FAQ: The infrared motion sensor

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Everything you ever wanted to know about IR motion sensors

Many of the automation systems that increasingly appear in our daily lives have a fundamental need to sense the presence and movement of human beings. Whether that system simply shuts off the lights to save energy at home or triggers an emergency response in a health care facility, accurate motion sensing is a crucial requirement.

Passive infrared (IR) sensors are a well-known, cost-effective motion sensing technology for these applications. Getting the most out of these sensors, however, requires some engineering expertise.

In this article, we'll examine some of most commonly asked questions about the capabilities of passive IR sensors as well as look at a new type of array based sensor that extends those capabilities dramatically.

- **How do IR motion sensors work?** These sensors discern human movement by detecting incident IR radiation, which varies in proportion to the temperature difference between human body surfaces and the surrounding environment. The sensors, in essence, can distinguish the thermal signature emitted by a human being from the thermal signature emitted by walls, ceilings, floors and other inanimate objects.

- **What infrared wavelengths are detected?** The most capable IR sensors detect infrared wavelengths 5 µm or longer. The human body emits 10 µm wavelengths.

- **What do I need to know about ambient temperature?** IR Sensors operate in a wide ambient temperature range from –20 to 60ºC and are designed for indoor use only. Outside that operating temperature range, the sensor may output false detection signals. Keep in mind that changes in ambient temperature can also affect sensor performance. For example, detection can be more difficult in the summer because there tends to be a smaller difference between body and ambient temperatures than in the winter.

- **Does clothing affect sensor performance?** The amount and color of clothing can make a small difference in sensor performance. Because clothing affects the amount of IR radiation emitted by the human body, it changes the differential between human body and ambient temperatures. The effect of clothing, however, is minor compared to the influence of ambient temperature.

• **What is the maximum sensing distance—and can it be adjusted?** The best IR sensors have a nominal sensing distance that can range from 2 to 12 meters, depending on the model. This distance specification does not necessarily represent the farthest distance the sensor can detect. Instead, it's the maximum distance at which sensing is guaranteed. IR motion sensors do not have an adjustable distance setting, but you can limit the sensor's detection range by mounting it at an angle that blocks its field of view.

• **How fast are IR motion sensors?** IR sensors have a response time of about 0.5 seconds. The response time represents the interval between the actual movement and the detection of that movement. The duration of the sensor output signal after detection depends on the speed of movement and the magnitude of temperature difference. It usually averages to at least 10mS.

• **What types of applications should use IR motion sensing?** This type of sensor is particularly well-suited to applications that require a wide detection area, even if that detection area that extends to walls and floors. IR motion sensors also excel at detecting even the slightest motions.

• **And what applications should not?** The broad detection area and sensitivity of IR sensors can also work against them in some applications. For example, these sensors do not offer adjustable distance settings required by some automation systems. They can also confuse humans and small animals. And their detection capabilities can be diminished in proximity to intense heat sources or materials that block IR radiation. In these cases, alternative sensing technologies, such as area reflective sensors, can be a good alternative.

• **Are there different types of IR sensors for different tasks?** Sensors come in different versions to meet specific detection requirements. At Panasonic, for example, our MP IR sensors come in seven versions. The standard standard sensor offers a wide horizontal detection ranges. Another sensor type specifically targets slight motion. The third type is a spot sensor which can limit the detection range—in small spaces, for example. The fourth offers a wide 12-meter detection area for use in large spaces. And the fifth version addresses battery-operated applications by offering power consumption as low as 1 µA. Two other low power models offer 2 and 6 µA, respectively.

Array sensor detects people and objects in motion or at rest

Passive infrared sensors work well when it comes to occupancy or object detection. They can also sense people or objects in motion, which makes them useful in building automation and security systems. These simple IR sensors, however, have traditionally had limitations that kept them out of more advanced detection applications.

For example, passive IR sensors cannot sense motionless objects. They cannot accurately detect direction of movement. Nor can they create thermal images. All three of these tasks are essential for the next generation of intelligent automation and security systems as well as digital signage, medical imaging and traffic safety applications.

Passive IR technology, however, continues to evolve, and a new type of IR array sensor eliminates the traditional limitations.

Instead of the single thermal sensing element employed by most passive IR sensors, the new sensors employ an array of IR sensing elements to measure actual temperature as well as temperature gradients within a 60º viewing area. Based on thermopile technology, these IR array sensors can simultaneously detect the direction of moving people and objects–up, down, left, right and diagonally. Its coordinated array of sensing elements can even detect multiple people or objects moving in different directions.

At close proximity, IR array sensors are even capable of detecting hand movements for simple gesture control

A new architecture for IR sensing. At the heart of this new passive infrared array is a thermopile IR detector chip, which consists of 64 thermopile elements arranged in an 8x8 format. A built-in thermistor and ASIC chip round out the electronics.

The integrated circuit performs calculations that allow mapping of temperature data as a thermal image.

The device is packaged in a RF-shielded metal cover with an integrated silicon lens through which the infrared energy passes. It has an I2C digital output for direct connection to a microprocessor.

IR array sensors offer an attractive balance between performance, cost and size. Their motion detection and thermal imaging capabilities approach those of active 3D sensing systems costing hundreds of dollars more. At the same time, IR array sensors fit within a compact surface mount (SMD) package.

RESOURCES:

For a detailed look at the technical specifications for our Grid-EYE infrared array sensors, including sensing distances and response times, visit "http://pewa.panasonic.com/components/built-in-sensors/infrared-array-sensors/ [1]"

For a video describing the Grid-EYE infrared array sensor evaluation kit, visit http://youtu.be/wOTOQfU5Qgw?hd=1 [2]

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