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# Design and Implementation of an Automatic Energy Saving System by Human Interaction for Smart Home

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***ABSTRACT-*** *Wastage of electricity is one of the main problems which we are facing now-a-days. In our home, school, colleges or industry we see that fan/lights are kept on even if nobody in the room or area/passage. This happens due to negligence or because we forgot to turn off lights or when we are in hurry. To avoid all such situations we have designed this concept called "Design and Implementation of an Automatic Energy Saving By Human Interaction For Smart Home ". It has two modules, first one is known as "PIR Based Motion Sensor Circuit" and the second module is known as "LDR Circuit". The main concept behind this project is to activate a light when a person enters the room only or when intensity of the light is below. This function is implemented using a pair of Infrared sensors. if somebody enters in the room and at that time lights are turned on. When the number of persons inside the room is zero, lights inside the room are turned off using a relay interface. In this way Relay does the operation of"Automatic room light controller". Since this project uses two sensors which monitors the person presence and also intensity of light parallely.*

***KEYWORDS: PIR(Passive Infrared), LDR(Light Dependant Resistor)***

## 1.INTRODUCTION:

Nowadays without electricity we cannot imagine our daily life because electricity has become a necessity for all, without which day-to-day life chores & daily activities become stand still. Due to the depletion of non-renewable resources, conservation of energy has become mandatory and by doing so we can reduce electricity bills as well. We know that energies like wind energy, solar energy and hydro energy are called renewable energy sources which are renewable in nature. Therefore, utilization of these resources for power supply is the best possible way of producing, conserving and renewing energy, which is advantageous as it is pollution free, affordable, and free from environmental impacts.

On the other hand, the energy resources like petroleum, coal, natural gas, uranium and propane are called non -renewable resources, because their supplies are limited. Many environmental effects and day-by-day depleting energy resources warn us to save energy by using automatic room controller and energy-efficient lighting systems. Nowadays the wastage of electricity has become a routine thing for us, and the problem has become frequent at homes, schools, and colleges and even in industries. Sometimes we notice fans and lights keep on working even in the absence of people. This often happens in homes, offices and public places due to utter negligence of the inmates.

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However, there is a solution to control energy efficient lights at home by using automatic room light controller. This article provides information about such a solution of energy efficient lighting to conserve energy by optimizing home appliances such as lights, fans, etc.

When we enter a room, as a habitual tendency, we often search for a switch to turn the light on, and if we are new to the room, we often find it difficult to locate the switch. Most of the times, many of us forget to switch off the lights while leaving the room in which we stay most of the time. This results in unnecessary power wastage. Therefore, an automatic room-light controller automatically turns on the lights when a person enters into a room, and turns off the lights when the person leaves the room. This automatic room controller can be implemented by using a simple PIR sensor circuit.

## 2. CIRCUIT DIAGRAM:

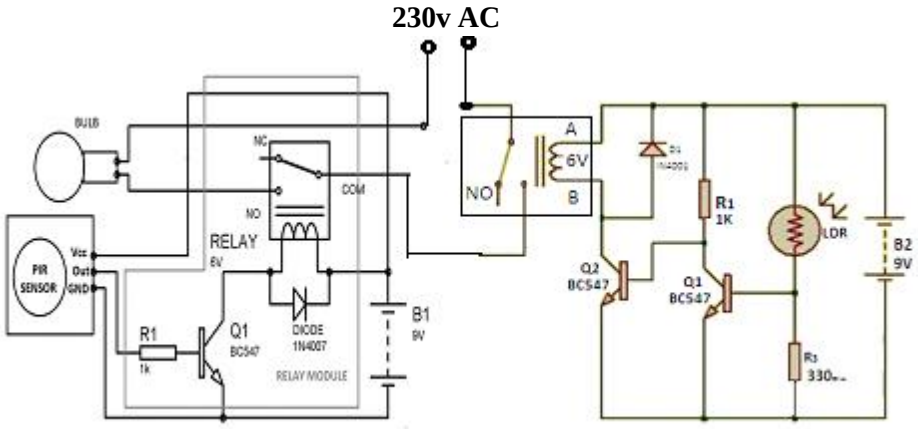


**Fig 2.1:Main circuit**

The above circuit shows the connection of sensor relay in order to control the room lighting. In fig 2.1 PIR sensor is used to detect the human presence in room, after it send output signal to gate of BC547 transistor so it closes the circuit and energizes the coil of relay. This makes the relay contact to open in such a way that bulb is connected to supply. Sensor will continuously monitor the room area and turn on the bulb until person exit from room. Similarly fig 2.2 show that connection of LDR(Light dependent register) sensor to relay. During the dim light condition this sensor will monitor the intensity of light ,if it falls below the reference value it send the signal to relay to turn on the bulb.

In the above circuit the normally opened terminal of the PIR sensor circuit relay is connect to the one terminal to the load and common terminal of this relay is connected to the normally opened terminal of the LDR circuit relay,the common terminal of the LDR circuit relay and other terminal of the relay is connected to the AC mains,Thus if both the relays are ON to activate a light.

## 3.HARDWARE CONFIGURATION:

### 3.1 PIR SENSOR:

The term PIR is the short form ofthe PassiveInfra Red. The term “passive”indicates that the sensor does not actively take part in the process, whichmeans, it does not emit the referred IR signals itself, rather passively detects the infrared radiationscoming from thehuman body in the surrounding area.The detected radiations are converted into an electrical charge, which is proportional to the detected level of the radiation. Then this charge is further improved by a built in FET and fed to the output pin of the device which becomes applicable to an external circuit for further triggering and amplification of the alarm stages.The PIR sensor range is up to 10 meters at an angle of +15o or -15o.The below image shows a typical pin configuration of the PIR sensor,

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which is quite simple to understand the pinouts; and, one may easily arrange them into a working circuit with the help of the following points:


**Fig 3.1: Passive Infrared Sensor (PIR)**

### 3.1.1Pin Configuration of PIR

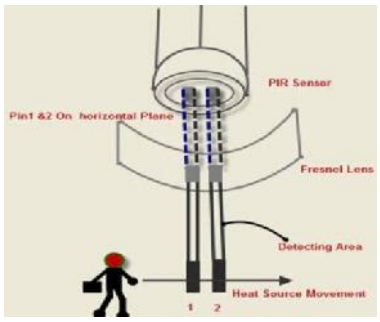


**Fig 3.2:Pin configuration of PIR sensor**

The Passive infrared sensors consist of three pins as indicated in the diagram shown above. Pin1 corresponds to the drain terminal of the device, which should be connected to the positive supply 5V DC.Pin2 corresponds to the source terminal of the device, which should be connected to the ground terminal via a 100K or 47K resistor. The Pin2 is the output pin of the sensor, and the detected IR signal is carried forward to an amplifier from the pin 2 of the sensor.Pin3 of the sensor is connected to the ground.

### 3.2 LDR SENSOR:

**Fig 3.3:LDR Sensor**

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells.They are made up of semiconductor materials having

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www.ijetsr.com
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high resistance. There are many different symbols used to indicate a LDR, one of the most commonly used symbol is shown in the figure below. The arrow indicates light falling on it. LDR

### 3.2.1 Working Principle of LDR:

A light dependent resistor works on the principle of photo conductivity.Photo conductivity is an optical phenomenon in which the materials conductivity is increased when light is absorbed by the material.When light falls i.e. when the photons fall on the device, the electrons in the valence band of the semiconductor material are excited to the conduction band. These photons in the incident light should have energy greater than the band gap of the semiconductor material to make the electrons jump from the valence band to the conduction band. Hence when light having enough energy strikes on the device, more and more electrons are excited to the conduction band which results in large number of charge carriers. The result of this process is more and more current starts flowing throgh the device when the circuit is closed and hence it is said that the resistance of the device has been decreased. This is the most common working principle of LDR.

### 3.3 Relay:

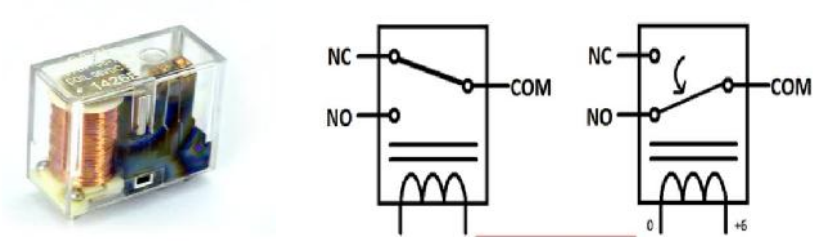


**Fig 3.4 Relay**

Relay is an electromagnetic switch, which is controlled by small current, and used to switch ON and OFF relatively much larger current. Means by applying small current we can switch ON the relay which allow much larger current to flow. Relay is the good example of controlling the AC (alternate current) devices, using a much smaller DC current. Commonly used Relay is Single Pole Double Throw (SPDT) Relay, it has five terminals as below:

When there is no voltage applied to the coil, COM (common) is connected to NC (normally closed contact). When there is some voltage applied to the coil, the electromagnetic field produced. Which attract the Armature (lever connected to spring), and COM and NO (normally open contact) gets connected, which allow larger current to flow. Relays are available in many ratings, here we used 6V operating voltage relay, which allow 7A-250VAC current to flow.

### 3.4 Flyback diode(1N4007):

A flyback diode (1N4007)sometimes called a snubber diode, commutating diode, freewheeling diode, suppressor diode, suppression diode, clamp diode, or catch diode is a diode used to eliminate flyback, which is the sudden voltage spike seen across an inductive load when its supply current is suddenly reduced or interrupted.

Here inductor (the relay coil) cannot change it's current instantly, the flyback diode provides a path for the current when the coil is switched off. Otherwise, a voltage spike will occur causing arcing on switch contacts or possibly destroying switching transistors.

### 3.5 Transistor:

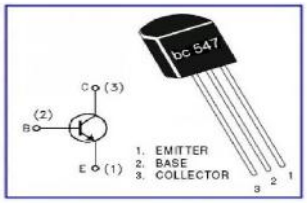


**Fig 3.5 Transistor**

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The BC548 is a general-purpose NPN bipolar junction transistor commonly used in European and American electronic equipment. It is notably often the first type of bipolar transistor hobbyists encounter, and is often featured in designs in hobby electronics magazines where a general-purpose transistor is required. The BC548 is low in cost[ and widely available.

Understanding Small Signal NPN and PNP Transistors

A BC547 transistor is a tiny three terminal device capable of converting small signal inputs into large amplified outputs,all transistors basically function in the same manner. They are broadly distinguished by their power ratings or power handling capacities. They may be also classified by their frequency handling capabilities and their amplification determining factor or hFE.

A BC547 is a general purpose, small signal transistor fit for almost all types of circuit applications and therefore extensively used for making an unlimited range of electronic gadgets today. Companies like NXP, PHILIPS, Micro Electronics, and FAIRCHILD, to name a few, are the leaders in manconnect a resistor of some minimum safe value to the base of the transistor.

This this circuit we use 1 K resistor, this will ensure that at least the device cannot get damaged through its “base" pin-out, because the resistor will never allow the relevant currents to develop to dangerous levels across the vulnerable base/emitter junction of the transistor.ufacturing this device.

**3.6 Battery:**


**Fig 3.6 Battery**

The nine-volt battery, or 9-volt battery, in its most common form was introduced for the early transistor radios. It has a rectangular prism shape with rounded edges and a polarized snap connector at the top. This type is commonly used in walkie-talkies, clocks and smoke detectors.

The nine-volt battery format is commonly available in primary carbon-zinc and alkaline chemistry, in primary lithium iron disulfide, and in rechargeable form in nickel-cadmium, nickel-metal hydride and lithium-ion. Mercury-oxide batteries of this format, once common, have not been manufactured in many years due to their mercury content. Designations for this format include NEDA 1604 and IEC 6F22 (for zinc-carbon) or MN1604 6LR61(for alkaline). Most nine-volt alkaline batteries are constructed of six individual 1.5V LR61 cells enclosed in a wrapper. These cells are slightly smaller than LR8D425 AAAA cells and can be used in their place for some devices, even though they are 3.5 mm shorter. Carbon-zinc types are made with six flat cells in a stack, enclosed in a moisture-resistant wrapper to prevent drying. Primary lithium types are made with 3 cells in series.In 2007, 9-volt batteries accounted for 4% of alkaline primary battery sales in the US. In Switzerland in 2008, 9-volt batteries totalled 2% of primary battery sales and 2% of secondary battery sales.Other nine-volt batteries of different sizes exist, such as the British "Ever Ready" PP series and certain lantern batteries.

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## 4.HARDWARE MODULE:

**Fig 4.1:Human enters at morning time**

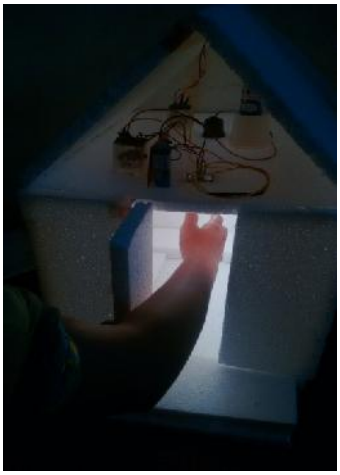

**Fig 4.2:Human enters at night time**

**From the above module fig 4.1** At the day time the light intensity is more and LDR senses the light and at that time if the human enters the room the light remains in the off state which is shown in the fig 4.1.At the night time the light intensity is less and ldr senses the intensity and that time if the human enters the room the light comes to the on state i.e,the bulb glows which is shown in the fig 4.2

## 5 ADVANTAGES AND DISADVANTAGES :

### 5.1 Advantages :

- It is easy to integrate with lighting system such as automatic lighting system.
- Light sensors need small voltage and power for its operation.
- Photoresistors are lower in cost, bi-directional and offer moderate response time.
- Phototransistors are very fast and provide immediate output compare to photoresistors.
- It can be used in very harse environment having irregular heat cycles (Active Motion Sensor).
- It has more lifespan which is about 100000 Hrs (Active type).
- It is easy to integrate with lighting system such as automatic lighting system.
- Light sensors need small voltage and power for its operation.
- Photoresistors are lower in cost, bi-directional and offer moderate response time.
- Phototransistors are very fast and provide immediate output compare to photoresistors.

It is easy to install motion sensors.

### 5.2 Disadvantages:

- Radio frequency at high power is harmful for humans (active type).
- frequency in microwave range do not penetrate metal objects (active type).
- Passive motion sensors do not operate above temperature of 350C.
- Passive Infrared (PIR) Sensor can detect human being within approx. 10 meters range.
- kind of moving object can trigger the PIR sensor type.

## 6 CONCLUSION:

In this proposed concept effective way of energy saving is done by using PIR sensor and LDR sensors. PIR sensor senses the human presence when a person enters the room and it will send the signal to relay thereby lights get automatically turned on. Later when the number of persons inside the room is zero, lights inside the

room are automatically turned off. Similarly at the same time LDR sensor will detects the intensity of the light, if it is low then it will turn on light by sending signal to relay. In this way effective utilization of energy is achieved for smart homes. The future scope of this proposed concept will increases the utilization of energy and also saving of money.

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