

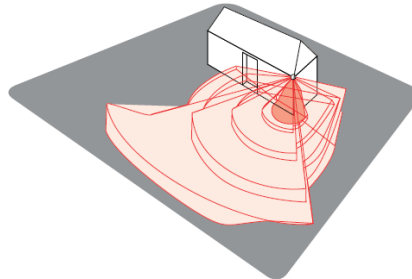
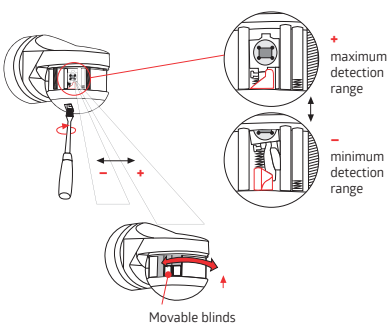
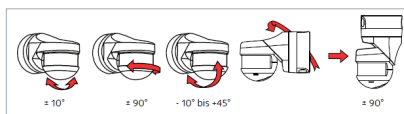
Small animal detection and real presence detection

Motion detectors are now used in many places, in or on industrial or office buildings as well as (private) residential buildings. In addition to indoor applications, the detectors are also used outdoors.

In darkness, the entrance area is automatically illuminated as soon as movement is detected. The key and the keyhole are then quickly found. In addition to this added convenience, outdoor motion detectors also offer protection against burglars. The light is perceived as disturbing by thieves and usually deters them. Motion detectors are a component for the prevention of burglary and are recommended by the police.

However, it occasionally comes to allegedly false switching operations. The light seems to switch on without apparent movement. The more often this happens, the more distracting it is felt. Moreover, energy is consumed unnecessarily. The causes are many.

The orientation of the motion detector plays a decisive role. Outdoor detectors usually have a very large detection range. If, for example, a road or pavement touches the edge of the detection zone, erroneous switching occurs. A better orientation of the detector can help here. High-quality devices have a so-called test mode in which the detector switches the light on and off continuously as soon as there is movement in the detection zone. In this mode, it is not necessary to constantly wait for the elapse of the follow-up time to align the detector. Most detectors are aligned on two axes. The head of the detector can be turned up and down and to the right or left. The RC-plus Next N from B.E.G. also offers the possibility of steplessly variable mechanical adjustment of the individual motion sensors in the detector head.



In outdoor areas, motion detectors with passive infrared sensors (PIR) are used almost exclusively. These sensors react to changes in heat that occur when living beings move. Plants do not emit any heat, so moving trees and shrubs are not detected. However, if there is a heat source behind the plant, e.g. a wall heated by the sun, a detector detects any movement of the plant caused by a gust of wind. The detection range must also be restricted with these "false" switching operations. Here, blinds can be used which are attached to the lens of the detector. The blinds are impermeable to IR radiation and thus certain parts of the detection zone are blanked out.

Animals usually have a similar body temperature to humans. Movements of cats and dogs are detected like human movements and cause the light to be switched on. The cause is therefore the same in both cases: the movement of a (warm) creature. Such "erroneous" switching can hardly be avoided. In order to understand which possibilities still exist and which consequences result from this, here are some explanations.

Passive Infrared Sensors

Infrared radiation lies in the electromagnetic spectrum between visible light and microwaves. Infrared radiation is primarily heat radiation and is generated by the movement of atoms and molecules in an object. This means that every object with a temperature above absolute zero, i.e. even an ice cube, radiates in the infrared range. The higher the temperature, the more the atoms and molecules move and the more infrared radiation they produce.

The infrared radiation generated by living beings is not homogeneous, which becomes clearly visible when an infrared camera is used. Due to their body temperature of 37°C, people radiate strongly in the infrared range, with a wavelength of about 10 µm (Fig. 1). Different parts of the body radiate to different degrees, the mouth, for example, is significantly warmer than the fingers. Thus, the infrared radiation emanating from the mouth is correspondingly stronger than the radiation emanating from the fingers.

Passive infrared sensors (PIR sensors) also operate in the wavelength range of 10 µm and enable the use of infrared radiation for motion detection, as they respond optimally to the heat radiation of a human or animal. Passive infrared means that



Fig.1

the sensors do not emit radiation, but only receive it. The detector then evaluates the signals from the sensors and switches on the light accordingly.

In order to detect movement, the IR rays must therefore reach the sensors. As the radiation decreases over the distance, the sensor can better detect a movement in 2 m proximity than in 20 m distance. However, movements at a distance of 20 m can also be registered. This depends on how much heat is radiated. A mouse emits less heat than a human being, a locomotive in operation, for example on a company premises, emits significantly more heat than a human being. (Fig.2)

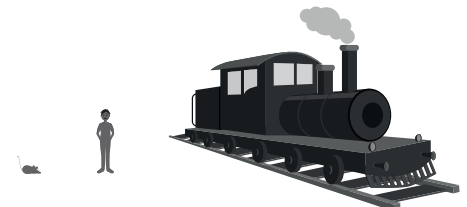
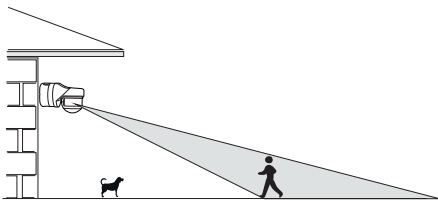
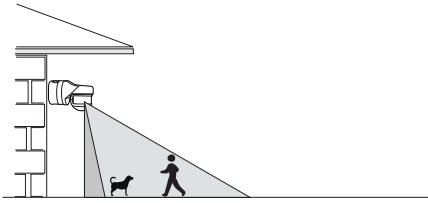


Fig.2

With good detectors, the sensitivity of the sensors can be variably adjusted. This setting determines the amount of heat from which the sensor is to respond. Smaller amounts of heat, e.g. those of a cat, are blanked out. But already by the radiation of a larger dog the light can be switched on by the detector. However, if the sensitivity is further reduced, there is a risk that small children's movements will no longer be detected.

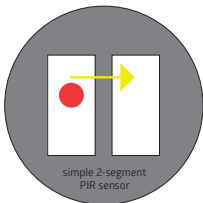
Another way to reduce "false" switching caused by animals is to hide the lower detection ranges. Cats often stray past house walls. Detectors with anti-creep protection do not detect this movement. With the RC-plus Next N from B.E.G., this function can be activated and deactivated by remote control. It should be borne in mind that thieves also like to sneak past the wall.

If a motion detector looks into the distance, lower detection zones are also hidden. Dead zones occur in which no movement is detected. Since the detection range is now far away and the heat radiation weakens over the distance, only larger heat sources, e.g. people, are detected. In this case, a road or a footpath running in larger distance from the house has to be taken into consideration.

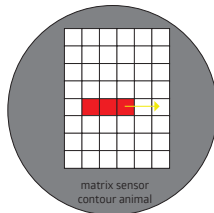
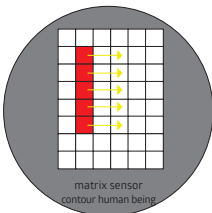


Modern passive infrared sensors

Like light, infrared radiation can also be focused through lenses. Motion detectors are equipped with a lens to focus the IR radiation onto the PIR sensor. The most common sensors consist of two plates made of pyroelectric crystal. If IR radiation hits such a crystal, this leads to a charge shift that can be measured. Motion is detected when IR radiation is detected by both plates.



More modern sensors have a matrix of pyroelectric plates through which simple contours can be detected in combination with suitable software. If more plates are active in the vertical, the object radiating heat could be a human being, if more are active in the horizontal, an animal.



Currently almost all motion detectors include simple PIR sensors with two plates. Matrix sensors have not yet established themselves due to their high price.

Detectors with camera technology

When the first motion detectors came onto the market about 35 years ago, two terms were also created: Motion detector and occupancy detector. Both are marketing- or sales-oriented terms. With the word „motion detector“ the function can still be developed. The term „occupancy detector“ is not self-explanatory. Even the manufacturers of the detectors interpret it differently. „Occupancy detectors detect minor movements, such as working

with a computer mouse“ or „Occupancy detectors include natural daylight light in their light measurement“, to name just two common definitions..

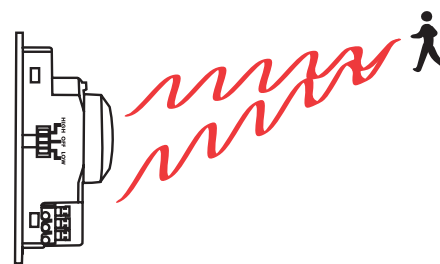
If a room is occupied, there is someone present in the room. Only a person can consciously perceive a presence. No technology can achieve this. Detectors that contain a camera and perform image analysis are the closest. Human contours can be filtered out by means of software. But even a life-size doll can be recognised incorrectly by the software.

In addition to the very high price of such detectors, questions of data protection or employment protection law often arise, for example when the detector comprising a camera is installed in an office. A camera in the office creates a bad feeling.

Microwave (HF) detector

Unlike passive infrared (PIR) detectors, high-frequency (HF) detectors are active detectors. They transmit waves with a high frequency but with a low power and evaluate echo signals.

HF waves have the property that they penetrate non-metallic materials, such as walls. Microwave detectors can therefore be hidden behind suspended ceilings or installed invisibly directly in a luminaire. These detectors use the so-called Doppler effect. An approaching vehicle sounds higher than a leaving vehicle. The self-motion compresses the sound waves in the direction of motion and expands them in the opposite direction. Microwave detectors work the other way round: they are fixed and emit waves. These waves are reflected by objects. When the objects move, the reflected waves have a slightly different frequency. The greater the frequency difference, the faster the object moves. The police use this technology for radar measurements during speed checks.



Compared to passive infrared detectors, microwave detectors operate independently of temperature. The only criterion for them is movement. Motors, curtains, the water in a sewer and outside leaves and of course animals of all kinds also move and are therefore sources of interference when it comes to detecting the movements of a human being.

The reflected signal can be evaluated via intelligent software algorithms. A swirling leaf can be filtered out, but with it also a hand waving person falls out of the detection. If a large dog passes an microwave detector at the same speed as a small human being, the microwave detector cannot detect any difference, which means that „incorrect“ switching due to moving animals cannot be ruled out either.

Microwave detectors are a good alternative to PIR detectors if environmental influences push passive infrared technology to its limits.

Conclusion:

Sensors cannot recognise animals, but incorrect switching due to the movements of animals can be reduced by reducing the sensors' sensitivity. However, reducing the sensitivity of the sensors has the consequence that the detector's detection range decreases. With a PIR detector, the correct alignment of the detector can often help, for example by using only the far field for detection. The detector thus simply overlooks most (small) animals.