

## PAPER DETAILS

TITLE: MOTION DETECTOR WITH PIR SENSOR USAGE AREAS AND ADVANTAGES

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## MOTION DETECTOR WITH PIR SENSOR USAGE AREAS AND ADVANTAGES

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**Abstract**-This study aimed to examine motion detector with pir sensor,a commonly used sensor which detects objects or living creatures by the heat they emit. This kind of sensors are important when we aim to save energy and in fact, they are good to use almost in both everyday life and high technology. This sensor is bought together with a circuit we've designed.

**Keywords:** Motion detector, pir, sensor, alarm, advantages of sensors, pir sensors

### 1. INTRODUCTION

Pir sensors are detecting sensors which uses heat emitted to detect place of an object or a living creature. Humans and warm-blooded animals emit heat and also infrared rays. This rays cannot be seen with human eyes because of low frequency. Infrared rays frequency is between 3T and 430T however visible light frequency is between 430T and 750T.

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Infrared rays are detected with fresnel lenses. This lenses have sort of a crystalline matter which turns into electrically charged surface when it meets infrared rays. This charged surface changes with the amount of rays it meets.

When fresnel lenses meet infrared rays it creates a 0.1 – 0.15 mA current through the output leg of sensor. But this value is not enough for our circuit to work. We preferred to lead into op-amps in lm324. Now the current has been passed through 4 op-amps and reached enough value for our circuit to work. We could make our circuit by using only two op-amps but four op-amps are needed for sensitivity. This operation make it possible to detect the motion in distance of 15cm.

## 2. EFFECTS ON ENERGY SAVING AND DETAILS OF PIR DETECTOR

Infrared radiation exists in the electromagnetic spectrum at a wavelength that is longer than visible light. It cannot be seen but it can be detected. Objects that generate heat also generate infrared radiation and those objects include animals and the human body whose radiation is strongest at a wavelength of 9.4um. Infrared in this range will not pass through many types of material that pass visible light such as ordinary window glass and plastic. However it will pass through, with some attenuation, material that is opaque to visible light such as germanium and silicon. An unprocessed silicon wafer makes a good IR window in a weatherproof enclosure for outdoor use. It also provides additional filtering for light in the visible range. 9.4um infrared will also pass through polyethylene which is usually used to make Fresnel lenses to focus the infrared onto sensor elements. The pyroelectric sensor is made of a crystalline material that generates a surface electric charge when exposed to heat in the form of infrared radiation. When the amount of radiation striking the crystal changes, the amount of charge also changes and can then be measured with a sensitive FET device built into the sensor. The sensor elements are sensitive to radiation over a wide

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range so a filter window is added to the TO5 package to limit detectable radiation to the 8 to 14mm range which is most sensitive to human body radiation.

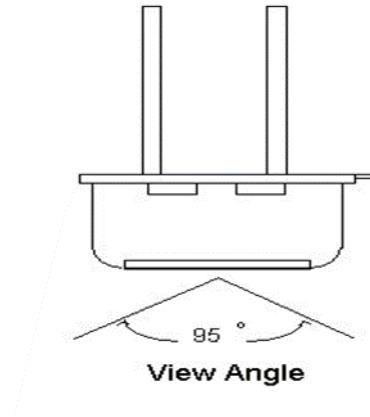


Figure1: View angle of pir sensor

The pyroelectric sensor is made of a crystalline material that generates a surface electric charge when exposed to heat in the form of infrared radiation. When the amount of radiation striking the crystal changes, the amount of charge also changes and can then be measured with a sensitive FET device built into the sensor. The sensor elements are sensitive to radiation over a wide range so a filter window is added to the TO5 package to limit detectable radiation to the 8 to 14mm

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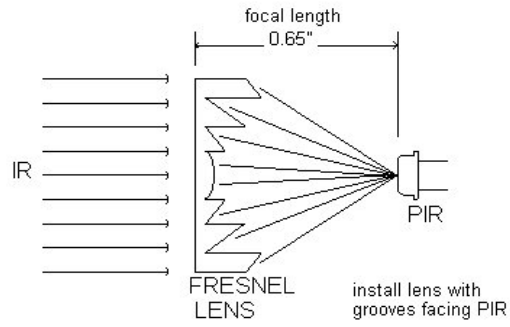
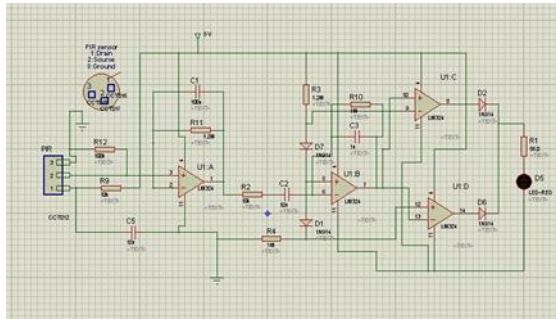


Figure2 : Working principle of pir sensor

range which is most sensitive to human body radiation.



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Occupancy Area	Energy Saving
Private Area	15-50%
Classroom	40-50%
Conference Room	25-70%
Restrooms	32-70%
Corridors	32-84%
Storage Areas	50-80%

Figure3 : Schema of the circuit

Table1. Energy Saving With PIR Sensor

By the use of PIR Sensor, considerable energy can be saved by switching off the lights when the space is not in use. Savings are huge in larger facilities.

It has been estimated that a single unit of energy saved at the end use point is equal to 2.3 units of energy produced.

If energy efficient methods are implemented properly about 25000 MW equivalent capacity of power can be saved through promotion of energy efficient measures

In 1997, researchers studied energy savings potential for occupancy sensors in buildings in 24 states representing a cross-section of commercial building types\*. The study monitored occupancy and the number of hours the lights were on in 158 rooms, including 37 private offices, 42 restrooms, 35 classrooms, 33 conference rooms and 11 break rooms. Potential energy savings for these spaces types were calculated as follows.

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Space Type	Savings Potential All Hours	Savings Potential Normal Hours	Savings Potential After Hours
Restroom	64%	20%	44%
Conference Room	52%	29%	23%
Private Office	40%	27%	13%
Break Room	30%	16%	14%
Class Room	60%	36%	24%

Table2. Energy Savings According To Hours

Mounting Configuration	Description
Ceiling	Appropriate for large areas that feature obstacles such as partitions, in addition to narrow spaces such as corridors and warehouse aisles. Units can be networked for control of areas that are larger than what can be controlled by a single sensor.
High Wall And Corner	Similarly appropriate for coverage of large areas that feature obstacles.
Wall Switch- Wall Box	Appropriate for smaller enclosed spaces such as private offices with clear line of sight between sensor and task area. Relatively inexpensive and easy to install.
Workstation	Appropriate for individual cubicles and workstations. The sensor is connected to a power strip for simultaneous control of lighting and plug-in loads such as computer monitors, task lights, radios and space heaters.

Table3: Compared PIR sensor placement

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Mounting Location	Sensor Technology	Angle of Coverage	Typical Effective Range*	Optimum Mounting Height
Ceiling	US	360	500-2000sq.ft	8-12ft.
Ceiling	PIR	360	300-1000sq.ft	8-30+ft.
Ceiling	DT	360	300-2000sq.ft	8-12ft.
Wall Switch	US	180	275-300sq.ft	40-48in.
Wall Switch	PIR	170-180	300-1000sq.ft	40-48in.
Cornerwide wiew	PIR/DT	110-120	To 40ft.	8-15ft.
Cornernarrow view	PIR	12	To 130ft.	8-15ft.
Corridor	US	360	To 100ft.	8-14ft.
High Mount	PIR	12-120	To 100ft	To30ft.
High mount corner	DT	110-120	500-1000ft.	8-12ft.
High mount ceiling	DT	360	500-1000ft	8-12ft

Table4: Compared Placement of Different Sensors

### 3. WORKING PRINCIPLE

Passive infrared sensors work by measuring the infrared energy of the surrounding environment. All living things give off heat, and these sensors can detect that heat. When a human or animal enters an area covered by passive infrared sensors, the increase in infrared energy tells the sensor that someone or something is moving through the area. Users can calibrate these sensors to trigger only at certain levels of infrared heat, in order to prevent them from going off in the presence of birds or small animals.

In our circuit,when PIR detects motion it creates a current about 0.10 - 0.15 miliampere. But this value is not enough for our circuit to work so we use opamps to increase the value(LM324). After 4 opamps (4 of them used to increase the effectivity) we have enough current for our circuit.

This project has some differences from other ones. First of all opamps are doubled because we couldn't get the presicion with two op-amp. So after calculations we decided to use 4 op-amps. And secondly we didnt use the capacitor (which should have been in one of opamp outputs) because it caused sealing.

As a result we had a PIR motion detector which can detect motion in a distance of 15-20 cm. If needed one can increase the presicion by op-amps.



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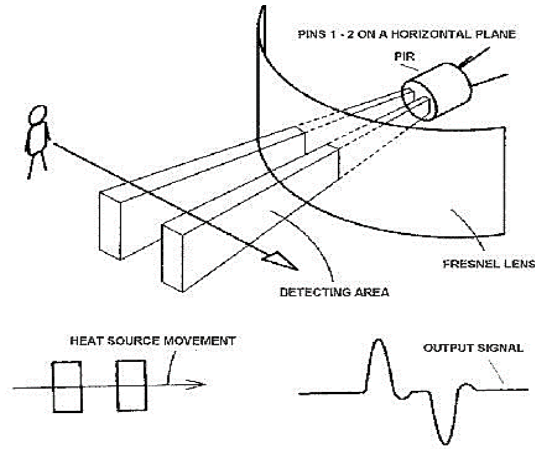


Figure4: Diagram of circuit

### 4. CONCLUSIONS

Motion detectors detect any sort of motion. When connected to a transformer the motion gets translated into an electric signal. This device is connected to a burglar alarm that immediately alerts a homeowner of any motion that gets detected. Motion Detectors have pet-immune functions, allowing detectors to ignore pets that weigh up to 40 pounds or 80 pounds. Technology also ensures to maximize accuracy and reduce energy usage. With a wide assortment of uses to suit different requirements, motion detectors are flexible, useful devices to have around the house. Motion detectors have the advantage of being portable, transportable, and easy to install with no monthly monitoring fees. Studies on crime prevention indicate that houses set up with motion detectors do help

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enhance security. They are a great way to get all the benefits of having a watchdog without the hassle of owning a dog.

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