Automatic Room Light Controller using Arduino and PIR Sensor

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Abstract:
Automatic Room Light Controller Using Arduino and PIR Sensor can be used to turn ON and OFF the illumination system of home / office routinely by sensing the existence of human [1]. Such Automatic Room Lights systems can be implemented in your Classrooms, faculty cabins, garages, staircases, bathrooms, etc. where we do not need constant light but only when individuals are existing[1]. Also, with the assistance of this system, we can save the energy bill as power will be consumed only when human is present i.e. when required lights will be spontaneously turned ON or OFF. This paper proposed system of Automatic room light controller using Arduino and PIR sensor and relay module. PIR sensor will spot the human activity and based on response of PIR sensor unit will control the switching action. Proposed method can help us to reduce the consumption of electricity.

Keywords: Arduino UNO, PIR sensor, Relay unit, room light.

I. INTRODUCTION

Scientific discoveries delivered us luxury and comforts. Technology has become vital and essential part of our lives. Tremendous advancement in technology is succeeded in last few years. Electrical energy has become an crucial part of human life. In recent years the people are looking forward for the automation in their day to day life, and even now the people are excited to save energy consumed to reduce the expenditures. People are becoming lazy to switch off the lights while leaving the room, so the large amount of energy is wasted if the light is remain ON in the absence of human being. Generally, in public and private sector companies, offices, school and colleges most of the people are not interested to switch OFF the electronic machines like fan, light, etc., while going out of the room [1].

As more and more consumer electronic and home appliances are used, the size of them is becoming large; power consumption in home area tends to grow. Moreover, unusable power consumption occurs in the absence of human being in public and private sectors.

Using the automation in switching the home or office lighting system, the consumption of electricity can be comprehensively reduce which will in turn save the money of the owner. Now the people are looking forward for automation in their daily life. The people are trying to reduce human efforts.

By using suggested system wastage of electricity can be reduced as electrical appliance will be automatically turned ON or OFF based on the presence of the human being with the help of PIR sensor [2], while departure no need to turn off the appliances or while arriving in your cabin no need to turn on the electrical appliances. This is the main enhancement of the projected system.

The main parts of the proposed system are Arduino, PIR Sensor and the Relay Module. This system can be considered as a major application of PIR sensors. The remaining paper is ordered as: section II is about basic details of various modules and components used for the system. Section III Proposed system description about hardware and software design. Section IV gives working of the system using Arduino and PIR sensor. Section V is the upcoming scope and section VI is the result and conclusion.

II. DETAILS OF PROPOSED SYSTEM MODULES

A. Arduino UNO

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various development boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable.

It can be powered by the USB cable or by an external 9-volt battery. It also has 16 MHz ceramic resonators, a USB connection jack, an external power supply jack, an ICSP (in-circuit serial programmer) header and a reset button. Its operating voltage is 5v, input voltage 7 to 12v (limit up to 20v).

A.1 Arduino UNO Pin Description:
<table>
<thead>
<tr>
<th>SR.NO</th>
<th>PIN NAME</th>
<th>USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Power USB</td>
<td>Arduino board can be driven by using the USB cable from computer.</td>
</tr>
<tr>
<td>2.</td>
<td>Power (Barrel Jack)</td>
<td>Arduino boards can be driven directly from the AC mains power supply by Power Barrel Jack.</td>
</tr>
<tr>
<td>3.</td>
<td>Voltage Regulator</td>
<td>Voltage Regulator function is to control the voltage given to the arduino board and stabilize the DC voltages used by processor.</td>
</tr>
<tr>
<td>4.</td>
<td>Crystal Oscillator</td>
<td>It helps Arduino in dealing with time issues. The number printed on top of Arduino crystal state about its frequency (16 MHz).</td>
</tr>
<tr>
<td>5,17</td>
<td>Arduino Reset</td>
<td>It reset the Arduino board and start the program from beginning.</td>
</tr>
<tr>
<td>6,7,</td>
<td>Pins</td>
<td>3.3 V- it supply 3.3v output voltage.</td>
</tr>
<tr>
<td>8,9</td>
<td></td>
<td>5 V- it supply 5v output voltage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GND- there are multiple GND pins any one of them can be used to ground the circuit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vin- it is used to power Arduino board from external supply.</td>
</tr>
<tr>
<td>10.</td>
<td>Analog pins</td>
<td>It has 6 analog input pins A0-A5. These pins can read signal from sensor and convert it to digital value that processor can read.</td>
</tr>
<tr>
<td>13.</td>
<td>Power LED Indicator</td>
<td>This LED should light up when you plug into your Arduino into a power source to indicate that your board is powered up correctly.</td>
</tr>
<tr>
<td>15.</td>
<td>Digital I/O</td>
<td>The Arduino UNO board has 14 digital i/o pins (of which 6 provide PWM (Pulse Width Modulation) output.</td>
</tr>
</tbody>
</table>

**SPECIFICATIONS OF ARDUINO:**

- Microcontroller: Microchip ATmega328P
- Operating Voltage: 5 volts
- Input Voltage: 7 to 20 volts
- Digital I/O Pins: 14 (of which 6 can provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by boot loader
- SRAM: 2 KB

**B. PIR Sensor**

PIR Sensor is short for passive infrared sensor, which applies for projects that essential to identify human or particle movement in a certain range, and it can also be mentioned as PIR (motion) sensor, or IR sensor. Since its powerful function and low-cost benefits, it has been implemented in tons of projects and widely accepted by the open-source hardware community for projects related to Arduino and raspberry pi. All this can support the beginners to learn about PIR sensor more easily.

**B.1 How does PIRs work?**

The passive infrared alarm does not release energy to space but relies on receiving infrared radiation from the human body to make an alarm. Any object with temperature is constantly radiating infrared rays to the outside world. The temperature of the human body is 36-37°C, and most of its radiant energy is concentrated in the wavelength range of 8-12 um.

**C. Relay Module**

The Relay module is a distinct hardware device used for remote switching. The Relay module houses two SPDT relays and one wide voltage range, optically isolated input. These are brought out to screw-type terminal blocks for easy field wiring. Relays are switches that open and close circuits electromechanically or electronically.
relay contact is normally open (NO), there is an open contact when the relay is not energized.

### C.1 PIN DESCRIPTION OF RELAY MODULE:

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Pin Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Coil End 1</td>
<td>Used to trigger (On/Off) the Relay. Generally one end is connected to 5V and the other end to ground.</td>
</tr>
<tr>
<td>2.</td>
<td>Coil End 2</td>
<td>Used to trigger (On/Off) the Relay. Generally one end is connected to 5V and the other end to ground.</td>
</tr>
<tr>
<td>3.</td>
<td>Common(COM)</td>
<td>Common is coupled to one End of the Load that is to be controlled.</td>
</tr>
<tr>
<td>4.</td>
<td>Normally Close(NC)</td>
<td>The other end of the load is either connected to NO or NC. If connected to NC the load remains connected before trigger.</td>
</tr>
<tr>
<td>5.</td>
<td>Normally Open (NO)</td>
<td>The other end of the load is either connected to NO or NC. If connected to NO the load remains disconnected before trigger.</td>
</tr>
</tbody>
</table>

### III. PROPOSED SYSTEM DESCRIPTION

For the proposed system of automatic room light controller for power saving. In the proposed the intensity of light is depending upon the number of persons present in the room [3].

### IV. WORKING OF THE SYSTEM

Functioning of this project is very simple and is explained here. Initially, when there is no human movement, the PIR Sensor doesn’t detect any individual and it’s OUT pin stays LOW. As the individual enters the room, the change in infrared radiation in the room is identified by the PIR Sensor. As a result, the output of the PIR Sensor becomes HIGH. Since the Data OUT of the PIR sensor is connected to Digital Pin 8 of Arduino, whenever it develops HIGH, Arduino will trigger the relay by making the relay pin LOW (as the relay module is an active LOW module). This will turn the Light ON. The light stays turned ON as long as there is movement in front of the sensor. If the person takes a nap or leaves the room, the IR Radiation will become stable (there will be no change) and hence, the Data OUT of the PIR Sensor will become LOW. This in turn will make the Arduino to turn OFF the relay (make the relay pin HIGH) and the room light will be turned OFF.

### V. CIRCUIT DIAGRAM

Whenever PIR sensor detects any body movement, its OUTPUT pin becomes HIGH, which applies the triggering voltage to the base of the transistor, transistor gets ON, and current started flowing through the coil. Coil in Relay get energies and create electromagnetic field, which permits much larger current (220v AC) to flow, which turns ON the BULB. You can increase or decrease the Bulb ON duration by setting up PIR sensor.

### VI. CONCLUSION

From the proposed system we can conclude that an approach is taken to control the room lights using various devices. As nowadays enormous amount of energy is wasted in daily life. With the help of this system the energy wastage can be preserved and can be contribute to large amount of power saving. The total effective cost of system is very less.
VII. FUTURE SCOPE

In the proposed system decision are taken based on presence of human but here we can also interface LDR (Light Dependent Resistor) along with PIR sensor for better working of the system. This system can also be interfaced with the Bluetooth module so the whole system can be controlled from the mobile by just single click. Applications of this system are:
1. It can be used in college labs, schools, etc.
2. It can also be used in bathrooms, staircases, etc. in the house.

VIII. REFERENCES

[1]. Mahesh Kumar Singh” Arduino based: Automatic Room Light Control” department of ECE, Buddha Institute of Technology, Gorakhpur (Uttar Pradesh), India.
