Flexible Application-Oriented Photoelectric Sensors: Latest Technologies and Implementation

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Oftentimes users are faced with difficult sensing applications. The correct sensing solution often comes in the form of photoelectric sensors. Users have the decision of which type of photoelectric sensor to choose—throughbeam, retroreflective or diffuse reflective. For especially difficult applications, innovative new diffuse sensors may present the best solution.

The rule of thumb when applying a photoelectric sensor to a general-purpose application is to first try to utilize a throughbeam sensor. The goal is always to achieve the highest level of transition between light and dark states. Throughbeam sensors provide the longest sensing distances and contain large amounts of margin or excess gain. Excess gain is required to burn through contaminants that build up on the lens of a sensor. They are ideal for detecting opaque objects but are sometimes too powerful to detect translucent objects. Throughbeam sensors are somewhat costly to purchase, and they necessitate wiring of both an emitter and a receiver located in separate housings. Most throughbeam sensors utilize an invisible infrared light source, making alignment difficult. Visible red LED models eliminate this problem. In applications where two sides of the target are inaccessible, or the cost of a throughbeam sensor is prohibitive, the second choice should always be a retroreflective sensor.

A retroreflective sensor combines the emitter and receiver into one common housing, thus reducing its purchased cost and eliminating the need to wire a second housing. A reflector is mounted opposite the sensor behind the target. The reflector is designed to return emitted light beams to the sensor's receiving element. They are ideal for detecting translucent objects. When sensing highly reflective surfaces, the use of a polarized retroreflective sensor is necessary. Retroreflective sensors have less margin or excess gain than throughbeam sensors, which reduces their overall sensing distance and the ability to operate in contaminated environments in comparison with throughbeams. They are less costly to purchase and take less time to install. However, to utilize a retroreflective sensor, you must have access to both sides of the target to facilitate reflector mounting. If the target is accessible from only one side, you must utilize a diffuse reflective sensor and now you have a more challenging application.

A standard diffuse reflective sensor also combines the emitter and receiver into one common housing and it eliminates the need for a reflector, which reduces installation time. A diffuse sensor emits its light beam and depends on the target itself to reflect light back to the sensor's receiving element (photodiode). The photodiode measures the intensity of the reflected light energy and outputs a voltage or current proportional to the amount of light received. Internal logic compares this current to a pre-set threshold (sensitivity adjustment) and creates an output condition when the threshold is surpassed. The goal of diffuse sensing is to obtain a relatively high margin when sensing an object. When the target is absent, reflections from any background should represent a margin as close to zero as possible. Shiny surfaces may reflect most of the light away from the receiver, making detection very difficult. Very dark, matte objects may absorb much of the light and reflect very little back for detection. Detecting objects positioned close to reflective backgrounds can be extremely challenging.

Typical problems associated with diffuse sensing:

Targets can be any color, size, or shape, they can be dull, clear, or may have varying degrees of specularity and surface irregularities. Targets may not be repeatably presented to the sensor. In addition, you may need to ignore shiny backgrounds, or translucent foregrounds, or both, thus performing a window evaluation. Targets may be anything and therein lies the problem.

The solutions and the technologies:

Background suppression diffuse sensors differ from standard diffuse sensors by utilizing a special PSD photodiode known as a Position Sensitive Device. This type of photodiode converts light to an output current depending on the position of light received, as opposed to the amount of light received. This concept is commonly referred to as triangulated optics or simply triangulation.

While triangulation is a more reliable detection method than standard diffuse optics, errors and miscalculations can still occur with highly reflective targets and backgrounds. In addition, these sensors require consistent target orientation and are subject to error should the target inclination change.

Based upon these factors, manufacturers are developing fully capable diffuse sensing technology. These new diffuse photoelectric sensors utilize a two-part diode to analyze and compare the near/far angle of reflected light and set a threshold based upon the ratio of the two. To further eliminate errors, the entire optics system of these sensors has been mirrored, offering dual-triangulated optics consisting of two receivers that utilize two-part diodes, and digital calculations that allow a target to be reliably detected from any direction, irregardless of its color, shape, specularity, background or surface condition.

These sensors can also be programmed for background suppression, foreground suppression, or both, enabling a window evaluation. This wave of the future in sensing technology is to provide users with the tools and flexibility needed to solve even the most difficult sensing applications.

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