in order to familiarize yourself with the product and its function.

The instructions constitute an integral part of the product and must be accessible to staff at all times.

These operating instructions do not provide information on operating the machine or system in which the product is integrated. For information about this, refer to the operating instructions of the specific machine.

The SensorApp "Color Inspection and Sorting"

- inspects unpackaged, primary or secondary packaged objects for color and size

- counts objects of different color and size

- detects the color or color gradations of objects, categorizing them into "good"/"mature", "bad"/"burnt"

- sorts out objects with anomalies (such as wrong color or size)

- detects the integrity and completeness of secondary packaging

- provides configurable result outputs via digital output and TCP/IP
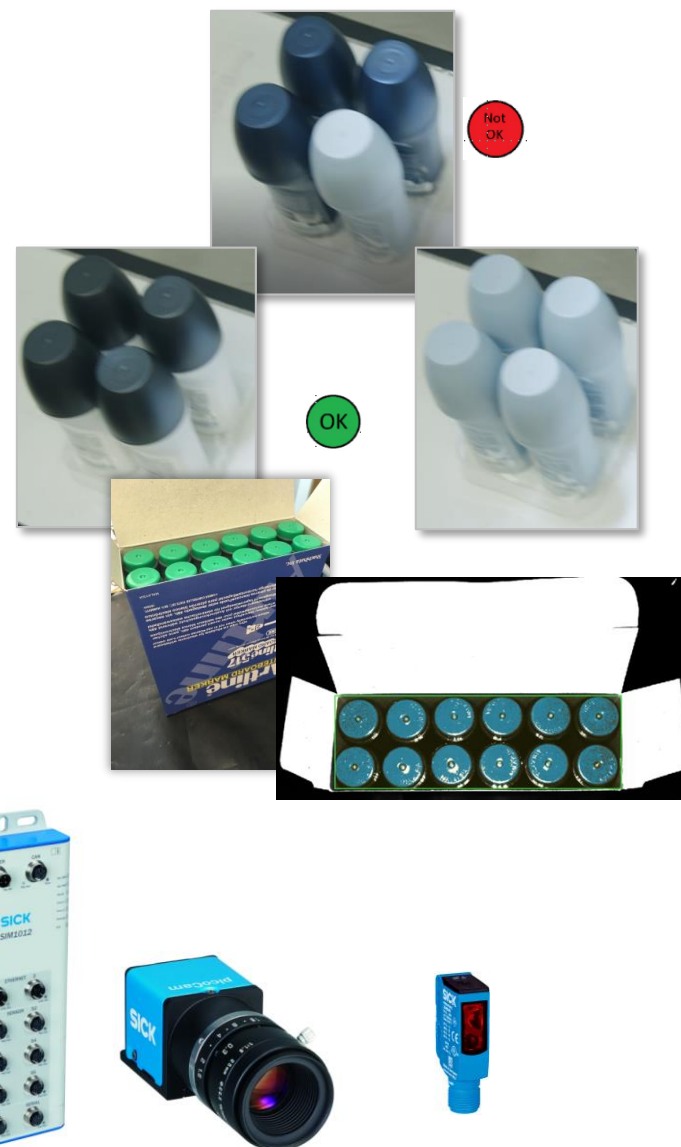
Hardware

The following devices/components support the use of *the SensorApp*:

- SIM4000, SIM1012 or SIM1004 (in preparation)

- picoCam30xC; x= 1,2,3,4 MPx or midiCam60xC; x= 1,2 MPx
    - A C-mount lens must be selected according to
      - application requirements (object distance and field-of-view $\rightarrow$ focal length)
      - the optical class of the camera (e.g. 1/3" or 2/3")

- Illumination unit; the app offers two modes
    - illumination is constantly on
    - flashing via strobe signal (to be supported by illumination unit)

- A photoelectric sensor, e. g. WTB9-3P2461 1049049

- A list of ready-to-use cables can be found in the SIMxxxx Cable Overview
  - Note: Alternatively to the LAN-connector of the PC the USB3-port can be used by means
   of an *USB3/Ethernet-adapter* (configure the IP-address of the adapter to e.g. 192.168.**0.10**)

- Power Supply: Any power supply (24 V output, ≥ 9A/~200W) is suitable
    - A M12/4pin/T-coded/female connector is required to connect to the SIM
      - Recommendation: Power Supply MeanWell 9,2A   GS220A24-R7B
      - Connector: RSonline 807-2918 (s. also SIMxxxx Cable Overview)

App-Installation

- The SICK AppManager software-tool (www.sick.com) is required for installing the app on a SIM device

- Be sure to have the latest FW on the SIM devices. The latest firmware can be found on the SICK Support Portal

Supported Web Browser

- Google Chrome is recommended
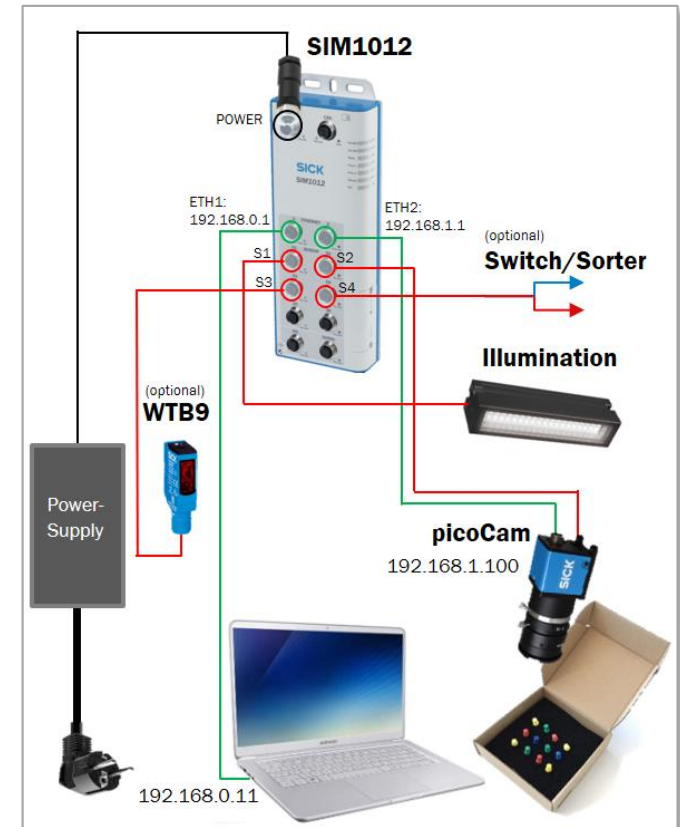
Jobs and Objects

- Up to 12 different objects defined by color and size can be handled in a job

- Up to 10 jobs can be selected in the UI or by remote TCP/IP
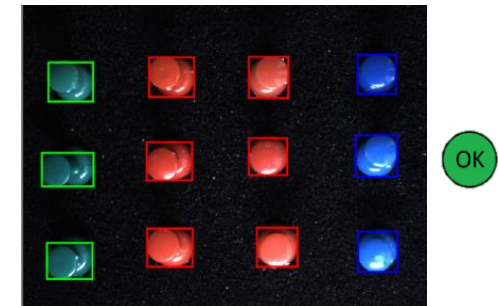
- Objects can be defined by color und pixel size

Rules

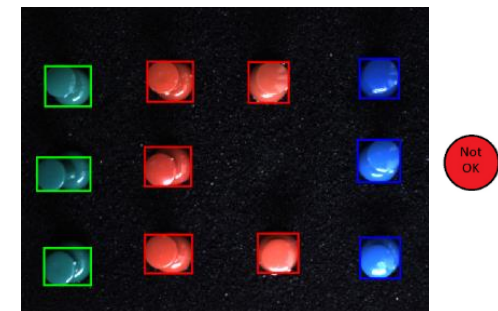- Rules define how many of each object are expected

Example:

Job No. 1 contains green, red and blue objects

Ok-result with 3 x green, 6 x red and 3 x blue objects

Not-Ok-result with 3 x green, 5 x red and 3 x blue objects

COLOR INSPECTION & SORTING
FEATURES

- Demo-mode with inbuilt images helps to understand the function principle

- Easy adaption of IP-address enables a quick set-up of the camera

- Step-by-step guided object definition procedure allows quick task set-up

- Color definition by means of the pipette enables easy teaching of colors
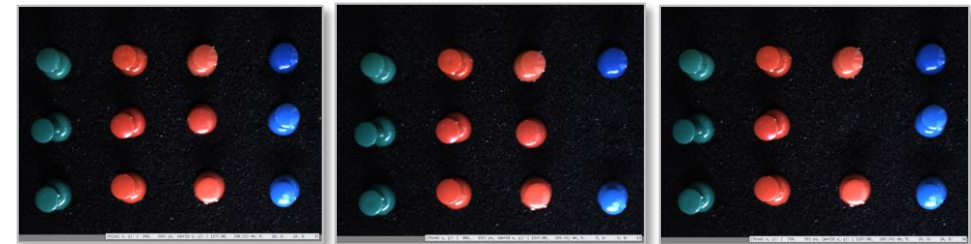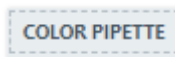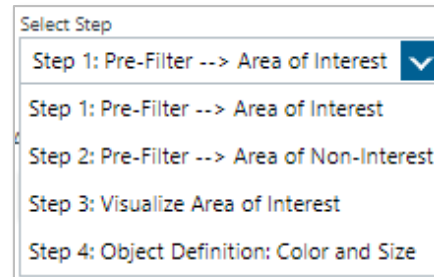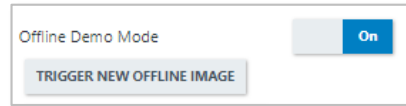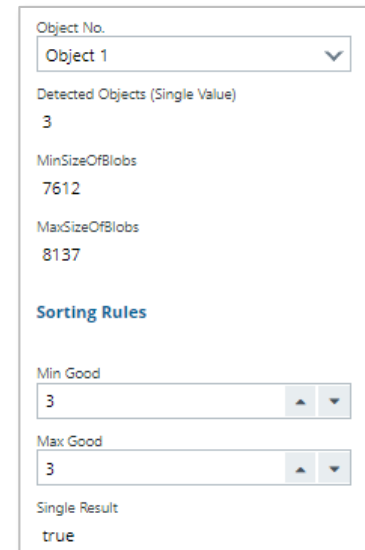
- Flexible rules for each object enables a wide range of decision possibilities for a total result

- Selectable output formats provide easy result handling

Offline Demo Mode — On
TRIGGER NEW OFFLINE IMAGE

Select Step
Step 1: Pre-Filter --> Area of Interest
Step 1: Pre-Filter --> Area of Interest
Step 2: Pre-Filter --> Area of Non-Interest
Step 3: Visualize Area of Interest
Step 4: Object Definition: Color and Size

COLOR PIPETTE

Output Data
No Output
No Output
Only Total Result
Single Results + Total Result
Single Values + Total Result

Camera Configuration
SCAN FOR CAMERA ON ETH2
Camera connected: ●
Required camera IP address
192.168.1.100
CONNECT CAMERA   CHANGE IP ADDRESS

Total Result
OK   Not OK

Object No.
Object 1
Detected Objects (Single Value)
3
MinSizeOfBlobs
7612
MaxSizeOfBlobs
8137

Sorting Rules

Min Good
3
Max Good
3
Single Result
true

COLOR INSPECTION AND SORTING
INSTALLATION - SOFTWARE

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The App must be installed to the SIM by means of the SICK AppManager:

- ☐ Prepare the SIM
  - ➢ Connect the PC and the SIM, use Ethernet port 1;
    Hint: Use an USB3/ETH-adapter (s. section "System Requirements")
    - IP-addresses of the SIMs are assumed as default addresses (as shown in the diagrams)
  - ➢ Connect the Power Supply to the SIM
  - ➢ Power-on the SIM

- ☐ Download the AppManager≥ 1.4. from SICK.com

- ☐ Unzip & install the AppManager on your PC;
  - ➢ Note, that admin-rights might be necessary for the installation

- ☐ Start the AppManager, the SIM should be detected automatically

- ☐ Log-in to the AppPool with your SICK-ID

- ☐ Click "AppPool" and select "Color Inspection and Sorting"

- ☐ Click "Download and Install", confirm installation

- ☐ Wait until the installation process is finished and klick OK

- ☐ Start your internet-browser (preferably Google Chrome)

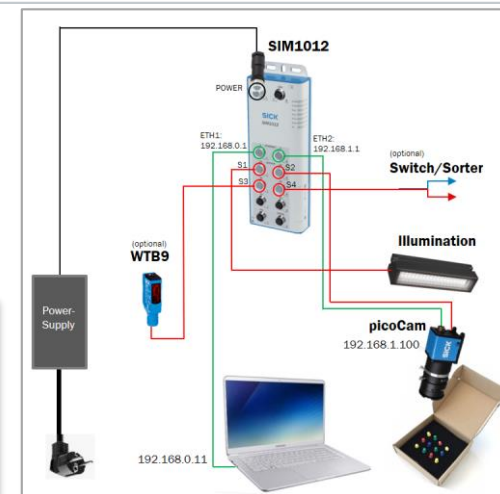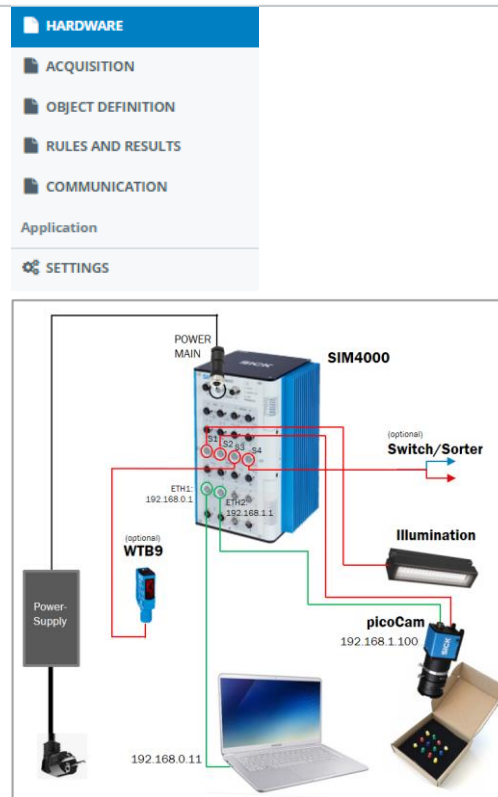- ☐ Type-in the SIM IP-address: 192.168.0.1
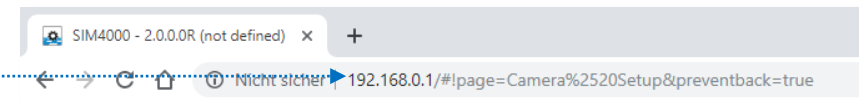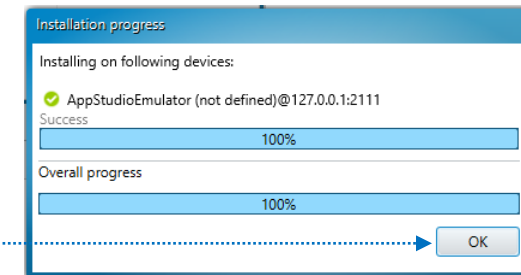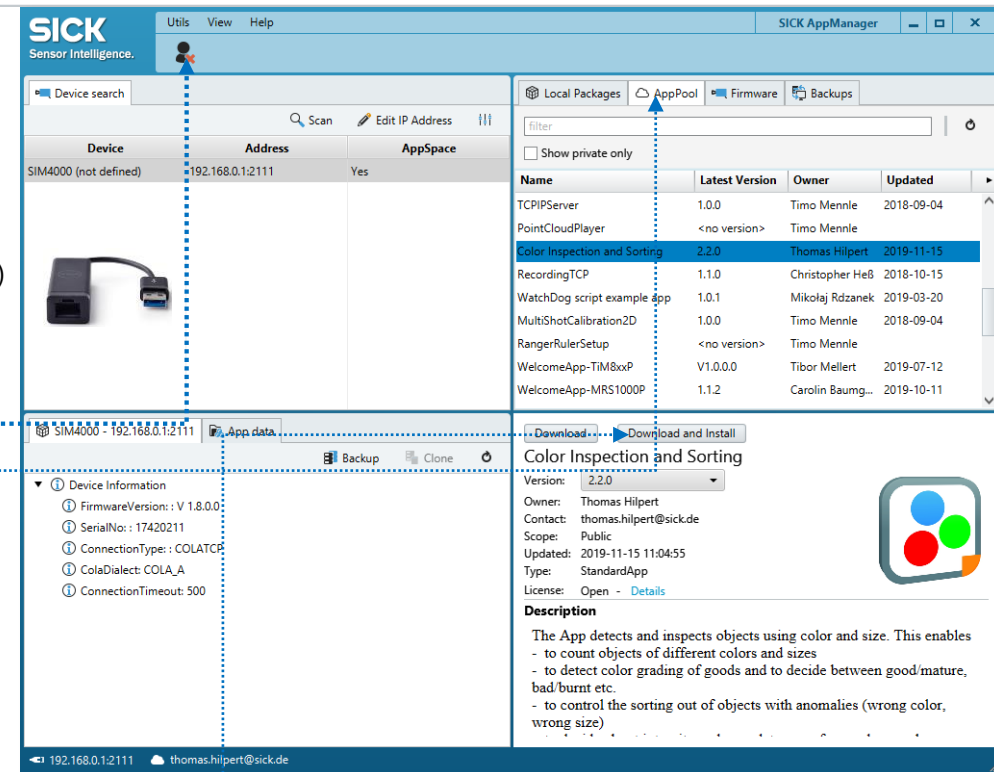
COLOR INSPECTION AND SORTING
INSTALLATION - HARDWARE

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The App requires correctly connected hardware components according to the graphic shown in the HARDWARE page.

❑ Connect the camera to Ethernet port 2

  ➢ The IP-address of the camera can be adjusted in *ACQUISITION* of the App, please use the address shown in the application graphic

❑ Connect the camera to SENSOR port 2

❑ Connect the illumination unit

  ➢ Power controlled illumination will be permanently on

  ➢ Strobe controlled illumination will be triggered by the camera via the SIM

❑ Connect the optoelectric sensor to S3, if required
  Select the trigger mode to "*Digital Input*" in "*ACQUISITION*"

❑ Use S4 to send out the Total Result to a sorter or a switch

❑ Adjust the timing of S3 and S4 if required and save to a job (more about "jobs" in the following)

❑ Power-down and restart the SIM to ensure all devices are connected

Details about the pin usage of the SENSOR ports are described in besides HARDWARE-page.

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The App can be operated by two methods

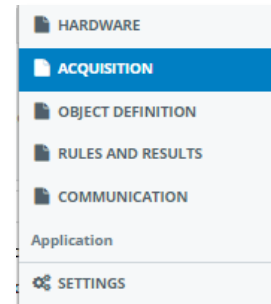|	
📄 HARDWARE	
📄 **ACQUISITION**	
📄 OBJECT DEFINITION	
📄 RULES AND RESULTS	
📄 COMMUNICATION	
Application	
⚙ SETTINGS	

1. Offline-demo mode

Only a SIM, but no camera/illumination /photoelectric sensor required for the offline-demo mode. This mode uses

— 3 pre-stored images

— manually saved live-images, use [SAVE LAST IMAGE]

❑ Activate Viewer and trigger a new offline image
❑ Use manually stored live-images as offline images

Offline Demo Mode **[On]**

[TRIGGER NEW OFFLINE IMAGE]

[CHANGE OFFLINE IMAGE SOURCE]

Activate Viewer **[On]**
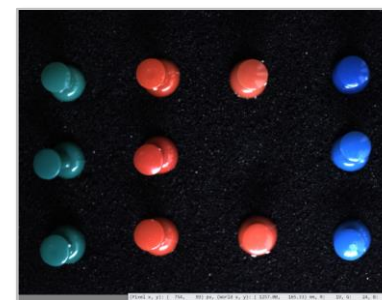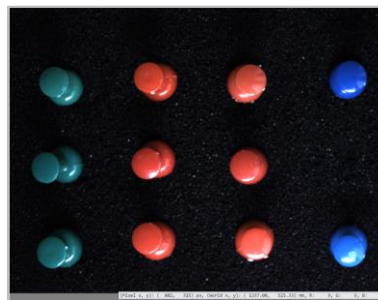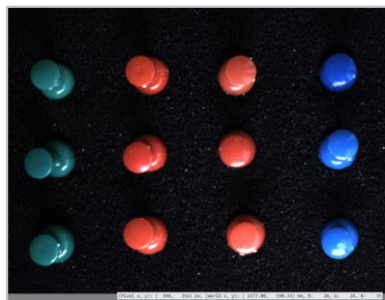
Note: The Resolution Scale Factor is valid for the pre-stored images as well as for live-camera images, use 0,5 for the demo
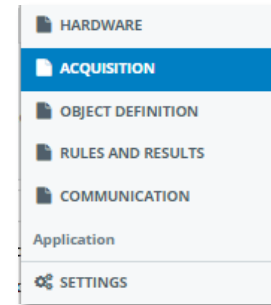
Resolution Scale Factor
[0.5]

The App can be operated by two methods

2. Camera mode using live-images from a camera, requiring

— picoCam or midiCam and suitable lens

— Illumination (permanent or strobe mode, s. COMMUNICATION)

— Opto-electric sensor (optional)

| HARDWARE |
| **ACQUISITION** |
| OBJECT DEFINITION |
| RULES AND RESULTS |
| COMMUNICATION |
| Application |
| ⚙ SETTINGS |

Camera Configuration

SCAN FOR CAMERA ON ETH2

Device: picoCam-302C, with IP 192.168.1.100

Camera connected: 🟢

Required camera IP address
192.168.1.100

CONNECT CAMERA   CHANGE IP ADDRESS

Offline Demo Mode   Off
Activate Viewer   On

Camera Configuration

❑ SCAN FOR CAMERA ON ETH2 to check for the IP-address of connected camera; if result is not identical to required address press CHANGE IP ADDRESS

❑ Select Camera Trigger mode:

- *SW-Trigger:* Trigger new image manually by typing SW IMAGE TRIGGER
  If a strobe based illumination is connected, a flash is activated

- *Continuous Mode:* Select Frame rate accordingly

- *Digital Input:* Camera is triggered by the photoelectric sensor connected at S3 of the SIM. If strobe mode for illumination is active, a flash is activated. The trigger signal can be delayed with *HW-Trigger Delay*

- *Ethernet:* Send "TRG" via TCP/IP to the SIM (s. COMMUNICATION). If strobe mode for illumination is active, a flash is activated

❑ Select a job and save camera settings SAVE CAMERA CONFIGS TO JOBS

❑ Save last image to an internal ring buffer SAVE LAST IMAGE
   - use this image in offline demo mode

Job No.
Job No. 1

Trigger Mode   HW-Trigger Delay [ms]
Digital Input   489

Shutter Time [µs]
20000

Framerate [fps]
2

Gain Factor
12

Resolution Scale Factor
0.5

Define Objects by Region, Color and Size

General:

To get familiar with the app it is recommended to apply the offline demo mode, using the 3 pre-stored images. There are three kinds of colored push pins (green, red and green), which can be considered as three different objects.

- The app allows to specify in complete 10 different jobs (recipes). Jobs can receive individual names. Existing jobs can be overwritten, but not deleted.

- Each job can handle up to 12 different objects
  Example: green push pins are an object

- Each object can be defined by color and size

  — Object color can be specified either by the color bar or using the COLOR PIPETTE. The color value correspond to the color bar. The "Color Tolerance" defines a deviation range of the selected color. The higher the value, the higher deviations of the selected color are accepted.

  — Objects are considered as blobs and as such can be specified by min and max pixel sizes.

- **The menu „Select Step" describes the recommended steps 1 to 4 to perform the object definition (details s. next page):**

  — Steps 1 and 2 are required to define a pre-filtering to decide between foreground (area of interest) and background.
    In step 1 the area of interest will be colored in green.
    In step 2 the detected area of non-interest will be colored in red.

  — Step 3 just views all detected/pre-filtered colored items

  — Step 4 defines color and size of objects

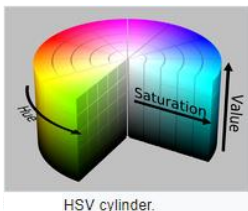## Define Objects by Region, Color and Size

OBJECT DEFINITION

Step by Step-Proceeding I:

- Activate Viewer to "On", TRIGGER NEW OFFLINE IMAGE
- Use "*Select Step*" for Steps 1, 2 and 3" to define foreground and background.

☐ **Step 1:** Set *Selection* value to achieve objects of interest high-lighted in green. All push pins have contrasting values referring to the black background, so in our case the preferred HSV component would be "Value" *)

Select Step
Step 1: Pre-Filter --> Area of Interest

Activate Viewer — On

TRIGGER NEW OFFLINE IMAGE

Pre-Filter Settings --> Area of Interest

Filter Image To Use
Value

Selection
50   255

Detected area of-interest items
(foreground = green)

☐ **Step 2:** Set *Selection* value to achieve the background colored in red; use again "Value" *)

Select Step
Step 2: Pre-Filter --> Area of Non-Interest

Activate Viewer — On

TRIGGER NEW OFFLINE IMAGE

Pre-Filter Settings --> Area of Non-Interest

HSV component to be used for pre-filtering
Value

Selection
0   49

Detected area of non-interest
(background = red)

☐ **Step 3:** Now the Area of Interest can be visualized :

Area of Interest

Select Image to Show
Value Image

Show AOI — On

HSV cylinder.

*) In the App the HSV-color space is applied, which is derivated from the RGB color space. HSV stands for **H**ue, **S**aturation and **V**alue:
- "Hue" is expressing the color in a wheel between 0 and 360°
- "Saturation" gives information about the purity of a color starting from 0 (grey) to 1 (pure saturated color)
- "Value" is referring to brightness, which corresponds to the grey value with black as "0" value.
In the demo case we prefer "Value" for the pre-filtering, as there is a strong contrast in brightness between the black image background and the colored push pins.

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Define Objects by Region, Color and Size

📄 **OBJECT DEFINITION**

Step by Step-Proceeding II:

Object Definition

| Object1 ▽ | Color ▽ |

Object Active ☑

Use ROI for this object ⬚

- ❏ **Step 4:** Define region of interest (ROI), color and size of objects.

    a) Select Object 1 and click "Object Active"
       Note: Only active objects are listed on RULES and RESULTs
       For the demo-mode ROI should not be activated

    b) Use the COLOR PIPETTE to define the target color of an object
       (e. g. green push pin)

       - Set Min/Max Blob Size initially to a huge range
       - See next page how to work with the COLOR PIPETTE

    c) Repeat a) and b) to determine further objects, e. g. red & blue
       push pins.

Min Blob Size	Max Blob Size	Found Blobs
1000 ▲ ▼	100000 ▲ ▼	-
MinFoundBlobSize	MaxFoundBlobSize	
-	-	

How to use the ROI-option (region of interest):

Use the ROI option for an object, if only a certain region of the image is of
interest. Per default the entire image is relevant.

Use ROI for this object ☑ EDIT ROI FOR OBJECT

- ❏ Click EDIT ROI FOR OBJECT and [icon] appears in the left image corner

- ❏ Span a field of interest

    — Change the size of interest by pulling they grey
      field in a corner to the required size

    — Move the ROI-frame by pulling they grey center
      square to the required area

- ❏ Press again EDIT ROI FOR OBJECT to finalize the ROI

Span a region of interest (ROI)
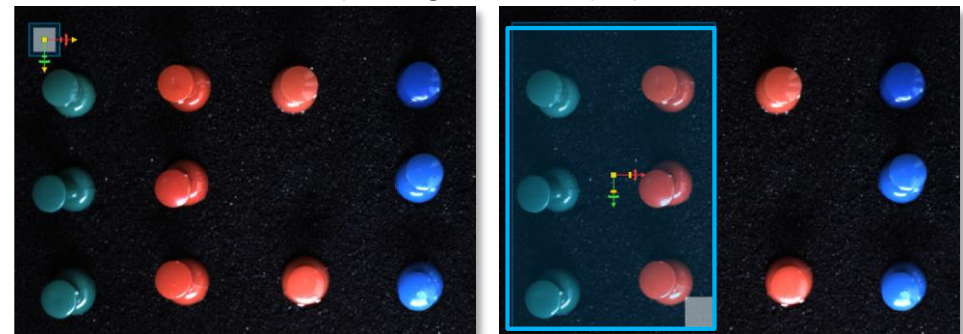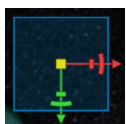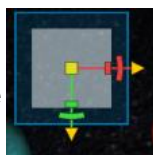
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Define Objects by Region, Color and Size

### How to define the color using the Color Pipette

[COLOR PIPETTE]

❑ Clicking the "COLOR PIPETTE" results in

— the viewer switches to color mode

— that the icon appears in the viewer

❑ Direct the cursor into the frame of the icon, resulting in a grey frame, which indicates the region of interest

❑ Keep the cursor in the grey field and move the icon to the region or object of interest (Fig. 1)

❑ Reduce the grey frame to the required region of interest by clicking on a corner or on a side and draw them to the required shape/size. Correct the position, if required, as shown above (Fig 2).
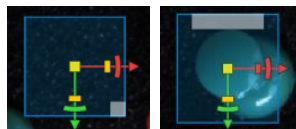
❑ Finalize Color definition by clicking somewhere outside of the icon, resulting in green pixel for detected blobs (Fig. 3)

❑ Vary the Color Tolerance value to achieve max. blobs of the specified object (Fig.3 → Fig. 4)

Recommendation: Set Blob size limits initially to a high range and adjust then both values according the indicated min/maxFoundBlobsize values, bounding boxes should still appear. .
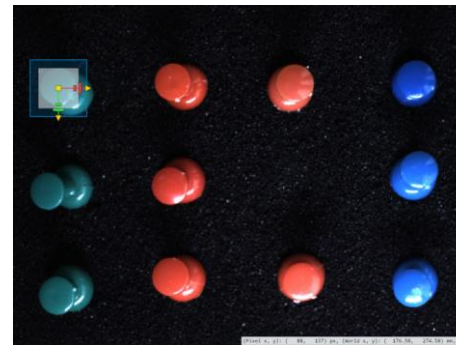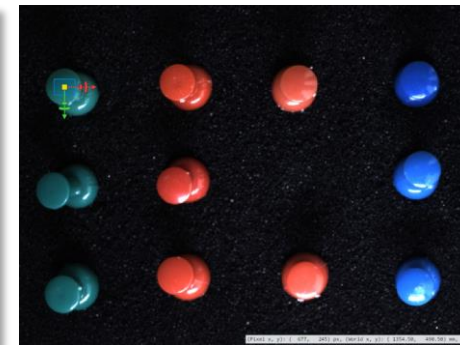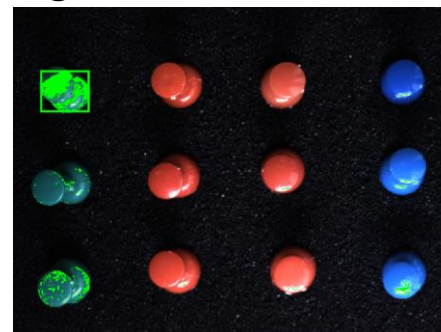

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Color Tolerance
2

Color Tolerance
6

Size

Min Blob Size	Max Blob Size	Found Blobs
4500	6000	3
MinFoundBlobSize	MaxFoundBlobSize	
4882	5114	

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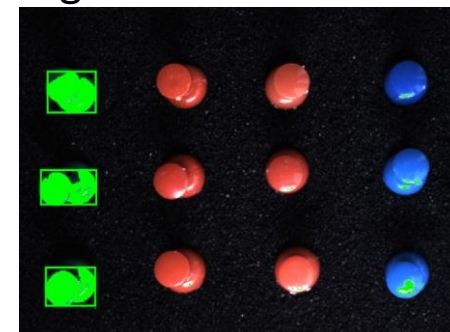
Define Sorting Rules for each object

HARDWARE
ACQUISITION
OBJECT DEFINITION
RULES AND RESULTS
COMMUNICATION
Application
SETTINGS

❑ For each <u>active</u> object a *min Good* and *max Good* number of expected objects can be defined.
Select the objects of interest (only 4 objects can be listed simultaneously, be sure that no other objects are activated accidently)

❑ Activate Processing and Activate View

❑ Trigger new image in case of Offline Demo mode

❑ If <u>all</u> rules are fulfilled, the *Total Result* is (OK) , else (Not OK)
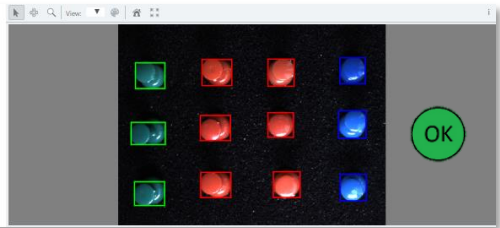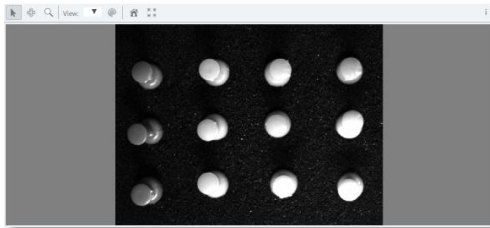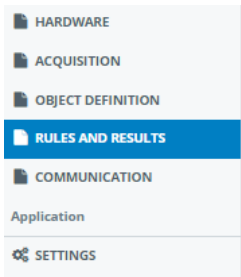
Object No. Object 1 Green Needles	Object No. Object 2 Red Needles	Object No. Object 3 Blue Needles
Detected Objects (Single Value) nil	Detected Objects (Single Value) nil	Detected Objects (Single Value) nil
MinSizeOfBlobs 5062	MinSizeOfBlobs 4190	MinSizeOfBlobs 4557
MaxSizeOfBlobs 5386	MaxSizeOfBlobs 5615	MaxSizeOfBlobs 4901

#	Active Objects
1	Object 1
2	Object 2
3	Object 3

Sorting Rules

| Min Good 3	Min Good 6	Min Good 3
Max Good 3	Max Good 6	Max Good 3
Single Result true	Single Result true	Single Result false
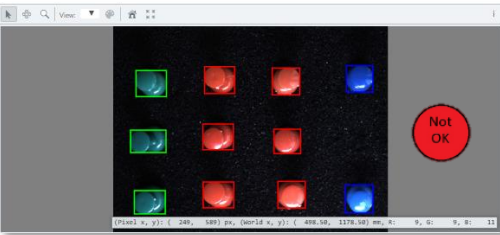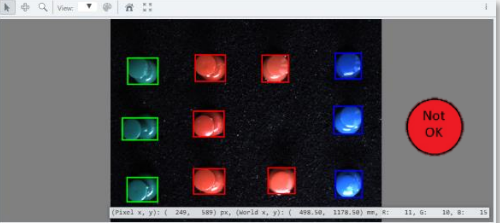
TCP-IP Communication

The SIM acts as a TCP IP client. Activate it if required and type in the server address and the port number.

- **Receiving input data from a TCP IP server:**
  - A camera trigger can be received via TCP IP using the command <STX>TRG<ETX> on the server side (see example with Hercules Communication tool)
  - Job selection per remote can be performed using the command <STX>CHGJOB4<ETX> on the server side (example, switching to job No. 4)

- **Sending output-data to a TCP IP server using the "*Output Data*" menu:**
  - "*No Output*": no result output is transferred
  - "*Only Total Result*": The overall OK/Not OK status is transferred to the TCP IP server as true/false signal
  - "*Single Results + Total Result*": The single results (true/false) of active objects are transmitted together with the total result.
  - „*Single Values + Total Results*": The single values of active objects are transmitted together with the total result.
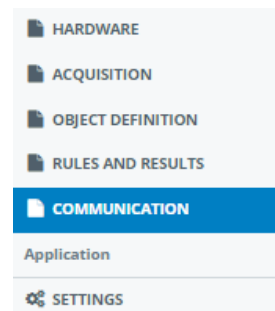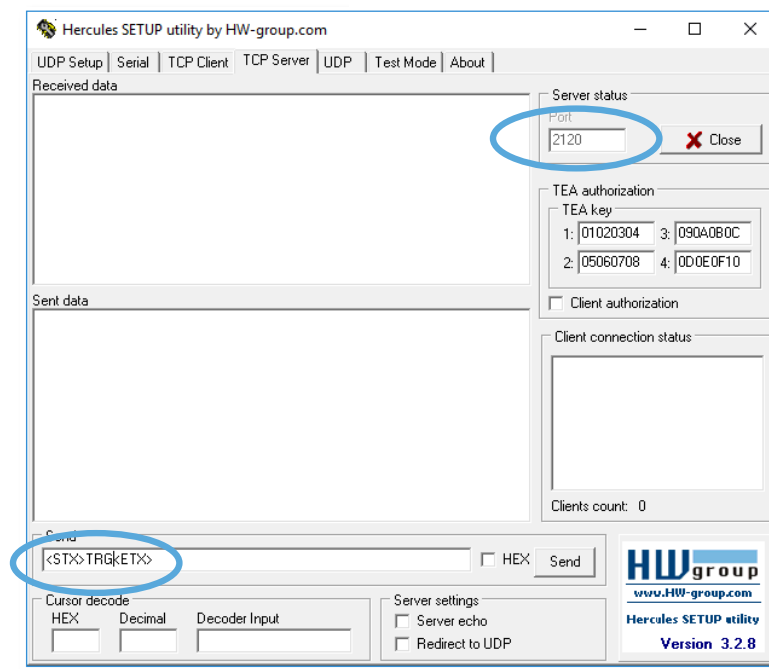
The PC-tool „Hercules" can simulate a TCP/IP server

Australia
Phone +61 3 9457 0600
         1800 334 802 – tollfree
E-Mail sales@sick.com.au

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Phone +43 22 36 62 28 8-0
E-Mail office@sick.at

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E-Mail info@sick.be

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Phone +55 11 3215-4900
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E-Mail information@sick.com

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Phone +420 2 57 91 18 50
E-Mail sick@sick.cz

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Phone +358-9-2515 800
E-Mail sick@sick.fi

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