AUTOMATIC STREET LIGHTING SYSTEM USES NE555 INTEGRATED CIRCUIT AND LDR

Satwinder Singh^{*1}, Suman Bhullar²

^{*1}ME student in Power Systems, ²Assistant Professor EIED Department, Thapar University, Patiala, India

***Corresponding Author: -**

Abstract: -

Street light is a raised source of light that is commonly used along walkways and streets when the surrounding turns dark. Presently High Intensity Discharge lamps are used for street lighting system based on principle of gas discharge, but they consume more power and have low CRI. By replacing the HPS with LED lamps we can save a lot of energy, reduce Co2 emissions and using the auto switching system we can also control power consumptions at the streets and eliminating manpower. With the broad availability of flexlighting technology like light-emitting diode Lamps, the street lighting system is fast reacting, reliably operating, and less power-conserving become reality. This project is all about to eliminate the manpower and reduce the energy consumptions at the street lights. This project includes controlling a circuit of street lights with the help of Transformer, Rectifier, Filter unit, LDR, NE 555 IC, BC 547 transistor, SPDT Relay, LED Lamp, resistance and capacitor during day and night.

Index terms: LDR, NE-555, Smart Street Lighting System, Energy efficient.

Distributed under Creative Commons CC BY-NC 4.0 OPEN ACCESS

I. INTRODUCTION

An electric light is a converter which produces light energy when electric current passes through it. The main purpose of road lighting is to make people, vehicles and objects on the road visibility. An engineering field green issue has been raised where many researchers and engineers are involving themselves to find the techniques to reduce energy consumption as well as product efficiency. The best method is the smart system where it is applied in industrial, residential, commercial areas. They have been helpful in the past and it is still being improved and implemented in every field. Smart system is an autonomous operation which detects the change in environment with the help of sensors and act to correct the offset cause of the environment. The systems perform continually to reach the optimal solution.

In today's busy life no one bothers to switch it ON or OFF when there is no need of light. In our country, in many city street lights are remained switched ON whole day, nobody takes responsibility of this and Municipal office can also not take any action against those people who has responsibility to switch off all the street lights when the sun is about to set. So the power wasting is more in many cities due to unawareness in officers and peoples. Our country has not enough electrical power to delivered 24 hrs to each place in our country, that's why we are suffering from power cuts due to shortage of power.

In India, in these days high intensity discharge (HID) lamps are used for street lighting. Recently, new street light modules have gained a lot of attention to reduce the amount of energy consumed by this type of lamp and also reduce the amount of Co₂ emissions. Latest technology light emitting diode lamp with their current performances has proved themselves to be the most suitable solution for street lighting. It offers many advantages such as: long life, less power consumption, no effect on the environment because it does not consist of lead, no external reflector, no emissions like HID lamps and they have high efficiency. LEDs are good light source and their efficiency is 160 Lm/W. By using this type of high efficiency lamps, we can reduce 50% of the energy used by HID lamps. This project introduced here gives a solution to this problem by eliminating manpower and reducing power consumption by use of latest technology LED Lamps.

II. LITERATURE REVIEW

Lee et. al (2006) surveyed various street light control systems and analyzed its characteristics. Through these efforts, they found that common drawbacks of most light control systems were uneasy of handling and difficulty of maintenance. To reduce uneasiness of handling and difficulty of maintenance on operating light control system, they designed new street light control system by using the Zigbee communication technique. They developed a Street light control system which could save maintenance time, costs and improve safety level.

Ereú et. al. (2006) carried out a study with the aim of establishing the proper methodology to calculate the amount of energy consumed by the street lighting system. The study focused on a lamp's nominal power, the average loss in the ballast, the average loss due to lamp aging and the technical losses in the conductor as a result of the joule effect.

Pantoni et. al. (2010) studied and developed efficient technologies highlighted by the ReLuz (Brazilian National Program of Public Lightning and EfficientLight Signalization) program. It was proposed, in that context, the development of remote command and monitoring infrastructure for management purposes for large areas. Specifically, it referred to the research and analysis of efficient routing algorithms in terms of energy consumption, guarantee of package delivery and good performance

Zhang et. al. (2010) implemented a remote-control system for urban road lighting joins in Computer Technology. Database technology, GIS and GPRS Mobile Network Technology were discussed and used in the application.

Yue et. al. (2010) improved street lighting control computer system composition, working principle and function; it could meet the increasing demand of the different holidays by different control strategies, and strengthen the relevant measures for energy-saving technologies, highlight characteristics such as energy-saving, environmentalprotection, controllable etc.

Ali et. al. (2011) proposed a low cost, high efficiency standalone solar street LED light system. The proposed system conserved power by two ways, the source and the load. The source was a PV array that is a clean renewable energy. Also, a single microcontroller system has been proposed for the power management of the system. The proposed system introduced a solution to the peak load problem of the Egyptian system.

Mullner et. al. (2011) presented the SSL system, a framework for fast, reliable and power efficient street lamp switching based on pedestrians' location and personal desires of safety (increased or reduced illuminated area all around at passersby).

Alli et. al. (2011) proposed low cost, highly efficient energy-free system for street lighting, as there was no power demand from the grid. A standalone solar street LED light system was proposed. The proposed system consists of a PV panel, storage system, LED lamp, power conditioning system and the controller, which can manage the direction and power system operation.

Popa et. al. (2012) focused on implementing a lighting control system that made street lighting to be an autonomous and efficient part of the urban environment. The paper presented an efficient street lighting system with reduced power consumption in comparison to classical lighting systems.

Siddiqui et. al. (2012) designed a system to reduce energy consumption of outdoor premises and demonstrated by developing a prototype to control street lamps. The system minimized energy consumption for the benefit of user and environment concurrently.

Priyasree et. al (2012) aimed at designing and implementation of an automatic system where in the street lights that were not required through the night could be dimmed. Thus, this paper once implemented on a large scale can bring in significant reductions in the power consumption caused by street lights.

Husin et. al. (2012) presented the automatic street lighting system; around 77% to 81% of power consumption could be reduced by using the proposed system.

Zotos et. al. (2012) developed energy-efficient, intelligent outdoor lighting management and monitoring system with remote control. This paper presented the results of a case study of an experimental installation of an intelligent road lighting system.

Lian et. al. (2012) defined an intelligent lighting control system, combining Zigbee with GPRS. The proposed control network showed to reduce the power consumption, decrease the management cost and monitored the status information of each street lighting unit.

Rajput et al. (2013) described the Intelligent Street Lighting system that integrated new technologies offering ease of maintenance and energy savings.

Castro et. al. (2013) presented the relevance of the smart lighting control to reach the sustainability of smarter cities. They had described the impact in the total power consumption of the lighting and consequently the interest to offer a higher control and optimization of its usage.

Srivastava et. al.(2013) made the project of Automatic Street lights was a cost effective, practical, eco-friendly and the safest way to save energy.

Latha et. al. (2013) proposed an approach for controlling Street Lighting system using millennium 3 PLC. The proposed controllers fast, reliable, and power efficient street lamp switching based on the light variations. The simulated results were also verified experimentally by using a light dependent resistor which sensed the light.

III.Required Hardware

Table No. 1: Required Hardware

S. No.	Hardware	Quantity
1	Transformer	1
2	Diodes IN4001	2
3	Capacitor-10nf	1
4	Resistance- 10K Ω	1
5	Transistor 7805	1
6	BC 547 Transistor	1
7	SPDT Relay	1
8	PC B	1
9	LD R	1
10	Ribbon Wire	1m
11	Wooden base	
12	Wooden towers	4
13	LE D	4

IV. Block Diagram

Figure 2: Block diagram

1. **Transformer (12012):** The 220V AC supply is fed as the primary of transformer which steps down this voltage into 12V. The output of transformer fed to rectify.
2. **Rectifier and filter unit:** Full wave rectifier is used to convert 12V ac into DC but the output of the rectifier is not pure DC so a capacitor is used in parallel to remove ripples present in DC supply. IN4001 diode is used for rectification and capacitor 2200uf, 25V is used as a filter.
3. **Transistor 7805:** It is a three pin transistor, which gives 5V at their output pin. The maximum input given up to 18V and output current up to 1A.
4. **NE 555 IC:** This IC is used in astable mode where it can operate as an oscillator. The input supply fed to IC from 5V, supply current 3 to 6 mA and output current 200mA.
5. **LDR:** It stands for the light dependent resistor. The resistance of LDR decreases with increasing incident light intensity and vice-versa.
6. **SPDT Relay:** It is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit to an electrical circuit which works at very high voltage. In a basic relay there are three contacts: normally open (NO), normally closed (NC) and common (COM). At no input state, the COM is connected to NO. When the operating voltage is applied the relay coil gets energized and the COM changes contact to NC.
7. **Transistor BC 547:** It is a three pin transistor. The input signal is fed at the base and output is collected from collectors. In this project, it is used as a switch.
8. **LED Lamp:** It is used for street lights lamp during the night. In these days, mostly LED preferred due to less consumption of power, less maintenance and long life. In this project we used 1W LED that operates on DC supply.

V. Circuit Diagram

Figure no. 2: Circuit Diagram

The above circuit is made to make the auto switching system of Smart Street light. The working of the circuit is depending upon the conditions of day night.

During the day: The sun rays continue falling on LDR and its resistance decreases, which results in an increase of the voltage at pin 2 of the IC

555. IC 555 has got comparator inbuilt, which compares between the input voltage from pin2 and $1/3^{\text{rd}}$ of the power supply voltage. The input rises above $1/3^{\text{rd}}$, output is set LOW and the relay gets de-energized. During the de - energized mode, the relay will operate in NO mode, hence there is no supply in NC mode so the street light will not turn ON at day time.

During the night: At night time when there is no light fall on LDR i.e. its resistance increases, which results in a decrease of the voltage at pin 2 of the IC 555, then the timing IC output goes HIGH and the relay gets energized and starts operating in NC mode hence the power supply from the COM point of relay gets connected with street light hence it will switch ON during the night.

The next day when the sun rises, then light will turn OFF automatically.

VI. Proposed Model

Fig. 3: Auto turn OFF during the day

Fig. 4: Auto turn ON during Night

VII. Benefits

- By using of the auto switching system of Smart Street light we can also reduce energy consumption because manually operates lighting system are not switched ON earlier before sunset and also not switched OFF properly even the sunlight comes.
- Complete elimination of man power.
- Reduce carbon dioxide emissions.
- Maintenance cost also reduces.
- Community satisfaction will be higher.
- Reduce energy costs

VIII.Applications

- Street lights
- Parking lights
- Garden lights

IX. Conclusion

This technique is a cost effective, eco-friendly and easiest way of saving energy. It solves our problems that are facing globally, saving of energy and waste material of lamps. The project has scope in various other applications like for providing lighting in industries, campuses and parking lots of huge shopping malls. This can also be used for surveillance in corporate campuses and industries.

REFERENCES

- [1].Ahmed Sanjana," Solar Powered traffic sensitive automated LED street lighting system", *M.E Thesis*, Dec 2012.
- [2].Ali M., Orabi M., Abdelkarim E., Qahouq J.A.A., Aroudi A.E., "Design and development of energy-free solar street LED light system," *IEEE PES Conference on Innovative Smart Grid Technologies - Middle East*, pp. 1- 7, 17-20 Dec. 2011.
- [3].Ahmed Sanjana," Solar Powered traffic sensitive automated LED street lighting system", *M.E Thesis*, Dec 2012.
- [4].Castro M., Jara A.J., Skarmeta A.F.G., "Smart Lighting Solutions for Smart Cities," *27th International Conference on Advanced Information Networking and Applications Workshops*, pp. 1374- 1379, 25-28 March 2013.
- [5].Ereu G.M., Mantilla J.O., "A Methodology to Determine Electrical Energy Consumption in Street Lighting Systems," *IEEE/PES on Transmission & Distribution Conference and Exposition: Latin America*, pp. 1-5, 15-18 Aug. 2006.
- [6].Husin Rohaida, Othman Zulkifli," Automatic Street Lighting System for Energy Efficiency based on Low Cost Microcontroller", *IJSSST*, Vol. 13, No. 1, 2012.
- [7].Lee J.D., Nam K.Y., Jeong S.H., Choi S.B., Ryoo H.S., Kim D.K., "Development of Zigbee based Street Light Control System," *IEEE PES on Power Systems Conference and Exposition*, pp. 2236- 2240, Oct. 29- Nov. 1 2006.
- [8].Li Lian, Li Li "Wireless dimming system for LED Street lamp based on Zigbee and GPRS," *3rd International Conference on System Science, Engineering Design and Manufacturing Informatization*, vol. no. 2, pp. 100-102, 2021 Oct. 2012.
- [9].Latha D. V. Pushpa," Simulation of PLC based Smart Street Lighting Control using LDR", *International Journal of Latest Trends in Engineering and Technology*, Vol. 2 Issue, July 2013.
- [10].Mullner Reinhard and Reiner Andreas," An energy efficient pedestrian aware Smart Street Lighting system", *International Journal of Pervasive Computing and Communications*, Vol. 7, No. 2, pp 147-161, 2011.
- [11].Pantoni R.P., Brandao D., "A geocast routing algorithm intended for street lighting system based on wireless sensor networks," *9th IEEE/IAS International Conference on Industry Applications*, pp. 1-6, 8-10 Nov. 2010.
- [12].Popa M and Marcu A," A Solution for Street Lighting in Smart Cities", *Carpathian Journal of Electronics and Computer Engineering*, Vol. 5, pp. 91-96, 2012.

- [13]. Priyasree Radhi, Kauser Rafiya," Automatic Street Light Intensity Control and Road Safety Module Using Embedded System", *International Conference on Computing and Control Engineering*, 12-13 April, 2012.
- [14]. Priyasree Radhi, Kauser Rafiya," Automatic Street Light Intensity Control and Road Safety Module Using Embedded System", *International Conference on Computing and Control Engineering*, 12-13 April, 2012.
- [15]. Siddiqui A.A., Ahmad A.W., Hee Kwon Yang, Chankil Lee, "ZigBee based energy efficient outdoor lighting control system," *14th International Conference on Advanced Communication Technology*, pp. 916-919, 19-22 Feb. 2012.
- [16]. Srivastava Sakshee," Automatic Street Lights", *Advance in Electronic and Electrical Engineering*, ISSN 2231-1297, Vol. 3, pp. 539-542, Number 5, 2013.
- [17]. Wu Yue, Shi Changhong, Zhang Xianghong, Yang Wei, "Design of new intelligent street light control system," *8th IEEE International Conference on Control and Automation*, pp. 1423-1427, 9-11 June 2010.
- [18]. Wei Liu Chee," Modular Intelligent Control System", *M.E Thesis*, May 2011.
- [19]. Yun-gui Zhang, Li-na Zhao, Li-na Wang, Sheng- Yong Zhang, "A Web-Based Management System for Urban Road Lighting," *International Conference on Web Information Systems and Mining*, vol. no. 2, pp. 279-282, 23-24 Oct. 2010.
- [20]. Zotos N., Stergiopoulos C., Anastasopoulos K., Bogdos G., Pallis E., Skianis C., " Case study of a dimmable outdoor lighting system with intelligent management and remote control," *International Conference on Telecommunications and Multimedia*, pp. 43-48, July 30Aug. 1 2012.

BIOGRAPHIES:

Satwinder Singh received his Diploma in Electronics and Telecommunications Engg. From PSBTE&IT Chandigarh in 2008 and Bachelor Degree in Electrical and Electronics Engg. From Punjab Technical University, Jalandhar in 2012. Recently, he is completed Master's degree in Power Systems in Electrical and Instrumentation Department and Researched on the topic of the Smart Street Lighting System from Thapar University, Patiala.

Ms. Suman Bhullar was born in 1976. She received his Bachelor and Masters Degree in Electrical Engineering from Punjab Technical University, Jalandhar in 1997 and 2001 respectively. Presently, she is an Assistant Professor and Pursuing PhD in Electrical and Instrumentation Department, Thapar University, Patiala.