As Seen In:
ELEVATOR WORLD

Sensor Solutions for Elevators

by Jim Dunn

Technical Overview

Sensing devices used in elevators can be divided into two broad categories: sensors for person/object detection, and sensors for car/cabin detection. In the past, among the most commonly used sensor for person/object detection was a photoelectric sensor. These sensors use light to detect the presence of an object, usually by the object breaking the beam. Photoelectric sensors consist of three essential components: a light source (sometimes called a transmitter or sender), a receiver (also called a photo-collector), and an output (can be a relay or a transistor/electronic output signal). While there are several different physical configuration options, a common arrangement is a through-beam pair, where the sender and receiver are in separate physical housings, generally placed on opposite ends of the cabin door opening.

The sensors place an invisible beam (infrared) of light across the door opening, and when a person or object 'breaks' the beam by passing between the two, an output signal is generated and sent to the controller, which will usually result in the door either reversing travel to open, or remaining open for a specific amount of time after the person or object has passed. While no longer commonly used in elevator doors, these sensors can be found in use on escalators.

Today, elevator door openings are covered using a variation of through-beam photoelectric sensors called light curtains. A light curtain consists of two sticks which are typically two meters tall. Each stick contains multiple photoelectric light beams, which create a crisscrossed curtain effect across the door opening. A passenger only needs to break a single beam to cause an output to be generated. Light curtains function as photoelectric sensors but offer additional benefits. First, they completely cover or protect over a height span of two meters (6.6 ft.) or more, from the

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An example of a light curtain from Carlo Gavazzi

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floor to top of the cabin door, whereas a standard photoelectric sensor with a single beam can only protect a limited space across the door span. Second, a properly designed light curtain will continue to function even if partially damaged, allowing the elevator to remain safely in operation until a technician can provide service. Additionally, light curtains can be mounted to the cabin doors and will automatically adjust their power level as the doors open and close, allowing for efficient energy use and flexibility for installation. Carlo Gavazzi offers a light curtain series dedicated to elevator applications that doesn't require additional or external components.

While the photoelectric sensors and light curtains are ideally suited for detecting persons or objects in the door opening, they cannot detect persons approaching the door. For this application, a radar sensor can be mounted above the elevator door frame, and be positioned to detect persons approaching the elevator door; this can be used to signal a car to come to the floor or to hold a door open. The radar sensor, which operates on the Doppler principle that measures changes in wave frequency relative to the motion of an object or person, can ignore people passing laterally in front of the door, but react to people approaching the door. The RAD Series from Carlo Gavazzi is appropriate for this application.

An even more advanced method for detecting persons approaching the door, and even in the door opening, is a vision based system that uses cameras and software to detect motion towards the elevator door. The GUARDIAN1 from Carlo Gavazzi uses a camera instead of infrared detectors. The software analyzes the images captured by the camera in real time, and processes them to generate an output if a person moves toward the door, but ignores the person moving laterally in front of the door. Additionally, the sensor can be adjusted to ignore permanent moving fixtures near the door opening (such as a plant or rotating sign).

There are two common devices used for cabin detection: mechanical limit switches and magnetic sensors. Limit switches use a lever or rollers that come into contact with the car as it travels in the elevator shaft. The motion of the limit switch lever is transferred to a contact, which either opens or closes depending upon the motion of the lever; when the car passes the switch, the lever and the contacts return to their normal state. This switch can be used to identify the floor that the car has reached. A variation of the limit is used for over-travel detection – when the car has gone beyond its upper or lower limits in the shaft. This switch will have a manual reset, so that if a car goes beyond its normal travel limits, the switch is tripped, causing an alarm to be sent, and then will remain disabled until a maintenance engineer has cleared the problem and manually resets the switch.

Magnetic sensors are also used for detecting the cabin. These devices are non-contact, unlike limit switches which rely on physical contact with the cabin. The magnetic sensor consists of a reed switch, which is activated when a magnet with proper polarity enters the range of the sensor. When the cabin (and magnet) pass out of the range of the sensor, the reed switch returns to its normal state, or if it is a bi-stable switch, will stay in its state until the cabin passes again in the opposite direction, which then causes the contacts to switch state again.

Applications

Detecting people near or in an elevator door opening is crucial to safe operation, as well as convenience for passengers. For detecting persons in the door opening in the past, limit switches and then photoelectric sensors were used. While functional, these devices had limitations; for limit switches it required that a person or object

The RAD sensor by Carlo Gavazzi

The GUARDIAN1

make physical contact with the door in order to activate the switch. For standard photoelectric sensors, the detection area was limited by the number of sensors and their positioning in the door opening. If an insufficient number or improper placement of sensors occurred, it would be possible for people to pass through the door opening undetected, creating a potential for the door to close on the person while still in the door opening.

Today, elevator light curtains provide full coverage of the door opening, from floor to ceiling, and can safely continue operation even if partially damaged, allowing for increased safety and efficiency. These devices will effectively detect a person or object anywhere in the door opening, without physical contact.

Radar sensors have the ability to ignore people passing laterally in front of an elevator door, but react to people approaching the door. This feature can be used to hold a door open, allowing a passenger to reach the car before the door closes. In some cases this device could be used as an alternative or supplemental option to a call button, providing the convenience of calling a car to the floor, or opening the door of the car, before the passenger reaches the door.

Camera based sensors provide both motion and presence detection in a single device. This allows the sensor to detect persons approaching the door, and thus hold the door open until they reach the car. It also detects if people or objects are in the door opening, to prevent the door from closing on them. Since this sensor is a passive device using a camera instead of radar signals or photoelectric beams, it is virtually immune to any type of interference.

Photoeletric sensors

Open door

When it comes to cabin detection in the shaft, such as presence at the floor or speed control, magnetic sensors are typically employed. The magnetic sensors are mounted on the outside of the cabin, and appropriate magnets are placed in the shaft at various locations, depending upon the specific application. The feedback from the sensors can be used to calculate speed in the shaft, or if the car is properly leveled.

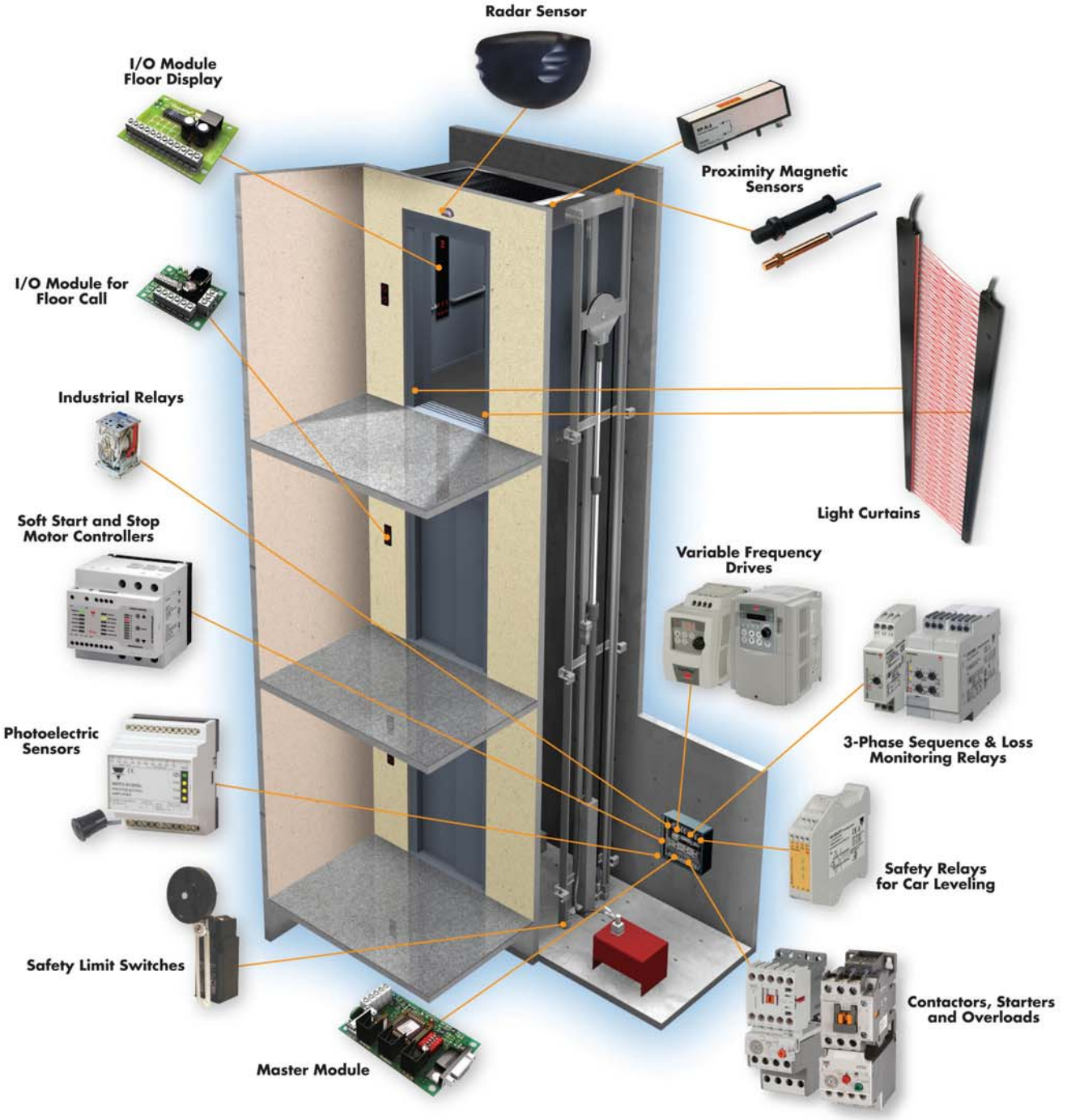
In today's climate of energy consciousness, many users are seeking ways to reduce energy consumption. An innovative approach to reducing energy consumption in the elevator cars, where lights are typically on even when the car is not in use, is to use the GUARDIAN1 sensor, which can detect motion in the car. When no motion is detected after a specific amount of time, the sensor can activate a signal to turn the cabin lights off, until the doors open again for a passenger to enter, at which time the lights can be turned on.

Carlo Gavazzi

Carlo Gavazzi is committed to meeting the needs and requirements of the elevator industry. Founded in 1931, the company is a global designer and manufacturer of electronics for industrial and building automation, with decades of experience serving the lift and escalator market. It also has an R&D group that is knowledgeable in the norms and regulations of the global elevator/lift market.

Automation Solutions for the Elevator Industry

CARLO GAVAZZI



For years, CARLO GAVAZZI has been providing automation solutions to the elevator and lift industry. Our current, voltage and three-phase monitoring relays are amongst the most comprehensive in the industry.

CARLO GAVAZZI also offers the Dupline® Elevator I/O Bus, elevator light curtains, contactors with CSA elevator ratings, as well as the other products shown above. Contact us today to discuss your application!

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