
VERISENS® APPLICATION DESCRIPTION

**APPLICATION: ENVELOPE WINDOW
DETECTION**

INDUSTRY: CONSUMER PRODUCTS

PRODUCT: ENVELOPE



BACKGROUND AND CONCLUSION

A major manufacturer of office products needs to verify that the plastic film covering a window on an envelope is present and intact. No material handling system was specified for this report, so the part presentation apparatus is unknown. This report documents the vision application with regard to the optimal method of detecting the envelope window.

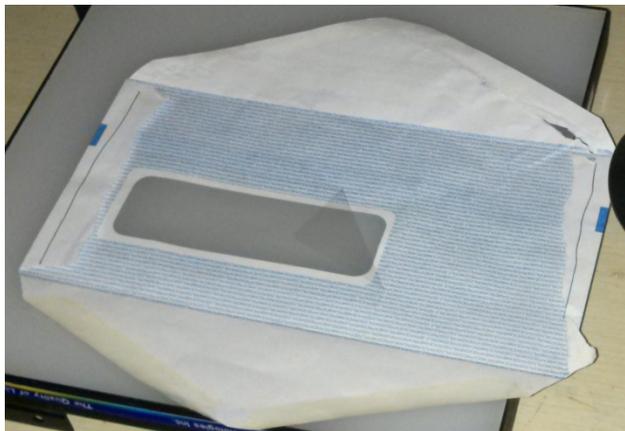


FIGURE 1: SAMPLE PART

Figure 1 is a photo of the part. Of concern is the intactness of the plastic film covering the window on the envelope. Note that on this sample a portion of the window is folded. The vision sensor must be able to detect the partial or complete absence of the film (no minimum area of “absence” has yet been specified).

Testing was performed with a sample set of 2 envelopes. Within parameters described below, it was determined that the Baumer VeriSens® vision sensor is able to detect the windows as required. One sensor will be required.

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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. The sample part was placed on a flat, backlit surface. Following are specific lighting and optics parameters:

XF100 (0.3 MP)

- 10mm lens with polarizer
- Working distance: 310mm;
- Field of View (FOV): approximately 130mm in the greater (y) dimension.
- Illumination: Back 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 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.

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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. Figure 3 illustrates the raw image applying a back light.

The intent at this step is to obtain a lighting scheme appropriate for the following inspection algorithms (“Tools”).

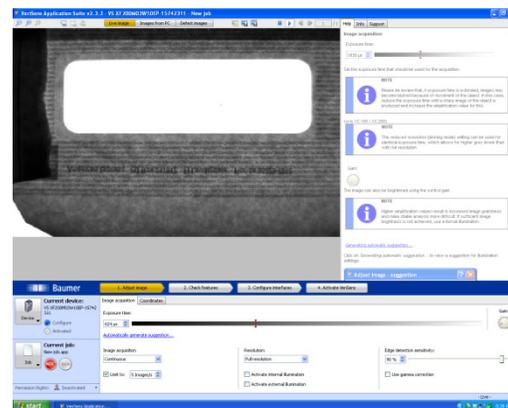


FIGURE 3: ADJUST IMAGE

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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:

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)

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In this application only one software tool was needed, the “Count Areas” Tool.

Figure 4 is a screen capture of one of the part samples with the Count Areas Tool applied. This sample part has a defective window; it is folded at the upper right hand corner. Close examination shows that there are actually three areas of different brightness: that where there is no film covering the window; that where the window is folded, yielding a double film thickness; and, that where the film thickness is normal. These brightness differences will be used to determine the status of the film.

The Count Areas Tool has four primary adjustments: Bright on Dark/ Dark on Bright, Binary Threshold and an Area Filter with high and low adjustments.

In Figure 4, the threshold value has been adjusted to 56. This means that pixels with a brightness of 56 and higher will be recognized by the VeriSens®. Pixel values ≥ 56 indicate “Window”

In Figure 5 the threshold value is 151. This means that pixels with values at or above 151 will be recognized, while those with values below 151 will be ignored. Pixel values ≥ 151 indicate “No Film”

In Figure 6 the threshold value is 128. A threshold value ≥ 128 indicates “No Double Film”.

By adjusting the Area Filters it is possible to detect any or all conditions.

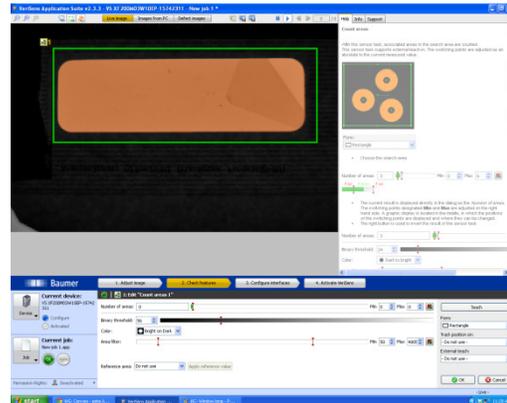


FIGURE 4: WINDOW FILM VARIATIONS

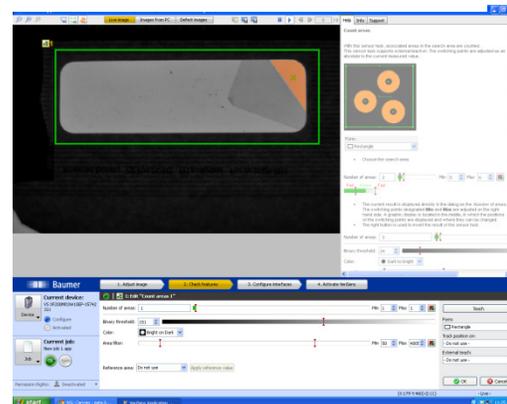


FIGURE 5: BRIGHTNESS, NO WINDOW

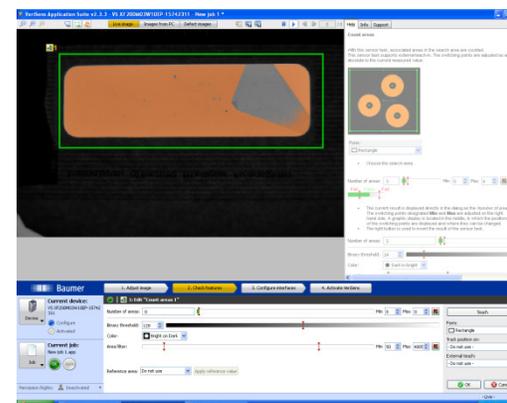


FIGURE 6: FOLDED FILM

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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. This digital output is sent to the machine's reject circuit.

Additionally, the VeriSens® has the ability to transmit via TCP/IP ASCII data corresponding to results values, positional information, good and bad images, etc.

STEP 4: ACTIVATE VERISSENS

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 criteria were submitted.

DELIVERABLES (SOME ITEMS BY OTHERS)

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

- (1) Baumer VeriSens® XF-100: VC XF100M03X00EP
- (1) Baumer Connector Cable for power and I/O: ESG 34JP0200G Flying Lead
- (1) Baumer Ethernet cable: KSG34A/KSG45AP0200G/E
- Baumer VeriSens® Installation assistance and training: one day- no charge
- Lighting (by others)
- Optics (by others)
- Part handling (by others)
- Peripheral equipment (Power supply, enclosure, I/O terminals, annunciator, etc.- by others)
- Engineering and documentation (by others)

Please contact your Baumer representative for a budget estimate.

CONTACT

Baumer, Ltd. USA

Pete Kepf, Vision Products Field Application Engineer

pkepf@baumer.com

865-518-1985

Baumer USA, Ltd.

Doug Erlemann, Vision Products Business Development Manager, West

derlemann@baumer.com

Baumer USA, Ltd.

Jon Chouinard, Vision Products Business Development Manager, East

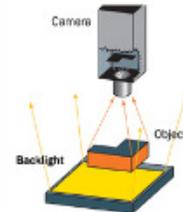
jchouinard@baumer.com

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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, resulting in a silhouette.

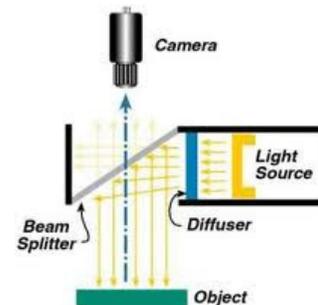
**Contrast**

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)

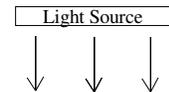
Lighting

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



Gray Scale

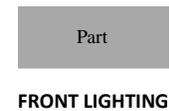
In an 8 bit monochrome system, black =0 and white = 255 with values between depicting varying shades of gray.



Optical Character

Recognition (OCR)

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



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"

$$\text{Resolution} = \text{FOV}/\text{pixels} \quad \text{Resolution} = 1"/480$$

$$\text{Resolution} = .002"/\text{pixel}$$

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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.

**Threshold (Gray Scale)**

With binary algorithms, the gray scale value above or below which the pixel values will be recognized.