

## **Automated Intelligent Power Saving System and Security System**

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### **Abstract**

The purpose of this project is to save the power used in places like libraries, staircases, parking, gardens etc. where lots of power is wasted unnecessarily by keeping the fans and lights ON even when there is no one present, and also at places where security is paramount and an alarm needs to be generated when someone is passing by. Thus, using the same machine, it can be used to save the power and also as a security alarm using a simple sensor called Passive Infrared (PIR) Sensor. When a person enters the monitored area, the Infrared energy emitted from the living body is focused by a Fresnel lens segment and the PIR sensor activates, and gives to the microcontroller which acts as a security surveillance system or power saving device according to the position of switch. If the switch is at position 1, the camera views the allotted area and generates an alarm indicating that someone entered and a message is sent to the nearby station. And, when the switch is at position 2, the lamp and fan may be ON or OFF. Thus, this article discusses the concept of how PIR sensor works to save the energy and to generate security alarm. Moreover, as there is need to save the energy as much as possible so as to meet the future generation and also in order to have high security, this proposed model would be a great aid to the society.

**Keywords:** PIR Sensor, Alarm or Buzzer, Microcontroller, Fan, Light, GSM module, mobile.

## 1. Introduction

The development of any country depends to a large extent on availability and usage of electricity. Conservation of electricity has now become a vital element of economic growth giving benefit to state's exchequer and this conservation is more essential due to the concern for fast depletion of non-renewable sources of energy in the country. Also, in some area there must be a check on who is passing through. In order for that a security system is required which indicates if someone entered by CCD Camera. It is suitable for apartment, villa, office building, etc.

## 2. PRINCIPLE

The PIR Sensor senses the motion of a human body by the change in surrounding ambient temperature. Then it turns on the load to which it is connected. The load remains on until it senses motion. The load may be any form of device, i.e. lamp, fan, alarm, etc. Once the motion is seized, it switches off the load.

## 3. Proposed Model

The operation of the experimental kit changes according to the position of the switch. Let us suppose that the kit is placed at the desired location. The basic operation of kit would be that when a person enters in that area the PIR sensor absorbs the black body radiation emitted by that person and activates. Depending upon the switch position the operation will change.

- When switch is at position 1, it acts as a security surveillance system and it turns the alarm ON. When the alarm is generated, a message is sent to the nearby station indicating that someone just entered. When the person leaves, the PIR sensor will activate the alarm again.
- When switch is at position 2, it acts as a power saving device and the lamp and fan turns ON. When the person leaves the place, the PIR sensor will activate again and the lamp and fan turns OFF.

### Basic Circuit

The circuit shown provides a visual indication of how it works (fig shown in next page)

### Components Used

The component used has been explained:

#### 1. PIR Sensor:

PIR sensors are passive electronic devices. Once the motion is detected by sensing infrared fluctuations, a high is sent to the signal pin. These sensors work well in detecting human motion. PIR sensors are composed of a solid state pyroelectric chip.

When exposed to infrared radiation, the chip generates an electric charge and this charge is amplified by an amplifier and thus the output voltage can be interfaced with other devices. The PIR Sensor has a range of approximately 5 meters and it can sense object up to 120° within a meter range. The sensitivity is enhanced by a translucent Fresnel Lens which covers the chip and it varies with environmental conditions. The sensor adjusts to slowly changing conditions but whenever there is a sudden change it responds by making its output high.

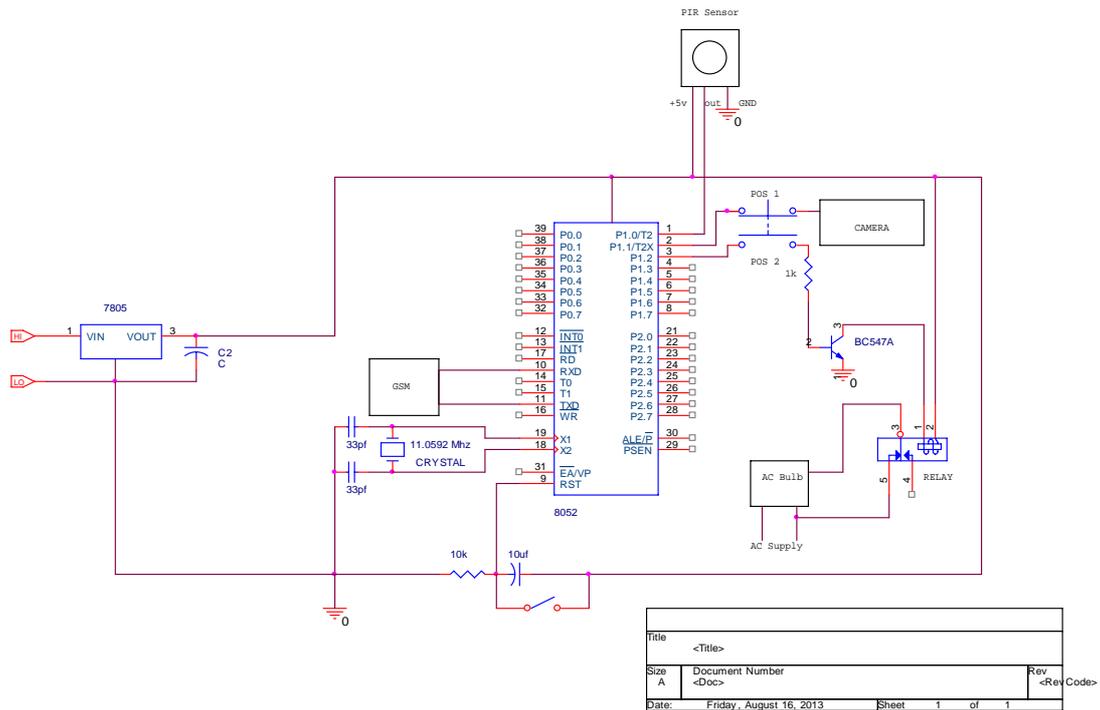


Fig. 1: Basic Circuit Model.



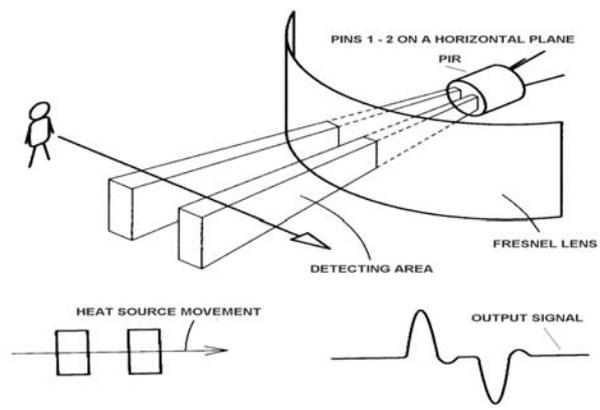
Fig. 2: Basic PIR Sensor

**Feature:**

- Input Voltage: DC 4.5-20V
- Static current: 50uA
- Trigger: H-Yes, L-No
- Block time: 2.5 S(default)
- Delay time: 5 S(default)
- Angle:< 120 degree
- Distance:5 feet(default) - max 20 feet
- Fresnel lens : Diameter: 23mm
- Dimensions: 32mm \* 24mm

**Operation:**

When a person enters the monitored region the infrared energy emitted from the intruder's body is focused by a Fresnel lens and overlaps a section on the chip, which had previously been looking at a much cooler point of the protected region. That portion of the chip is now much warmer than earlier. When the intruder moves, the hot spot on the surface of the chip also moves. This causes the relay to de-energize, thereby activating the detection input on the alarm control panel. PIR sensors are used with plastic segmented parabolic mirrors to focus the infrared energy. The PIR sensor has two slots and these slots are made of a material sensitive to IR. When idle, both slots detect the same amount of IR. When a warm body passes by, it intercepts one half of the PIR sensor, that causes a positive differential change between the two halves. And when the warm body leaves the area, the sensor generates a negative differential change.



**Fig. 3:** Operation Representation.

#### 4. Why Pir Sensor Over IR Sensor?

IR Sensor	PIR Sensor
<ul style="list-style-type: none"> <li>▪ * Infrared sensor use dual beam transmission, one side with transmitter for emitting infrared ray, the other side with receiver for receiving the ray.</li> <li>▪ *Infrared beam sensor can not transmit over long range distance.</li> </ul>	<ul style="list-style-type: none"> <li>*PIR sensor doesn't emit the infrared ray, it receives the infrared ray that is emitted by objects.</li> <li>*PIR sensor doesn't emit the infrared ray, it receives the infrared ray that is emitted by objects.</li> </ul>

#### 2. Transistor:

The transistor is mainly used for switching and amplification. In this case, transistor is used for switching the relay. The reason for choosing BC547A over other transistor is because relay needs a minimum rating of 5mA and 16mA and BC547A has comparatively higher rating than other transistors.

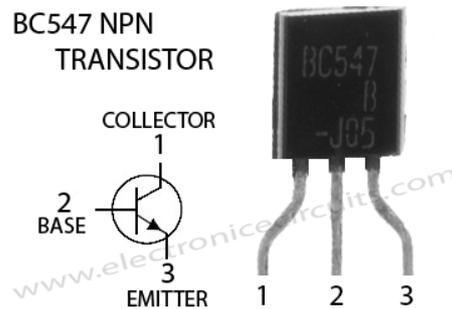


Fig. 4: BC547 transistor.

#### 3. Relay:

A relay is an electrically operated switch. To control a circuit by a low-power signal, relays are used. We are using two relays, one for switching the lamp and one, and the other for switching the alarm system.



Fig. 4: SPDT sealed COM-00100 Relay.

The relay used here is SPDT Sealed COM-00100. This is a high quality Single Pole - Double Throw (SPDT) sealed relays. These are used to switch high current, and/or high voltage devices. This relay coil is rated up to 12V having a minimum switching voltage of 5V. The contacts are rated up to 5A (@250VAC, 30VDC).

#### 4. GSM Module:

GSM (Global System for Mobile) / GPRS (General Packet Radio Service) TTL-Modem is SIM900 Quad-band GPRS / GSM device, and it works on frequencies of 850, 900, 1800 and 1900 MHz. It is very compact in size and easy to use as plug in GSM Modem. The Modem is designed with 3V3 and 5VDC TTL interfacing circuitry, which allows user to directly interface with 5V Microcontroller as well as 3V3 Microcontrollers. The baud rate can be configurable from 9600-115200 bps through AT (Attention) commands. This GSM/GPRS TTL Modem has internal TCP/IP stack to enable User to connect with internet through GPRS feature. It is suitable for SMS as well as DATA transfer application in mobile phone to mobile phone interface. The modem can be interfaced with a Microcontroller using USART (Universal Synchronous Asynchronous Receiver and Transmitter) feature (serial communication).

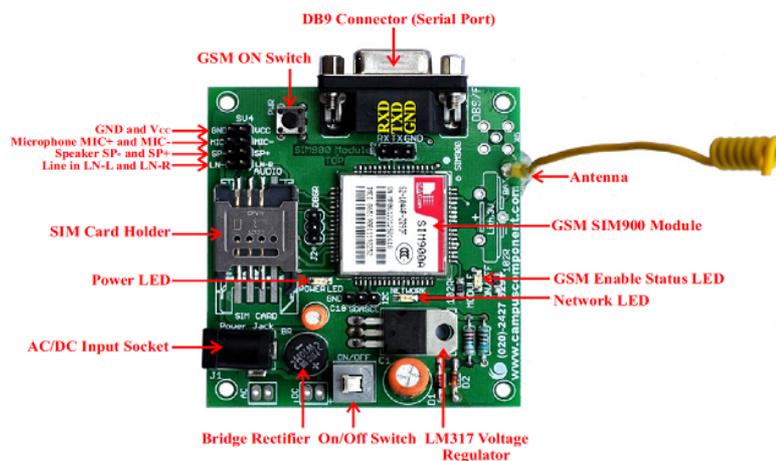
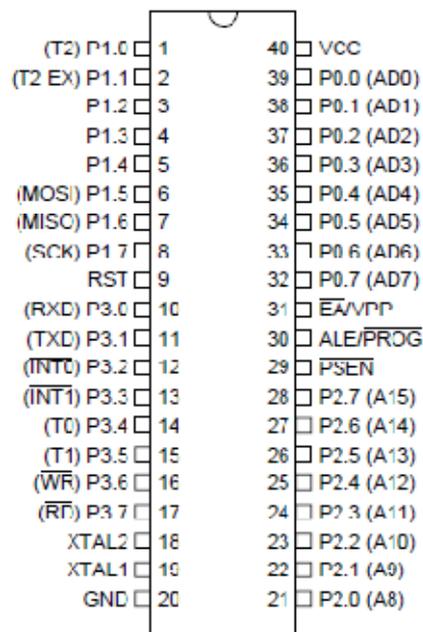


Fig. 6: GSM Module.

#### 5. ATMEL AT89S52 Microcontroller:

The AT89S52 is high-performance, low-power CMOS 8-bit microcontroller with 8Kbytes of in-system programmable Flash memory. It is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard 80C51 instruction set pin out. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, AT89S52 is a powerful microcontroller which provides a cost-effective and highly-flexible solution to many embedded control applications. It provides the following standard features: 256 bytes of RAM, 8K bytes of Flash, Watchdog timer, 32 I/O lines, three 16-bit timer/counters, two data pointers, on-chip oscillator, a full duplex serial port, clock circuitry and a six-

vector two-level interrupt architecture, and in addition to that, the AT89S52 is designed with static logic for operation down to zero frequency and it also supports two software selectable power saving modes. The first mode is the Idle Mode which stops the CPU while allowing the timer/ counters, RAM, serial port, and interrupt system to continue functioning. The second mode is the Power-down mode which saves the RAM contents but freezes the oscillator, thus disabling all other chip functions until the next interrupt occurs. The on-chip Flash allows the program memory to be reprogrammed in-system.



**Fig. 7:** AT89S52 Microcontroller.

## 6. DPDT Switch:

DPDT stands for Double Pole Double Throw switch. By using this, the polarity of the applied voltage can be changed. This type of switches is used in situations where we need different outputs. It has 3 states ON, OFF, ON. The primary difference between the two ON states is that the polarity of both the states is opposite with respect to each other.



**Fig. 8:** DPDT Switch.

### 7. Load Appliances:

The different types of loads being used are:

- a) Fan and Light of any type
- b) Camera for surveillance
- c) Alarm or Buzzer
- d) Basic mobile phone for intimation



**Fig. 9:** Load Appliances.

### 5. Working:

The OUT pin of the PIR sensor is connected to port P1.0 of the microcontroller. Two systems, one for security surveillance and the other for power conservation is connected to port P1.1 and P1.2 respectively and both the system are connected via a DPDT switch. The GSM module is connected to the RxD and TxD pin. The experiment kit is connected to a 240V supply. Whenever someone enters the area the PIR sensor

activates which switches the transistor to which the DPDT switch is connected. Whenever the transistor goes high, the corresponding load connected turns ON.

- When the switch is at position 1, the port P1.1 is activated and the model acts as a security alarm. The transistor turns ON which turns ON the camera and produces an alarm indicating that someone just passed. The GSM module sends a message to the nearby station that someone just intruded or passed by.
- When the switch is at position 2, the port P1.2 is activated and the model act as a power saving device. The transistor turns ON which switches the relay and it turns on the fan and light and other electrical appliances connected to it.

When the person leaves from that area, the PIR sensor activates again and the corresponding security surveillance or power saving device is turned OFF.

## 6. Observation

The following observation was made based upon our review of electricity consumption when applied for stair case:

RESIDENTIAL METER	W/o PIR	WITH PIR
Cost of electricity per kwh (in Rupees)	4	4
Operational hours of passage tube lights	12	3
Power capacity of tube light in watts	57	57
Total consumption in watts	684	171
Number of days	30	30
Total power used by one tube light in kwh	20.5	5.13
Amount paid per month (in Rupees)	82	20.5
Savings per month per tube light (in Rupees)		61.5

Thus from the above data we can conclude that Rs. 61.5 is saved in a month when PIR sensor is used. Thus implement this setup in a large scale then a significant amount of total power consumed will be reduced and thereby reducing the cost of electricity.

## 7. Advantages

- They detect infrared light from a large distance, depending on how the PIR sensor is calibrated.
- PIR sensors are generally compact and can be fitted into virtually any electronic device.
- They are low cost and low power devices, have a wide lens range, , pretty rugged and can be easily interfaced with other devices.

- The same device can be used for two different purposes, thus providing multi-functionality features.

## 8. Applications

- Common restroom, for lights & exhaust fans
- Common staircases
- In parking area
- For garden lights
- For changing rooms in shops
- For corridors
- Library
- Halloween Props
- Robotics
- Safety locker room in banks
- Museum
- Prison

## 9. Conclusion

- In this experimental setup, we are able to turn automatically the appliances ON and OFF as required and security alarm.
- By implementing this setup, we can expect more power conservation and high security.
- This concept not only ensures that our work will be useful in the future but it will also provide flexibility to adapt and extend as needs change.
- This device is compatible with our existing system used for providing comfort.

## References

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