VeriSens® Application Description

Application: Assembly Verification

Industry: Consumer Products

Product: Plastic Assembly

Background and conclusion

A major manufacturer of filter products needs to be able to verify the assembly of a plastic component. Specifically, it needs to determine the color and number of O-rings on the end fitting of a filter module. No specific part positioning method has been specified, although it is known that the components will be able to be viewed one at a time with a discretionary lighting and camera sensor location.

FIGURE 1: SAMPLE PART

Testing was performed with a sample set of 3 parts. Two of the parts have two black O-rings; one part sample has one red O-ring. An optional requirement was that the vision sensor be able to determine the width, or thickness of the O-rings. Budget constrains precluded the ability of the sensor to perform that inspection due to resolution constraints.

The Baumer VeriSens® vision sensor was readily able to determine the difference between red and black O-rings and the number of O-rings present.

Figure 1 is a photo of the sample parts.

With the appropriate lighting and optics, the Baumer VeriSens vision sensor has been shown to be an effective tool to determine the number of O-rings and to differentiate between red and black O-rings.

INSPECTION STATION OVERVIEW

Figure 2 is a picture of the laboratory setup for the code reading application. Testing was performed using a Baumer VeriSens® XF100 with a 0.3 Megapixel sensor and a fixed 10mm lens. The XF100 has an internal light source that can provide front lighting. The sample part was placed on a flat surface. In order to duplicate actual in-plant conditions, a significant amount of ambient light was permitted.

Following are specific lighting and optics parameters:

XF100 (0.3 MP)

- 10mm lens
- Working distance: Approximately 80mm;
- Field of View (FOV): approximately 30mm in the greater (y) dimension.
- Illumination: Front Light

FIGURE 2: LABORATORY SETUP

VeriSens® setup/ configuration are performed on a PC connected via an Ethernet cable. Once configuration is performed, the sensor operates stand-alone and the PC is not required. The Ethernet connection, however, may be used for data transfer (e.g. location, bar code, OCR) via TCP/IP for applications such as motion control and data acquisition. The sensor can store up to 255 configuration recipes ("jobs"). VeriSens® has 5 digital inputs and 5 digital outputs. These are used for such functions as image acquisition, job selection, part reject, etc.

VISION 1-2-3: IMAGE- TOOLS- I/O

Inspection setup with VeriSens® from Baumer is simple and intuitive. The "AppSuite" configuration software consists mostly of drop-down menus and slide bar adjustments. There are few text entries required, and no programming or scripting. There are three steps to configuring the VeriSens® vision sensor, each of which is described in detail for this application below:
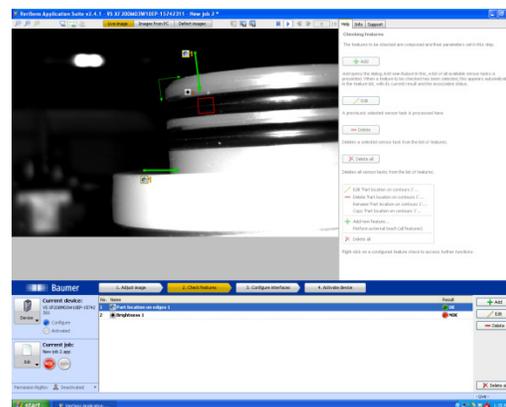
1) Adjust Image
2) Select the appropriate vision tool
3) Configure Input/ Output Interfaces

When these three steps are completed, simply download the configuration parameters from the PC to VeriSens®.

STEP 1: ADJUST IMAGE

The first step of any automated visual inspection is to establish proper part positioning, lighting and lens focus. The intent at this step is to obtain a part location, Field Of View (FOV) and lighting scheme appropriate for the necessary inspection algorithms ("Tools").

Figure 3 illustrates the illumination, FOV and focus suitable for detecting one Black O-ring.

STEP 2: CHECK FEATURES

Step 2 is to select the proper software tools to perform the required inspection(s). VeriSens® is equipped with a complete software library of powerful vision algorithms including:

FIGURE 3: ADJUST IMAGE

100 Series:

- Pattern Recognition
- Normalized correlation
- Edge Detection
- Connectivity Analysis
- Grey scale Histogramming

These algorithms permit functions such as:

- 360 degree part location
- Image template matching
- Measurements and Dimensions

- Feature extraction (area, x/y location, brightness)

200 Series:

- All 100 Series tools described above
- Bar code read and quality
- Matrix code read and quality
- Optical Character Recognition (OCR)
- Optical Character Verification (OCV)

In this application two software tools were needed to detect two O-rings, the "Locate on Edges" tool and the "Brightness" tool.

FIGURE 4: LOCATE ON EGDES AND COUNT AREA- BAD

Note the green horizontal and vertical lines at the top and left side of the part in Figure 4. During evaluation, a number of parts was placed in nearly, but not precisely, the same location in front of the vision sensor. In order to be able to position the Brightness tools in the same locations with respect to part motion, adjustments for vertical and horizontal positional displacement needed to be made. Thus, as the apparent edges of the part move within the FOV, the inspection tools, Brightness, will move accordingly.

FIGURE 5: KNIT LINES, GOOD

Also in Figure 4, when applying the Brightness tools, the gray scale value (0=black; 255 = white) must match the taught values in order for the part to be considered good. One square Region of Interest (ROI) and one round ROI were employed to demonstrate versatility.

In Figure 5, the Brightness tool serves the same purpose as in Figure 4. The taught gray scale value, however, is different from that of the black O-ring.

STEP 3: CONFIGURE INTERFACES
Step 3 is to configure the outputs. VeriSens® has 5 digital inputs and 5 digital outputs. In this instance, one of five digital outputs can be assigned to provide a signal corresponding to a non-conforming condition for. This digital output is sent to the machine's reject circuit.

VeriSens® also can transmit via TCP/IP ASCII data corresponding to results values, positional information, good and bad images, etc.
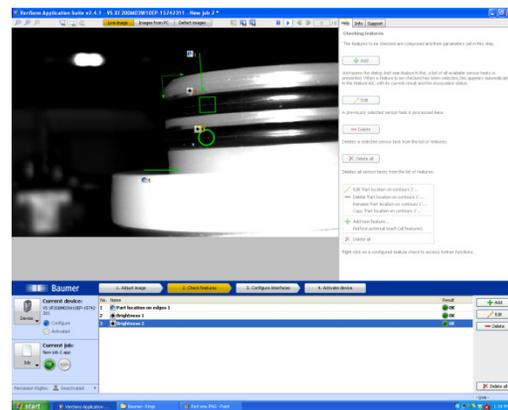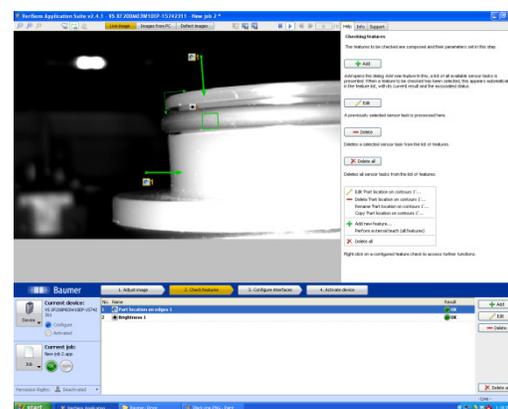
STEP 4: ACTIVATE VERISENS

Step 4 is to simply download the configuration parameters to the VeriSens®. The job may also be stored on the configuration PC prior to activation. Once activated, VeriSens functions as a stand-alone sensor and the PC can be disconnected.

OPERATION

No operational parameters were specified.

DELIVERABLES (SOME ITEMS BY OTHERS)

A typical system contains the following (one per lane):

- (1) Baumer VeriSens® : VC XC100M03X00EP- IR

- (1) Baumer Connector Cable for power and I/O: ESG 34JP0200G Flying Lead

- (1) Baumer Ethernet cable: KSG34A/KSG45AP0200G/E

- (Optional) Additional one each of the three above for knit lines

- Baumer VeriSens® Installation assistance and training: one day- no charge

- Peripheral equipment (Power supply, enclosure, I/O terminals, annunciator, mounting, etc.- by others)

- Engineering and documentation (by others)

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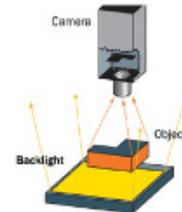Jon Chouinard, Vision Products Business Development Manager, East

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GLOSSARY

Back Lighting   Lighting technique in which the light source and the camera are on opposite sides of the part to be inspected.

Contrast   Measured in grayscale (Black = 0; white = 255).

A minimum contrast must be present in order to differentiate a feature from its background.

BACKLIGHT

Dual On Axis Light   (DOAL) On Axis illumination uses beam splitting techniques to enable the illumination to be positioned between the camera and the object so that the camera is situated behind the light. Note: Due to light loss in the beam splitter the unit generally needs to be positioned as close as possible to the object.
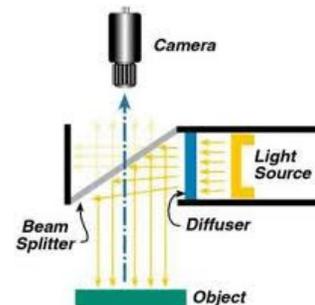
Edge Detection   A software tool that calculates the gradient location across a pixel matrix based upon the difference between the grayscale values. Typically, a nearest line fit is calculated across several pixels within the maximum gradient and this line is determined to be the edge.

Feature Extraction   The ability of machine vision software to separate a feature from its background and determine some attribute (area, brightness, etc.)
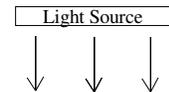
Front (or Top)

Lighting	Lighting technique in which the light source and the camera are on the same side of the part to be inspected.
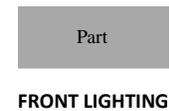
Camera

Gray Scale	In an 8 bit monochrome system, black =0 and white = 255 with values between depicting varying shades of gray.

Light Source

Optical Character

Recognition (OCR)	The ability of machine vision software to determine the value of a string of previously unknown characters.

Part

FRONT LIGHTING

Optical Character

Verification (OCV)	The ability of machine vision software to determine whether or not the value of a string of previously taught characters matches the current image.

Resolution	Measured in Units of measure per pixel.

Field of View ÷ minimum number of pixels on the sensor. For example, a 1" FOV with a VGA sensor has a resolution of approximately .002"

Resolution = FOV/pixels Resolution = 1"/480

Resolution =.002"/ pixel

Structured Lighting Lighting technique whereby the illumination source has a defined geometry: line, grid, pattern, etc. It is often employed to obtain geometric information about a part that is inspected. The vision system measures attributes of the light pattern in order to obtain information about the part. Below examples are: (1) Line used to determine vertical displacement on a paper feed; (2) three line pattern used to count crayons in a box; (3) Grid used to detect 3D contour information.

| PAPER VERTICAL DISPLACEMENT | CRAYON COUNT | GRID PATTERN |

Threshold (Gray Scale) With binary algorithms**,** the gray scale value above or below which the pixel values will be recognized.