

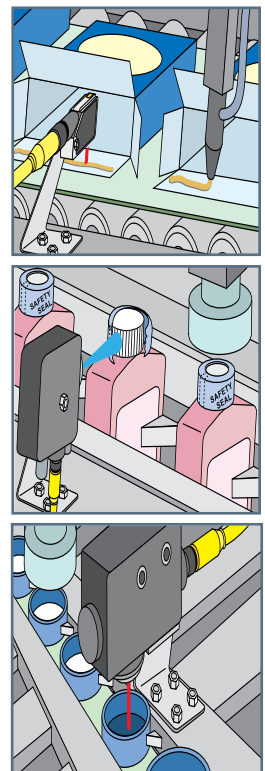


COLOR-BLIND NO MORE

CONTRAST AND COLOR SENSORS OPEN EYES IN PACKAGING

Not just for detecting registration eye-marks anymore, contrast and color sensors have a wide range of different potential uses in packaging and converting processes. This white paper identifies ten not-so-common applications where contrast and/or color sensing could do the job of a much more expensive vision sensor. Luminescence sensing is also discussed.

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In a black and white world, using photoelectric sensors would be very straightforward. Every photoelectric sensor would be specified with two sensing ranges, one for the black targets and one for the white targets. Since there would be no other colors, there would be no concerns about the effect of color on reflectivity and sensing range, or monitoring various shades of a color, or identifying one color out of a whole spectrum of possibilities.

Of course, things are not so simple. In their technicolor lives, photoelectric sensors may be required to sort colored products, identify coded markings, and confirm the presence of an adhesive or date codes on a package. Unfortunately, they are typically not equipped to handle such demands. And vision systems, with their four and five digit price tags, are often cost-prohibitive.

Enter contrast sensors and color sensors. Bridging the gap between photoelectric sensors and vision systems, they are equipped to see even slight differences of the same color. While a photoelectric sensor simply evaluates the amount of transmitted light that returns to the receiver, a contrast or color sensor must evaluate the type of reflected light. Contrast sensors, also called color mark or registration mark sensors, detect the difference between two colors, often corresponding to a target color and a background color. The threshold at which the sensor's output changes state is typically halfway between the target color's and background color's reflected light values. Anything lighter than the switching threshold is one state, and anything darker is the opposite state. Color sensors look for a characteristic response of one color. In short, contrast sensors detect differences between colors; color sensors detect a specific color.

Contrast sensors often use RGB (Red, Green, Blue) technology. This means that red, green, or blue light is emitted from the sensor's transmitter, and its receiver evaluates the light reflected off the target and received by the sensor. Contrast sensors operating on the RGB principle often automatically select the optimal color light source for an application based on the colors of the target and background.

Color sensors are often based on the RGB principle as well. They typically send pulses from each of the three colored LEDs and evaluate the responses before sending the next group of pulses. The reflected responses are compared to the programmed color's responses. More precise color sensors require more samples of these pulse packets, which increase the response time. Some high-precision color sensors emit a white light to evaluate a more complete spectrum of the reflected light. Color sensors are typically single-channel (single color) sensors, but more sophisticated models offer multiple channel programming for the identification of multiple colors.

Contrast sensors and color sensors are often pigeonholed in traditional applications, while non-traditional but more powerful uses are overlooked. The most typical application for contrast sensors in packaging and converting is the detection of a registration mark on a web of media. The mark can be used to trigger a cutting, folding,

or gluing process for individual wrappers or cartons. Following are ten less conventional but very powerful applications for contrast and color sensors in the packaging and converting industries.

(1) Adhesive Verification

A contrast sensor can easily verify the presence of adhesive. No glue or an inadequate amount of glue holding a carton together can spell disaster for a packaging operation if containers fall apart. Contrast sensors evaluate the difference in reflectivity from the packaging media and the same media with a bead of glue on it. (See Figure 1.) Even a bead of clear epoxy just a few millimeters

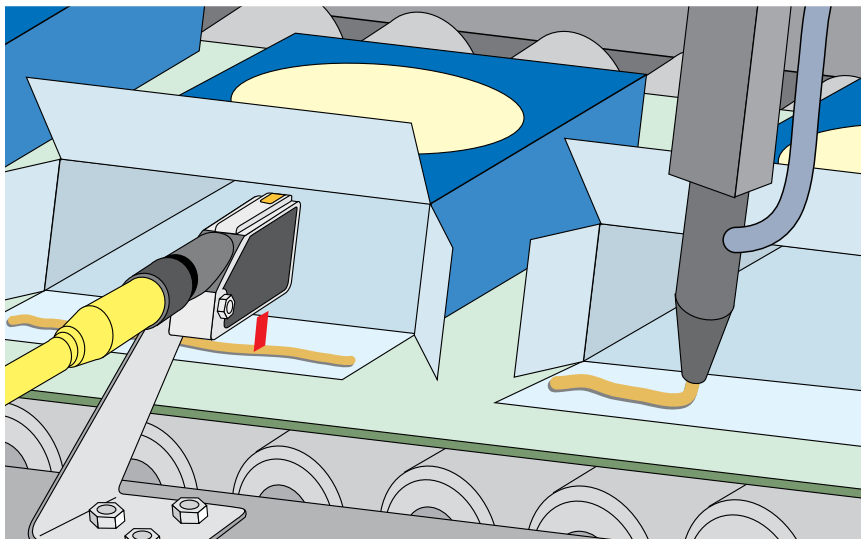


Figure 1

wide can be detected with a contrast sensor. A manufacturer may also have to detect a clear bead of glue on a clear plastic or Mylar surface. Because of this "clear on clear" scenario, a photoelectric sensor is ineffective, while a luminescence sensor can easily detect many types of clear adhesives. (See section on Luminescence sensors.)

(2) Date Code/Bar Code Check

Verifying that a date/lot code, bar code, expiration date, or other printed information is present without the need to read it can be critical. A barcode reader or person reads and interprets the printed data, but using either to simply confirm the printed information is present is a costly endeavor. A contrast or color sensor can be a simple and inexpensive way to detect the presence of markings on a package. The sensor would be used when the printed mark is always lighter or always darker than the package. The switching threshold is set between the mark color and the package color and will change state when the mark is present. When a package passes through the light spot of the sensor without any mark, its output will not turn on. A color sensor can be utilized when the package color changes but is not the same color as the mark.

(3) Tamper-Proof Seal Confirmation

Confirming the presence of a plastic wrapper placed over a pharmaceutical bottle cap is an invaluable safety check. (See Figure 2.) This seal ensures that the final product is safe and shows any evidence of tampering. Often this means a clear plastic film on a glossy container, with a difference in reflectivity too slight

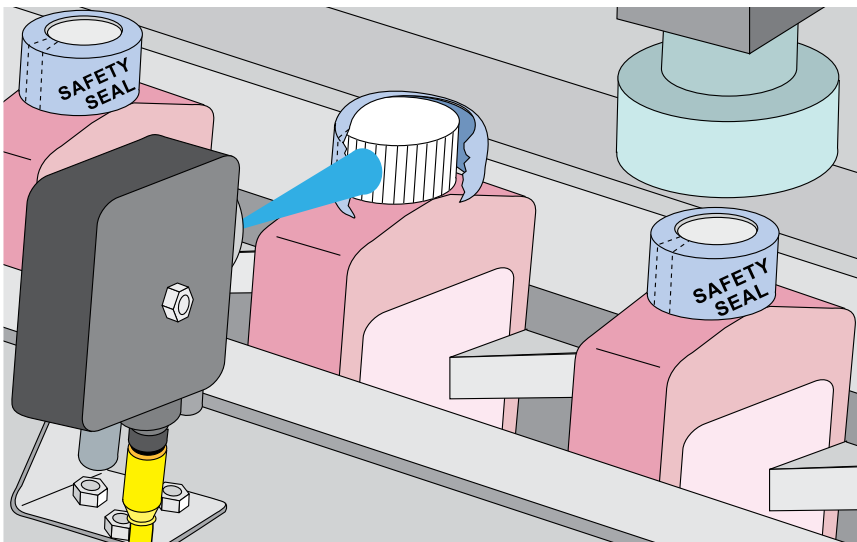


Figure 2

for even a contrast sensor. Luminescence sensors (Luminescence section) can detect many of the films used in tamper-proof overwraps. Because these wraps react to ultraviolet light emitted from the luminescence sensor, they react differently than the bottle.

(4) Leaflet Detection

Another important check in a packaging application is confirming that a leaflet is inserted into a carton. For pharmaceutical products, the leaflets can contain safety information that is required by law, and missing leaflets means the product is not compliant with regulations. A luminescence sensor (Luminescence section) can detect a leaflet and ignore the package when the leaflet alone reacts to ultraviolet light. Some papers are inherently luminescent, and, if they aren't, they can be made luminescent by an invisible marking.

(5) Print Quality Check

As caps on bottles are printed with a logo, the shade of the printed color may become lighter or darker over time due to variances in the printing process. A contrast sensor with an analog output is a useful way to gauge the color of a print for quality purposes. The light spot evaluates the reflectivity of each printed logo. The analog current output indicates how light or dark the print marks are on a scale, thus indicating when the print color becomes too faded or too bright.

(6) Lid Insert Verification

A lid or cap may have a plastic insert placed inside it to provide an optimal seal. A contrast sensor can be used to confirm the presence of the insert in the lid. When the insert is present, the contrast sensor sees one type of reflection; it sees another when the insert is absent. A laser contrast sensor can provide an extended sensing range of several feet to differentiate the insert presence and absence. (See Figure 3.) This same sensor could also be used to detect protective packaging material (i.e., foam or plastic bubble webs).

(7) Shrink-Wrap Presence

To confirm that a pallet of boxes has been fully shrink-wrapped, a laser contrast sensor may be used to differentiate between the brown cardboard of the boxes and the glossy clear wrap over the boxes. The difference in reflectivity will indicate if the plastic wrap has been applied correctly.

(8) Label Presence/Position

A pair of fiber optic contrast sensors can confirm that a wrap-around label is in place and properly aligned on a container. The two fiber optic tips would be aimed at opposite borders of the label, so that if the label is askew, only one contrast sensor sees the label. If the label is missing, neither sensor detects the label. A trigger sensor, such as a standard retro-reflective photoelectric sensor, can be used to activate the contrast sensors when the container is in position.

(9) Color Sorting

Multicolored lids on paint canisters are sorted using a color sensor to route them to the appropriate packing station. If more than two color canisters are used, a color sensor is the best choice to select one out of multiple colors. While some color sensors can be taught to recognize only one color, other color sensors can be programmed for more than ten separate colors with an output for each color.

(10) Blister Packaging

Color sensors can be used to confirm the presence of pills or other products in clear blister packaging and to check their colors. If a pill is missing from a blister pocket, the color sensor does not see the reflected color response that was taught, and the package is flagged. A color sensor could also confirm if chewing gum in blister packaging is green or white, for example.

Selecting a contrast, color, or luminescence sensor requires an understanding of what is needed in an application. Contrast sensors

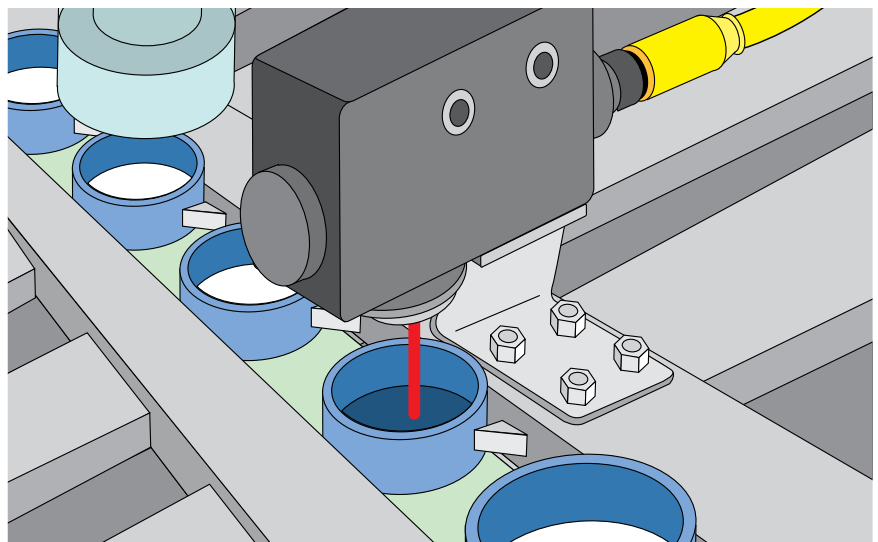


Figure 3

distinguish one color against another background color. Color sensors detect the color itself against a number of background colors and can be used to determine if the color deviates. Luminescence sensors detect luminescent materials against non-

luminescent backgrounds and are ideal for irregular or translucent surfaces. Contrast and color sensors truly bridge the gap between photoelectric sensors and costly, complicated vision systems for a variety of packaging and converting uses.

Luminescence sensing

Luminescence sensors make up a specific type of contrast sensors. Like contrast sensors, they distinguish two different conditions by emitting a light onto a target and evaluating the reflected light. However, luminescence sensors emit ultraviolet (UV) light, unlike the visible light spectrum emitted by color and contrast sensors. Some materials, called luminophores, react specifically to UV light and are inherently present in the target or are added to it. These materials are stimulated by UV light and emit radiation in the visible light spectrum. This process is called photoluminescence. The color or wavelength of the received light depends in part on the type of luminophore. So a luminescence sensor detects a target when the sensor emits UV light and receives visible light at a specific wavelength reflected back. (See Figure 4.)

The targets used for luminescence sensors are often additives, but many materials are inherently luminescent, including some oils, epoxies, greases, inks, glues, chalks, and detergents. Luminescence sensors detect markings that would be impossible using a standard photoelectric or contrast sensor. Marks on irregular backgrounds and invisible markings are easily sensed using an luminescence sensor. For example, detecting a mark on wood, normally very difficult due to irregular grains and colors, is straightforward with a luminescence sensor. Detecting a mark that is invisible, such as markings on aerosol container caps, is also easy.

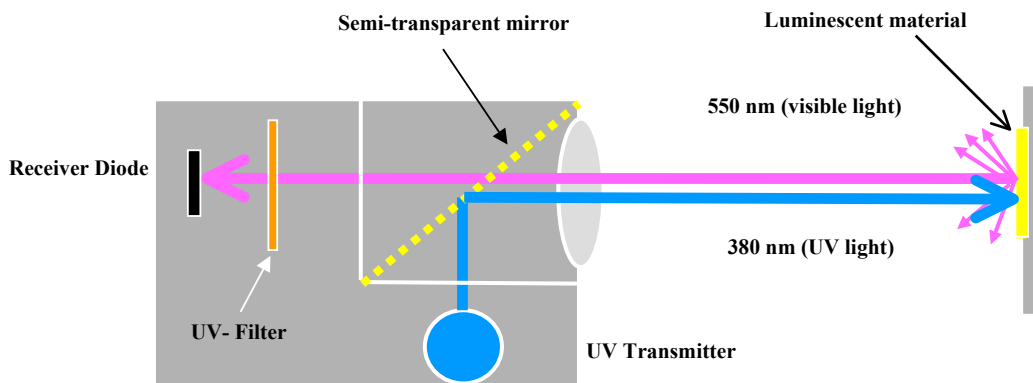


Figure 4: Anatomy of a Luminescence Sensor