MAKING SENSE OF SENSING TECHNOLOGIES

How to determine the right product for your application

Editor's note:
Have you ever struggled to determine which technology-based sensing solution is best for your needs? BEA Standards & Codes Manager Jeff Dunham's educational article outlines which technologies to use depending on the application and environmental factors.

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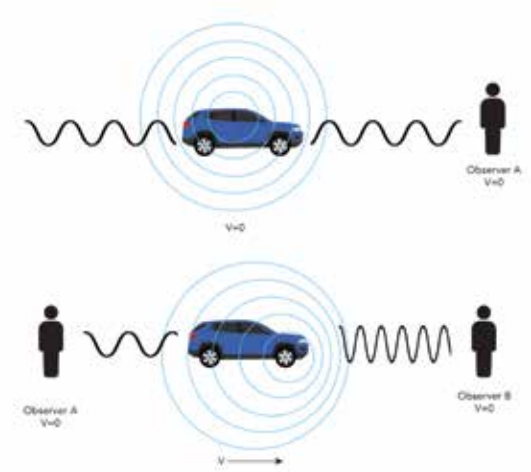
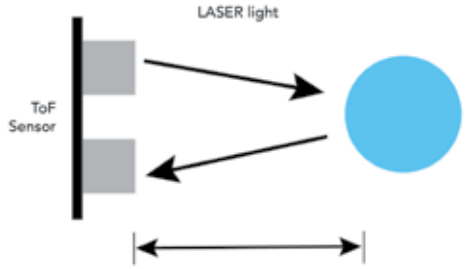
Overview of sensing technologies

The principal noncontact technologies used for automation within the door and gate industries are Infrared, Radar, and Laser. Each type will be defined and described in various application situations. The goal is for you to understand how to apply these technologies effectively and efficiently to application situation constraints while also considering multiple environments.



Illustrates the change in signal reflected off an object with Doppler Radar.



Illustrates the principle of Time-of-Flight LASER technology, which uses the speed of light to calculate the distance between a detected object and the diode.

DEFINING TECHNOLOGY TYPES

1. INFRARED (also known as an Opto-Electronic Sensor)

Infrared sensors are transducers that convert arrays of light into an electronic signal to detect static and/or moving obstructions, objects, or vehicles within a detection zone. Infrared sensors include photoelectric beams, overhead-mounted presence sensors, door-mounted presence sensors, and static or fixed-mounted presence sensors capable of creating vertical or horizontal detection zones.

The various types of Infrared sensors utilize Active Infrared technology. Each type has its pros and cons depending on the applications. These types are generally defined as:

Diffused Active Infrared: Looks for a change of reflectivity at ground level where the Infrared spots are diffused to create a fog-like area of less concentrated IR spots.

Focus Active Infrared: Looks for a change of reflectivity at ground level in a more precise and defined area and can therefore be configured closer to the protected area than Diffused.

Triangulation Active Infrared: Does not depend on reflectivity at the ground level. The sensor measures the position of an Infrared spot and not the quantity of reflected energy.

Passive Infrared: Looks for a temperature change and requires a motion component. It is not utilized because it cannot be relied upon to detect the presence of stationary targets.

2. RADAR (also referred to as Doppler effect or shift)

Radar utilizes the Doppler effect, which is the change in the frequency of a wave in relation to an approaching or departing target moving relative to the source of the wave.

Frequency Modulated Continuous Wave radar (FMCW) is a type of radar system that uses a continuous wave signal with a frequency that increases or decreases over time to measure distance, speed, and approaching angle of the target. Filtering of each type creates various levels of function and performance and is typically used for the initial activation of a given system.

3. LASER

Laser is another form of an Opto-Electronic Sensor that utilizes distance measuring via Time-of-Flight (ToF) technology. The technology can detect motion and presence in a vertical or horizontal array or plane.

Laser ToF: Utilizes a Laser diode to transmit a light beam pulse to a target and measures the time it takes to return that pulse. Knowing the speed of light, we can divide the overall time measurement by two to determine a given distance.

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Applying sensor technologies

By understanding the environment and available technologies, there are instances when more than one sensing system can be used effectively for the same application. Sometimes using more than one technology may be advantageous in achieving desired results based on the environment and traffic type.

Another advantage of sensing technology is that many products now use a mobile app and/or handheld wireless remote control devices that communicate with the sensor and allows users to fine-tune the device from the ground and away from traffic. Using these tools provides visual confirmation of the detection zones and settings.

Outfitting applications with technology

The case study below is designed to educate you about what variables and job specifications should be considered before determining the appropriate sensor solution.

Application situation

A major shipping company has several warehouses across the United States. They utilize commercial overhead doors (CDOs) for vehicle entry and exit. Each overhead door has an adjacent manual door for pedestrians. The overhead door operator is activated via a standard three-button system and equipped with a standard photo-beam to prevent entrapment. The operator is a jackshaft type, and the system is UL 325-compliant.

The request is to automate their overhead doors for vehicular flow at critical times of the day. When trucks leave to deliver goods in the mornings, chaos is controlled. There is no activity until the end of the day when vehicles show up randomly to park in preparation for the night shift or to load for the next day's delivery.

The customer wants to automate vehicular exit and entryways to allow the doors to close when not in use. Currently, the doors are typically open in the morning, remain open throughout the day, and finally close in the evening after the last truck returns.

Application solutions

Some assumptions must be determined without seeing the application. We recommend breaking the application into two parts: Exit and Entry. They should be treated independently as they have different environments and constraints.

For example, the exterior is a wide-open space where the vehicles enter from the property once passing through the security checkpoint. The interior offers limited space with a tight turning radius and slow-moving vehicles. Some vehicles approach slowly while others stop in front of the door and then reapproach it.

Exit strategy

Determining which products to use for the exit access point will require more significant thought and scrutiny due to the tighter conditions and how the vehicles approach the door. Since harsh weather and other environmental conditions factors are not an immediate concern, this can be considered an indoor application.

Vehicles that slowly approach the door, stop, and move again present challenges to Doppler radar sensors. That is primarily because the slow and varying speed component of the vehicles may not be enough to trigger the motion sensor, which will cause the door to remain closed.

> **“BY UNDERSTANDING THE ENVIRONMENT AND AVAILABLE TECHNOLOGIES, THERE ARE INSTANCES WHEN MORE THAN ONE SENSING SYSTEM CAN BE USED EFFECTIVELY FOR THE SAME APPLICATION.”**

Even though harsh weather or environmental conditions are not a factor, we still need to ensure that the presence-sensing devices we select rely on Active Infrared technology. For example, if the vehicles enter from the outside while it's raining, then tire tracks could leave water on the floor. Wet tire tracks are enough to trigger the Active Infrared technology because it is background-dependent (meaning it depends on the ground conditions with respect to its reflectivity). The reflected signal from the dry floor to the wet floor will cause a change of reflected infrared back to the sensor to cause a false positive and thus hold the door open for an extended period of time.

The appropriate technology

The best choice for this application is the Laser technology. It is very precise and can be configured to fit most door openings by the inch. Additionally, Laser technology is a presence-sensing technology, so the slow-moving trucks are not an issue.

The stopped trucks are also not a cause for concern because Laser technology offers a virtual pull-cord function built into the sensor. The virtual pull-cord function will allow an installer to program virtual spots in a given area that must be covered for a programmed amount of time. For example, a truck must stop and cover the spot for a preprogrammed time to cause detection and open the door.

The floor condition from wet tire tracks or other disturbances will not cause issues since Laser technology measures distance from the sensor to the floor and can configure its detection zone to float or hover above the floor. An industry term for this is the “uncovered zone,” which is typically adjustable depending on the sensor's make and model.

Entry plan

For the entryway, consider a motion sensor that can detect vehicles while ignoring pedestrians. A Doppler radar motion sensor is an excellent and economical choice. It's a proven technology for vehicle detection algorithms that uses the Doppler principle and is capable of operating in harsh weather conditions and environments thanks to its IP65/NEMA 4 rating.

A presence-sensing Active Infrared device may not be the best choice because that technology is background-dependent and will depend on the ground conditions and reflectivity of the object. A dynamic and changing environment (e.g., standing water on the ground) will likely cause false positives of detection, thus causing the door to open and remain open for extended periods.

Based on the complexities of the environmental conditions and traffic patterns, Laser sensing devices can better accommodate the application while maintaining an IP65+ rating for operating in an outdoor environment.

Loops could also work for the application described. With loops, unique aspects such as installation time, saw cutting, capturing saw dust and/or water/coolant while cutting, weather, and harsh environments need to be considered. Also, what is the floor condition? What is its construction (i.e., rebar)? One must consider the possibility of business disruption due to extended installation time.

Conclusion

We examined one application and offered potential sensing technology solutions for that project. But as any installer knows, every job is unique. By understanding the features and advantages of each technology available, you can more easily determine which sensing product to use for your application. ■

About the author

Jeff Dunham has worked in the door industry for over 40 years. Dunham is an active member of multiple leading certification committees and trade associations. Additionally, his involvement with UL325 Standard for Safety and the UL325 Standards Technical Panel through DASMA gives him hands-on knowledge specific to the door, operator, and gate industry.