THE ENERGY OBSERVER

Energy Efficiency Information for the Facility Manager

Quarterly Issue – December 2007

Occupancy Sensors for Lighting Control

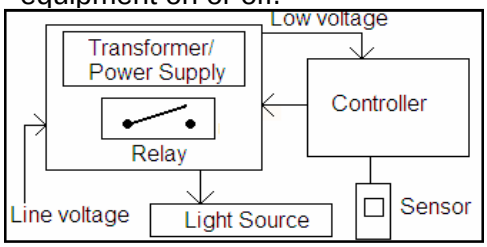
The Energy Observer summarizes published material on proven energy technologies and practices, and encourages users to share experiences with generic energy products and services. This quarterly bulletin also identifies informational sources and energy training for facility managers and staff. ***The Energy Observer*** is a service of the **Energy Office, Michigan Department of Labor & Economic Growth.**

This issue of The Energy Observer focuses on the use of occupancy sensors to reduce energy use in lighting. These devices automatically turn off lighting and other equipment based on their detection of motion in a specific area. Originally developed for security systems, occupancy sensors have since been engineered to control not only lighting but also HVAC systems for commercial spaces. These devices have grown more common recently as energy management has become a priority. For example, the typical office uses 29% of its electricity for lighting. Occupancy sensors can reduce this use by half. The table below shows potential electricity savings from using occupancy sensors to control lighting in various types of spaces.

Type of Space	U.S. EPA Prediction
Private Offices	13-50%
Classrooms	40-46%
Conference Rooms	22-65%
Restrooms	30-90%
Corridors	30-80%
Storage Areas	45-80%

Source: http://www.p2pays.org/ref/32/31316.pdf

A complete sensor consists of a motion sensor, an electronic control unit, and a controllable switch/relay. The detector senses motion and determines whether there are occupants in the space. It also has a timer which signals the electronic control unit after a set period of inactivity. The control unit uses this signal to activate the switch/relay to turn equipment on or off.



Source: http://www.lightsearch.com/resources/lightguides/sensors.html

For lighting applications, there are three main sensor types: passive infrared, ultrasonic, and hybrid.

Passive Infrared (PIR)

PIR is an electronic sensor which measures the infrared radiation being emitted from an object in its view. Motion is detected when an infrared source, such as a human, passes in front of another infrared source with a different temperature such as a wall. PIR sensors react to the changes in heat patterns created by the moving person and turn lights on accordingly. The controller "eye" must have an unobstructed view of the building area being scanned. The best applications for passive infrared occupancy sensors are small open spaces, such as private offices and conference rooms.

The advantages of passive infrared are that they are highly resistant to false triggering, relatively inexpensive, and do not radiate any energy (hence the name "passive"). The disadvantages are that they are strictly for line of sight use, and cannot see around objects. Doors, stairways and partitions have a tendency to block motion detection and reduce effectiveness. Also, the farther away the object to be detected is, the larger the motion needs to be to trigger the device.

Ultrasonic Sensors

Ultrasonic sensors emit an inaudible sound pattern and then "read" the reflection. This sound is above the range of human hearing. A break in the pattern caused by any motion in the area triggers the control. Ultrasonic sensors can "see" around obstructions and are best for areas with cabinets and shelving, restrooms and open areas requiring 360-degree coverage.

The advantages of ultrasonic devices are that they are sensitive to all types of motion and generally there are zero coverage gaps, since they can detect movements not within the line of sight.

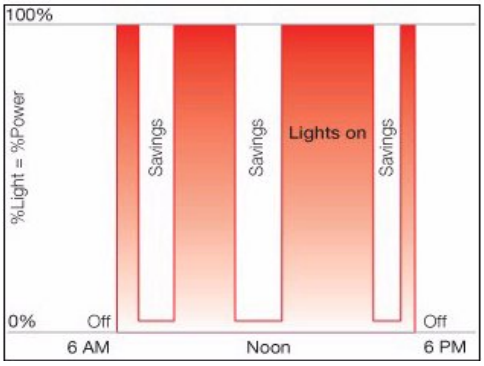
The disadvantages are that they are more expensive than PIR and also more prone to false signals, such as from a house plant being agitated by a draft. In addition, they may interfere with other ultrasonic sensors or hearing aids. They are recommended for larger areas, open offices, conference rooms, bathrooms, and unusually shaped areas.

Hybrid

Some occupancy sensors use *both* passive infrared and ultrasonic technology. They can be used to control one lamp, one fixture or many fixtures. They are usually foolproof, allowing for wide coverage and range of applications. The disadvantages are that they are more expensive, and may require more adjustments. Because they use both technologies, hybrid sensors can be used to control lighting in almost any space, however large open areas and areas with irregular occupancy patterns are generally the most cost effective.

Sensor Setting and Placement

Proper placement and orientation of occupancy sensors is crucial. They must be able to sense all occupants to avoid inadvertently turning off lights while the space is occupied. In addition, the sensor must not be too sensitive as to cause "false positive" triggering such as the detection of passerbys in adjoining hallways. Occupancy sensors with the sensitivity set too high may not save a satisfactory amount of energy, but too low a sensitivity may cause lighting to shut off inadvertently when the occupants are not making large enough movements, such as during a presentation or in a classroom during a test. This can prove to be very annoying to occupants.



Source: Lutron Electronics Co.

Cost

Occupancy sensors range in cost from around $30 to $130, depending on the type and manufacturer. The simple payback period from their installation ranges from 0.5 to 5 years, depending on the level of occupancy and the potential for energy savings in the building or area.

Lighting Audits

A lighting audit is one way to determine the cost effectiveness of installing occupancy sensors at a particular location. During a lighting audit, a variety of information is gathered about the facility and the lighting systems currently in use, such as the number of bulbs, their respective wattages, and hours of use. From this data, a lighting engineer is able to determine the feasibility of installing occupancy sensors alone and/or how their installation could help reduce energy if included as part of a larger lighting project.

More information about occupancy sensors can be found at these web-sites:

http://www.eere.energy.gov/buildings/info/components/lighting/lightingcontrols/occupancysensors.html

http://www.lightsearch.com/resources/lightguides/audits.html

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