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Embedded Based Automation for Energy Conservation in Restricted Areas

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Abstract: ***Wastage of electricity is one of the main problems which we are facing today. In homes, schools, colleges, industries etc, we see that lights are kept on even if there is no one inside the room. This happens due to negligence or because we forget to turn off the lights when we are in a hurry. The presence of humans can't be identified by using cameras in the restricted areas like trail rooms and rest rooms of shopping malls, theaters, etc. The power wastage in certain areas is unavoidable and the lights are kept on always. The amount of electricity usage is high in theatres and malls where the lights are always kept on in the restricted areas. To avoid all these problems, a project is proposed to automatically control the room lights by sensing the presence of humans with the help of sensors without using camera thereby preventing electricity wastage.***
Keywords: ***PIR Sensor, LDR, Arduino UNO, IR sensor, Relay***

I. INTRODUCTION

In recent years the energy crisis has become one problem which the whole world must meet. The largest part of energy consumption is done by home power consumption in the world. In particular, the power consumption of lamps in a typical home is a factor which can't be unnoticed. In different places the typical user needs different light intensities. Occasionally the light intensity from outside is sufficient for the person inside the room, and thus no need to turn on any light. But occasionally the user leaves but forgets to turn off the light. These factors cause energy waste. So some power management of light control in a room is necessary in order to save energy. Visitor counter technique is implemented using IR sensor to count the number of persons inside the room. So, we can use the IR sensor for the interruption process. The existing system for energy conservation uses IR sensors which can be interrupted by even animals, birds etc. There is no proper system to detect whether the interruption is caused by a human being. Due to the counter mechanism used in the existing system, the circuit can be used only when a single person cuts the rays of the sensor. Hence it cannot be used when two person cross simultaneously. PIR sensor is used to detect the presence of human being in a detection area. Here, we can use PIR sensor to detect the human presence inside the room. Light Dependent Resistor (LDR) generates the analog signal proportional to the available light inside the room and brightness of the light is controlled accordingly. In addition to this, it also senses the intensity of sunlight in the room. Light Dependent Resistor (LDR) sensor is used to check the intensity of sunlight in the room. An LCD is used here to display the total rooms, vacant rooms and also the sensing level (high/ low) of the PIR and the IR sensors. The microcontroller receives the output from the sensors. A relay is used to turn on/off the light. The output of the microcontroller is received by the relay driver circuit which is used to drive the relay. The light is kept ON until the rays from the IR sensor are interrupted by the human. The objective of this project is to develop a controller based system that can light up the room automatically in order to prevent the wastage of electricity by sensing the presence of human being inside the room. The controller used here is Atmega328. The human presence is detected with the help of Passive Infrared (PIR) sensor.

II. BLOCK DIAGRAM

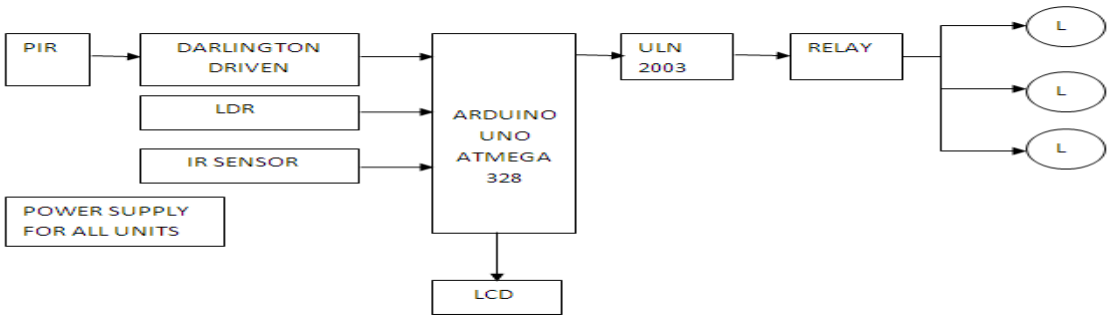

Fig. 1 Overall block diagram Unit

The microcontroller used here is Arduino UNO Atmega328. LDR is used to check the intensity of sunlight in the room. PIR sensor is used to sense the human being. IR sensor is used to keep the light turned on until the human is present. The output of the three sensors is received by the microcontroller Atmega328. The output of the microcontroller is then passed to the relay which is used to turn on/off the lights with the help of relay driver.

III. HARDWARE DESCRIPTION

A. *Arduino UNO*

The Atmel ATMEGA328 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATMEGA328 achieves throughputs close to 1MIPS per MHz. This empowers system designer to optimize the device for power consumption versus processing speed.

B. *Relay*

A relay is an electrically operated switch. Magnetic field which attracts a lever and changes the switch contacts is created by current flowing through the coil of the relay. Relays allow one circuit to switch a second circuit which can be entirely discrete from the first. The coil current may be on or off so relays need two switch positions and most have double throw (changeover) switch contacts.

C. *Protection Diodes For Relay*

Transistors and ICs must be protected from the brief high voltage produced when a relay coil is switched off. The diagram shows how a signal diode (ex 1N4148) is connected 'backwards' across the relay coil to provide this protection. Current flowing through a relay coil creates a magnetic field which collapses suddenly when the current is switched off. The unexpected flop of the magnetic field induces a momentary high voltage across the relay coil which is very likely to damage transistors and ICs. The protection diode allows the induced voltage to drive a momentary current through the coil (and diode) so the magnetic field dies away quickly rather than instantly. This prevents the induced voltage becoming high enough to cause damage to transistors and IC.

D. *Relay Driver*

A relay driver IC is an electromagnetic switch that can be used whenever we want to use a low voltage circuit to switch a light bulb ON or OFF which is connected to 230V main supply. ULN2003 is a high voltage and high current darlington array IC. It contains seven open collector darlington pairs with common emitters. The two bipolar transistors is the arrangement of a darlington pair. Every channel or darlington pair in ULN2003is rated at 500mA and can withstand peak current of 600mA. While driving inductive loads each driver contains a suppression diode to dissipate voltage spikes.

E. *Light Dependent Resistor*

Light dependent resistors or LDRs are often used in circuits where it is necessary to detect the presence or the level of light. It is a component that has a variable resistance that changes with the light intensity that falls upon it. When an LDR is kept in dark, its resistance is very high. This resistance is called dark resistance. It can be as high as 1012 ohms. When the device is allowed to absorb light, its resistance will be decreased drastically. LDR's are often used as light sensors. Although other devices such as photodiodes or phototransistor can also be used, LDR's are convenient to use. They provide large change in resistance for changes in the light level.

F. *IR Sensor*

An infrared sensor emits and/or detects infrared radiation to sense its surroundings. To transmit an infrared signal, Infrared Sensor is used as Obstacle detector, this infrared signal bounces from the surface of an object and the signal is received at the infrared receiver. Infrared Transmitter is a light emitting diode (LED) which produces infrared radiations. Hence, they are called IR LED's. Even though an IR LED looks like a normal LED, the radiation emitted by it is obscure to the human eye. Infrared receivers are likewise named as infrared sensors as they detect the radiation from an IR transmitter. IR receivers come in the form of photodiodes and phototransistors. Infrared Photodiodes remain dissimilar from normal photodiodes as they detect only infrared radiation.

G. *Darlington Pair*

The first transistor's emitter feeds into the second transistor's base and as a result the input signal is amplified by the time it reaches

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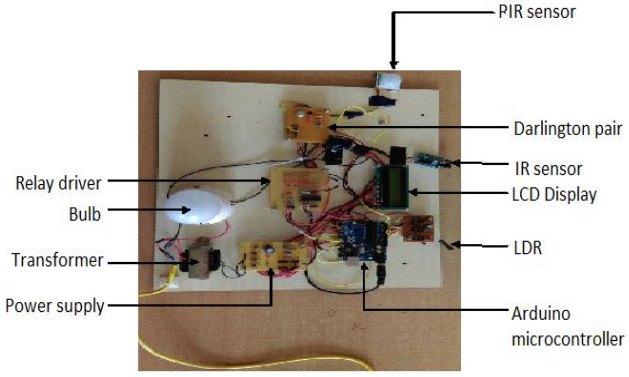
the output. This circuit is used for amplifying currents, i.e., the amplified current from the first transistor is further amplified by the second transistor. If only one transistor is used the transistor combination exhibits higher current gain.

H. Passive Infrared Sensor (PIR sensor)

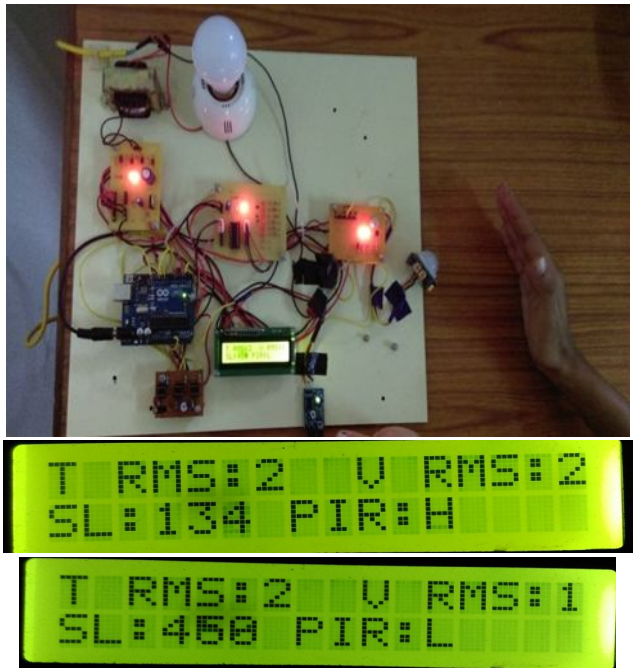
All objects with a temperature above absolute zero emit heat energy in the form of radiation. Mostly this radiation is invisible to the human eye because it radiates at infrared wavelengths, then it can be detected by electronic devices invented for such a purpose. The most frequent consumption of the PIR sensor is as an 'area' sensor which is used to detect 'someone moving in the front yard', or 'someone moving in the bathroom', or 'someone moving through a doorway', or even 'someone opened the beer cooler', it is all technically the same sensor and logic. There is a simple electronic device which is sensitive to 'heat', or rather the infrared light that is emitted by warm or hot objects (like humans).

The PIR Sensor has a range of approximately 20 feet. This can vary with environmental conditions. The sensor is designed to adjust to gradually changing conditions that would happen normally as the day progresses and the environmental situations adjustment, but responds by toggling its output when sudden changes occur, such as when there is motion.

IV. RESULT



When a person enters the room, firstly the person is sensed in PIR sensor to confirm whether it a human or not and then IR sensor senses the human presence until the person is inside the room. Finally the number of vacant rooms is displayed in LCD display.



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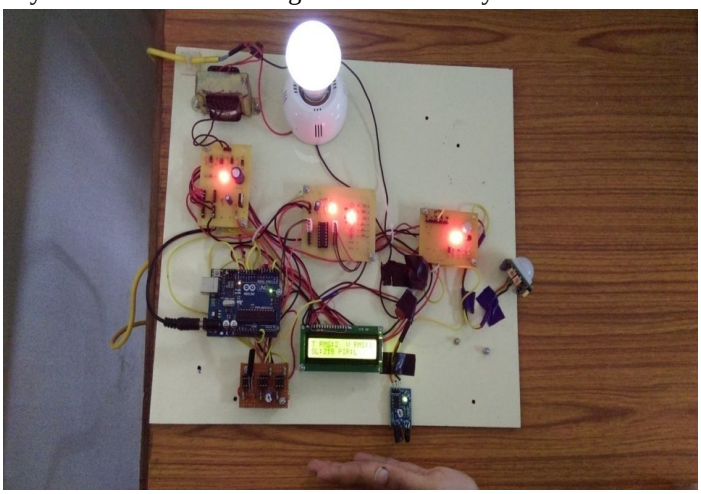
At low intensity (SL<250) and PIR senses the human presence (PIR : H) ,then the V RMS will be the same as T RMS. At high light intensity (SL >250), PIR senses the human entering the room and the IR interruption indicates that the room is occupied by the human hence V RMS is decreased by one. The bulb doesn't glow since it is day time.



At low light intensity (SL <250) and PIR senses thehuman entering the room and the IR interruption indicate that the room is occupied by the room and makes to glow the bulb ON. The V RMS is decreased by one from the T RMS available.

V. CONCLUSION

The current concept has been implemented for a single room. It can also be expanded for more than one room and the expected outcome can be achieved.By modifying this circuit and using additional relays, it is possible to control fans also. It is not only applicable in restricted areas like restrooms and trial rooms but in normal rooms also. A counting mechanism can also be included in this circuit for counting the number of person in a room.

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BIOGRAPHY

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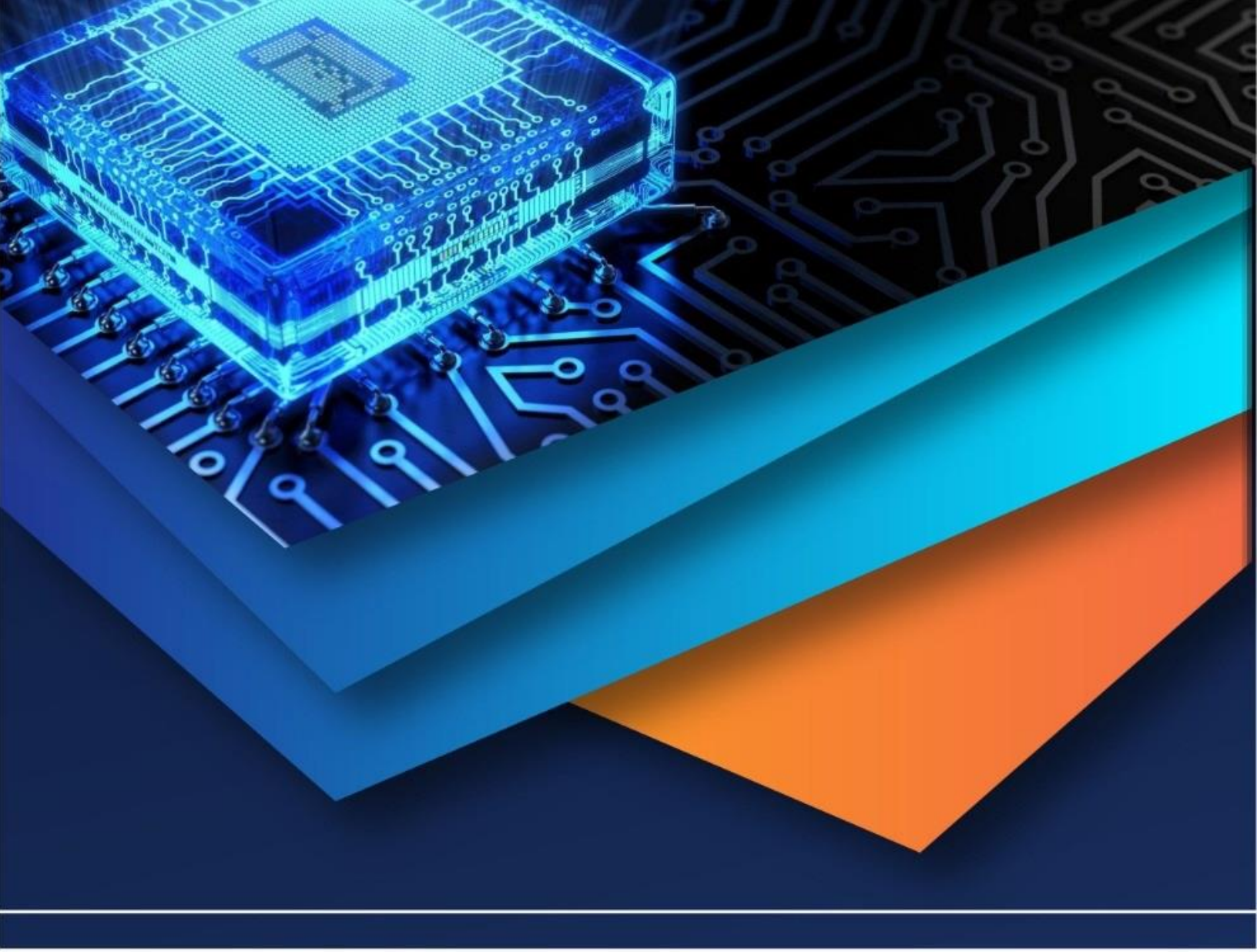

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