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Implementation of Energy Saver Circuit using 8051 Microcontroller

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Abstract— In this paper, we have proposed the development of a module based on 8051 microcontroller that allows us to operate a 220V AC lamp with a remote control and regulate the intensity of the lamp as per our needs. The ability to control the intensity of the lamp according to our requirement waives of unwanted wastage of energy thus providing an economic relief and reducing wastage of primary energy sources at this hour of shortage of non-renewable energy sources. Remote control provides an interface to the system that is simple to understand, operate, reliable and durable irrespective of usage and also economical. It adds comfort to our daily life by eliminating unwanted movement to operate the appliances. Remote control facilitates controlling various appliances from a convenient distance. The module is easy to install,convenient to use, energy saving and also cost effective without allowing compensation of efficiency.

Keywords-*8051 microcontroller; remote control; intensity; non-renewable energy*

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I. INTRODUCTION

Zenith Electronics Corporation (formerly known as Zenith Radio Corporation) produced the first ever remote control ‘Lazy Bones’ in 1950. Its production started in the fall of 1956 and was devised quickly and known as ‘Zenith Space Command’ [1].

Basically, a remote control works in the following manner. A button is pressed. The transistor amplifies the signal and sends it to the LED which translates the signal into infrared light. The sensor on the appliance detects the infrared light and reacts appropriately. The remote control’s function is to wait for the user to press a key and then translate that into infrared light signals that are received by the receiving appliance. The carrier frequency of such infrared signals is typically around 36 kHz [2].

In this section, the solution to remote controlled light intensity control system is considered and an extensive survey follows considering previous works.

A remote-controlled system to monitor and manage street lighting systems was proposed by Caponetto (2008) et al [3]. It consists of the master and slave board, master board being present at the electrical panels and slave board at the street lamps. Power line modem is the means of communication between the master and slave board while GPRS-GSM communication was used to communicate between the remote control central unit and the master board. It had provision of putting the lights on/off, monitor the current flow through the lights and to check its status at the slave boards.

Chen (2008) et al [4] proposed a wireless long distance intelligent city street lamp monitoring and control system based on SCM technology, electric power carrier communication, and wireless communication. A maximum communication distance of 1000m was achieved and an illumination monitor equipment was also designed that assures that the lights are put off in case of communication failure.

Saad et al [5] proposed a paper on ‘Automatic Light Control System Using Microcontroller’. Light dependent resistor was deployed to identify illumination conditions of the environment and photoelectric sensor for the detection of traffic. Input data from the sensors were fed to PIC16F877A microcontroller that controlled the street lights accordingly.

Deepak Kapgate [6] proposed deployment of wireless sensor networks to operate street lights. Network processing device (nodes) was used to sense the environmental illumination conditions and gather data to put the streetlights on/off and control their intensity accordingly.

Rajput (2012) et al [7] considered intelligent street lighting system with a basis on GSM technology, wireless sensor network and C8051F350 microcontroller. Location of the street lights are identified using GSM technology and environmental illumination conditions detected using sensors. It deploys location aware application and WSN application for information. Internet connectivity round the clock is a must in this system.

II. CIRCUIT DIAGRAM AND DESCRIPION OF REMOTE CONTROLLED LIGHT DIMMER CIRCUIT

A. Existing Circuit

1) Components used

- TSOP1738 is the infrared sensor.
- Zener Diode regulates the voltage across the sensor.
- IC1 & IC3 are NE555 ICs which are wired as Monostable Multivibrators.
- IC2 is a Decade Counter.
- The diodes (D7-D11) & resistors (R5-R9) along with the Capacitor C5 controls the pulse-width of IC2.
- The Transistor (BC548) along with the Resistors R10 & R11 acts as a switch.
- MOC3021 is an Optoisolator.
- A Snubber Network consisting of a resistor & capacitor (R13 & C7) regulates the rate of change of voltage across the Triac.
- The Triac BT136 regulates the intensity of the light with the variations in its firing angle.
- 7809 is a 9V Dimmer.
- MCT2E is an Optocoupler.

- The diodes (D1-D6) and the capacitor (C9) constitute the Rectifier & Filter section.
- The circuit consists of a step down Transformer (12V-0-12V).

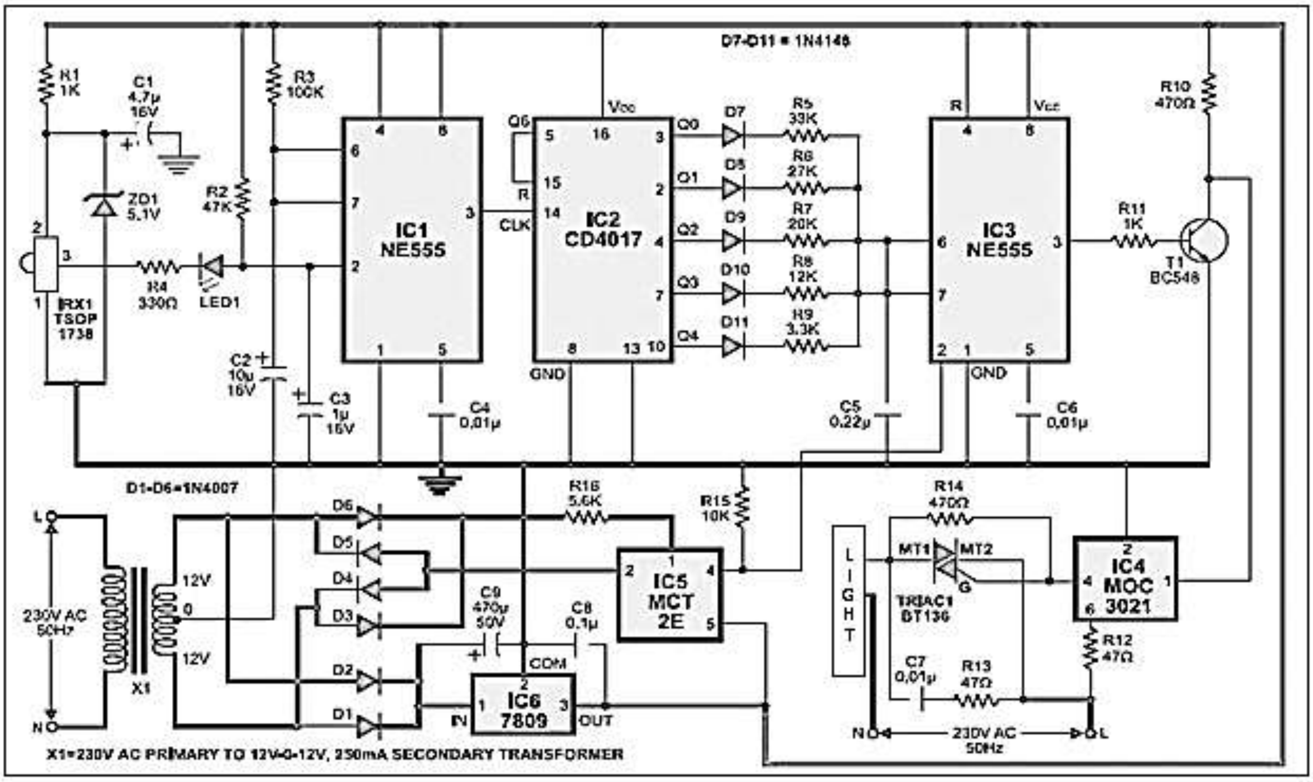

Figure 1. Existing circuit diagram

2) Description of the circuit

The 230V from AC mains is stepped down to 12V and regulated by IC7809, capacitor and Diodes to 9V. This filtered 9V is used for providing supply to the entire circuit. Any of the buttons of the remote control can be used to control the intensity of the light. It produces infrared rays which is received by the infrared ray receiver module.TSOP 1738 is used as the infrared ray receiver, rated to receive signals with a frequency of maximum 38 kHz. The TSOP 1738 sensor receives the infrared rays and triggers the first monostable multivibrator NE555 through a LED and Resistor R4. Monostable multivibrator circuit is implemented using the NE555 IC that delays the clock to decade counter CD4017. Only five of the output pins (Q0 through Q4) of CD4017 are used as outputs amongst 10 of its output pins (Q0 through Q9) and Q6 resets the counter. The output of decade counter is taken from resistors R5 to R9. The resistor R5 to R9 and capacitor C5 controls the pulse width which determines the intensity of the light. When it is high at Q0, the capacitor C5 is charged through R5, when Q1 is high capacitor C5 is charged through R6 and so on, thereby controlling the intensity of the light accordingly. Here the intensity of the light is controlled at five levels and thus five of the outputs pins of the counter are used. Another monostable multivibrator implemented using NE555 that is triggered by the pulses from optocoupler MCT2E implemented as a Zero crossing detector. The output from decade counter is fed to NE555 and the output of NE555 is in turn fed to the transistor BC548, whose output is given to the Optoisolator MOC3021 used to drive the Triac BT136. Resistor R13 (47ohm) and capacitor C7 (0.01µF) is used as snubber network for the Triac. The Resistors R5 to R9 and capacitor C5 controls the pulse width. When Q0 output is high the pulse width is maximum, when Q1 output is high pulse width is decreased slightly. As the pulse width decreases firing angle of the triac increases and intensity of the light also increases. From the remote control, we are actually controlling the pulse width, which in turn varies the firing angle of triac, thereby varying the intensity of the light.

B. Proposed circuit

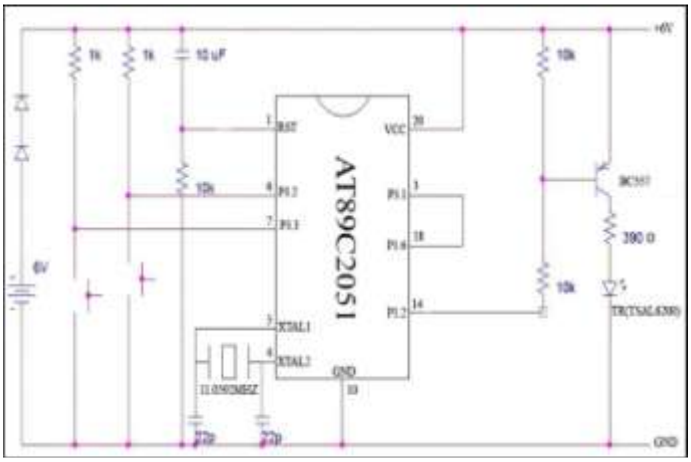

Figure 2. Transmitter circuit (Remote control)

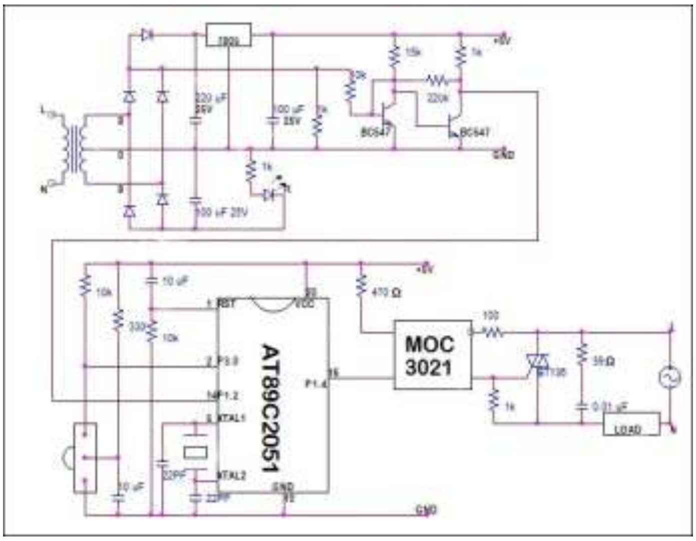

Figure 3. Receiver and control circuit

The circuit will be discussed in the following five parts:

- Remote Control Circuit
- Power Input Circuit
- Zero Crossing Circuit
- Operation of Microcontroller and Sensor
- Firing Circuit

In this section the interconnection between the parts used and their working would be discussed extensively. In the proposed circuit we have used various components like transformer, diode, voltage regulator, resistor, transistor, capacitor, IR LED, microcontroller, optoisolator and triac.

1) Remote control circuit

In the remote control transmitter circuit,we have used AT89C2051 microcontroller, diodes, transistor (BC557) and TSAL62 as the IR LED. A microcontroller based program is implemented into the microcontroller to control the IR LED (TSAL62).

2) Power input circuit

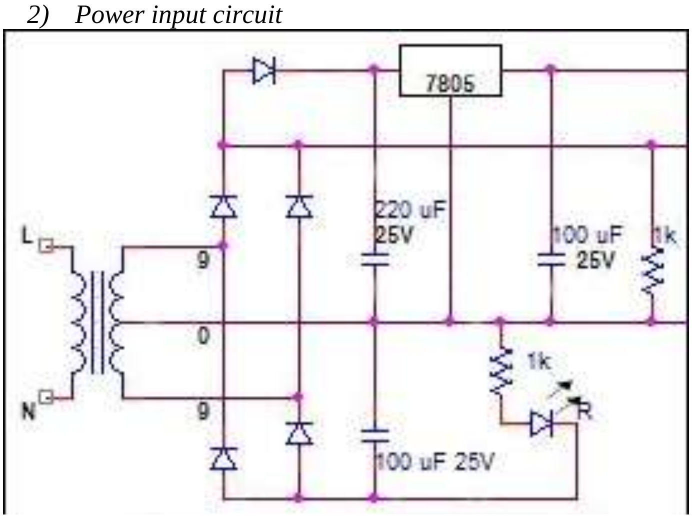

Figure 4. Power input circuit

Power input circuit consists of 4 parts: center tapped transformer(9v-0-9v), full wave bridge rectifier implemented using diodes, capacitor filter and 5V voltage regulator(LM7805).

- High AC voltage of 230Vfrom household power supply is stepped down to 9V using the step-down center tapped transformer.
- Here four IN4001 diodes have been used to implement the full wave bridge rectifier. The diodes D2 and D3 being forward biased and D1 and D4 being reverse biased, current flows through D2 then the load and eventually through D3 during the positive half cycle.
- Diodes D1 and D4 being forward biased and D2 and D3 being reverse biased, current flows through D4 then the load and eventually through D1 during the negative half cycle.
- In both the cycles, i.e., positive and negative half cycle, load current flow in the same direction, thus giving a pulsating DC voltage across the bridge rectifier output.
- The pulsating contents of the DC voltage are the ripples and a capacitor is used to filter out the ripples from the pulsating DC.
- Finally, the filtered DC voltage is fed to the input of LM7805 voltage regulator that provides a steady output voltage of 5V.

3) Zero crossing circuit

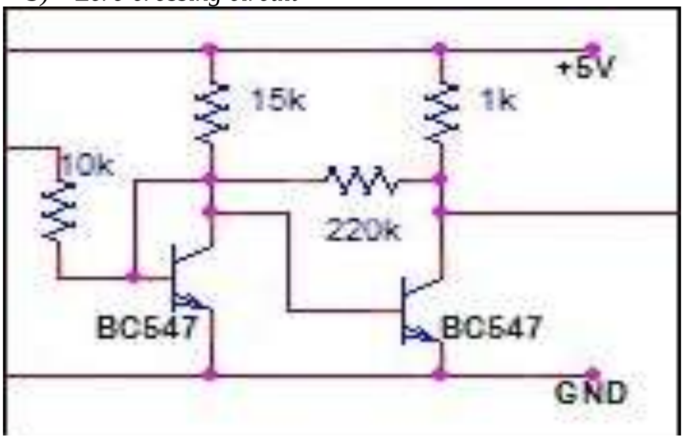

Figure 5. Zero crossing circuit

Zero crossing detectors are circuits that produces pulses every time the voltage drops to zero level. A zero crossing detector is used here to adjust the firing angle. Here the zero-crossing circuit is implemented using two transistors (BC547) that forms a Darlington pair. Output from thetransformer is fed to the transistor base so that when voltage changes its sign, there is a zero crossing point and the microcontroller can adjust the firing angle with respect to zero crossing point.

4) Microcontroller main board circuit

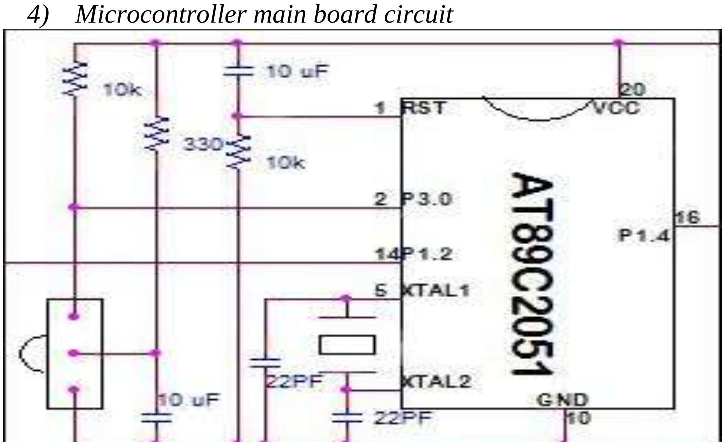

Figure 6. Microcontroller main board circuit

The TSOP1738 receiver at the receiver end, receives the IR signal at 38 kHz. TSOP1738 senses the IR pulses from the remote control and converts them into electrical signal which is decoded into binary data and fed to the microcontroller to carry out the required processing of the command. Pins 20 and 10 of the AT89C2051 microcontroller are connected to VCC and GND respectively. Port P1 is used as the output port. A microcontroller based program implemented into the microcontroller to control the light intensity.

5) Firing circuit

In firing circuit we use the Optoisolator MOC3021 and a Triac, which is an electronic component that can be triggered by either a positive or a negative voltage when applied to its gate electrode. Once it is triggered, it continues to conduct until the current through it drops below a threshold value or a reverse voltage is applied. It can be used as a switch for AC devices.

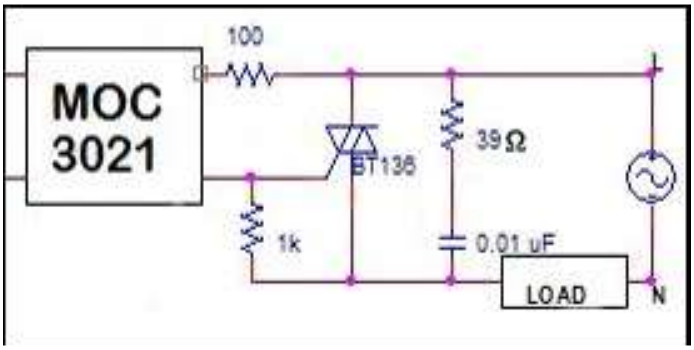

Figure 7. Firing circuit

The Optoisolator MOC 3021 is used for driving the Triac BT136. Triac is a type of thyristor. Here the resistor (39 ohm) andcapacitor (0.01µF) combination is used as snubber network for the Triac. As the pulse width decreases firing angle of the triac increases and intensity of the light also increases. By using remote control, we are actually controlling pulse width, which in turn varies the firing angle of triac, and there by varying the intensity of the light.

III. Experimental Results

The experimental observations are given as follows:

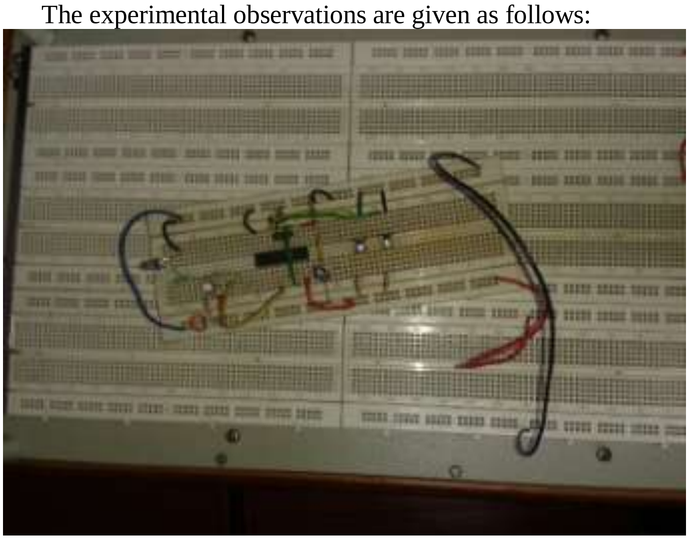

Figure 8. Remote control transmitter circuit

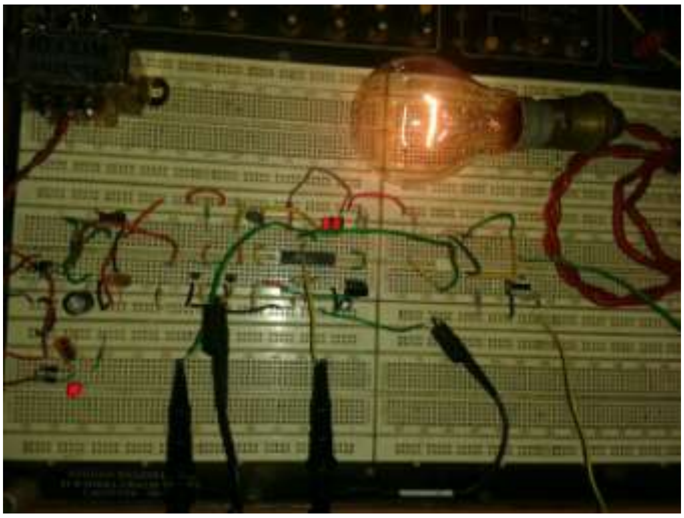

Figure 9. Operation at low intensity

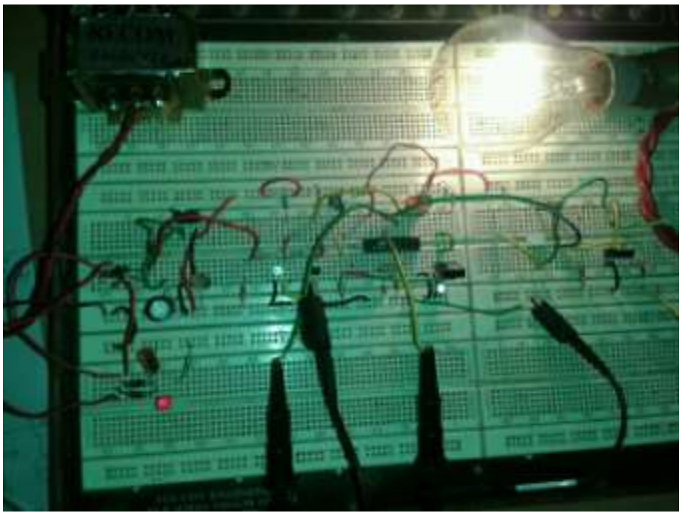

Figure 10. Operation at medium intensity

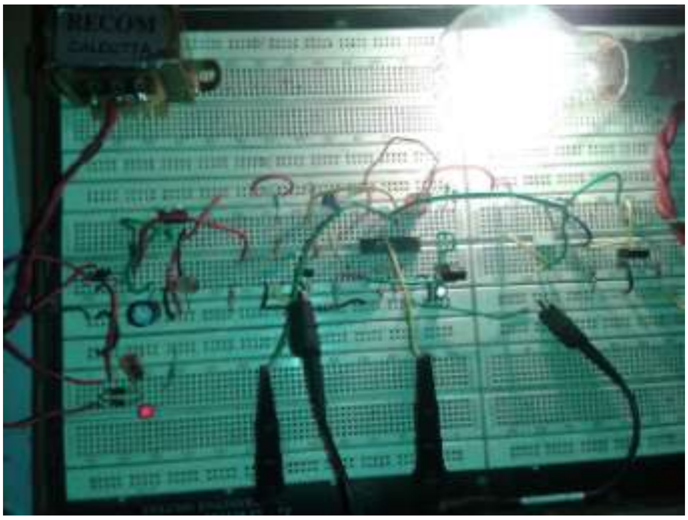

Figure 11. Operation at high intensity

IV. Conclusion

The IR remote controlled light dimmer is implemented using IR sensor, monostable multivibrator, decade counter, transformer, comparator, optoisolator and triac. It is portable in size and the receiver responds only to the infra-red signal transmitted by any modern day remote control. The system responds favorable and alters the voltage smoothly when any button of modern day remote control is pressed, irrespective of ac supply voltage frequency. The receiver transmitter maximum distance is approximately 20m. The experimental output voltage obtained across the load matches the theoretical wave shape, indicating a full wave voltage control of the light dimmer.

With the knowledge of new techniques in Electronics we are able to make our life more comfortable. One such application of electronics is used in ―REMOTE CONTROLLED LIGHT DIMMER. The same circuit finds its use in many more applications like fan regulator, AC motor controller etc. The intensity of light can be controlled in five levels from off position to maximum intensity possible. So it finds use as a night lamp by keeping the intensity of lamp in low level.

The circuit also finds its use for switching ON and OFF any electronic circuitry. Our normal T.V remote can be used for all these purposes. So it is very useful or a real help to old age and sick people, since they can control the intensity from the place where they are sitting.

The room light intensity control system consisted of different parts. Every part had some difficulties but helped us learn more. The project was a dangerous one because of dealing with AC voltages (220V) and also the lamp dazzled our eyes. We had a lot of problems such as having some broken components etc. but we overcame them all.

The project helped us learn how to use a microcontroller, how to program it and how to handle a problem by using the microcontroller. Also the other parts of our project (firing circuit, zero-crossing detector, sensor circuit) gave us an opportunity to know more about power electronics.

We learned how to control high voltages with small voltages and how to create an intelligent circuit with microcontroller. The components used in the project were general purpose IC's and we gained a lot of information about them for future projects.

We have prepared this project for hardware implementation. But this circuit has few drawbacks; the intensity of light can be controlled in five levels from off position to maximum. But it cannot possible to control the light intensity in reverse direction, i.e. from maximum to off position.

After that we have design this project by using microcontroller, for elimination this drawback. In this project by using microcontroller we can also get eight or sixteen levels to control the light intensity. So we feel that our product serves something good to this world and we like to present it before this prosperous world.

In future it may be designed for display of the light intensity levels. That will be very fruitful for clear understanding. Following features of the light intensity will be display in the LCD.

- Number of counts
- Voltage level in every step
- Wattage

References

[1] M. S. Ahmed, A. S. Mohammed, T. G. Onimole, P. O. Attah, "Design and construction of a remote controlled fan regulator," Leonardo Electronic Journal of Practices and Tech. 5:9 (July-December), 2006, p. 55-62.

[2] S. Maiti and P. K. Nandi, "IR remote control signal decoder for home automation," International Journal of Engg. Science and Innovative Tech. (IJESIT), vol. 3, issue 3, May 2014.

[3] R. Caponetto and L. Dongola, "Power consumption reduction in a remote controlled street lighting system," Proc. Int. Symp. Power Electron., Elect. Drives, Autom. Motion, pp. 428–433, June 2008.

[4] Y. Chen and Z. Liu, "Distributed intelligent city street lamp monitoring and control system based on wireless communication chip nRF401," Int. Conf. on Networks Security, Wireless Communications and Trusted Computing, April 2009.

[5] M. Saad, A. Farij, A. Salah and A. Abdaljalil, "Automatic street light control system using microcontroller," Mathematical Methods and Optimization Techniques in Engineering, 2003, vol. 3.

[6] D. Kapgate, "Wireless streetlight control system," Int. Journal of Computer Applications, vol. 41, No. 2, March 2012.

[7] K. Y. Rajput, G. Khatav, M. Pujari and P. Yadav, "Intelligent Street Lighting System using gsm," Int. Journal of Engg. Sci. Invention, volume 2, issue 3, p. 60-69, March 2013.