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Solar Powered Smart Street Light Control System

Bashir N. Jamadar[1], Balasaheb B. Vhankhande[2], Bushara B. Jamadar[3]

[1,2] Department of Humanities and Science, Walchand College of Engineering, Sangli (Maharastra, India)

[3]XII[th] Electronics Subject, Nav Krishana Valley Junior College, Sangli (Maharastra, India)

E-mail: bashir.jamadar@walchandsangli.ac.in, balasaheb.vhankhande@walchandsangli.ac.in, busharajamadar161105@gmail.com

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Abstract:

As we know, energy resources are limited and consumption of energy has been increased tremendously.Hence, to meet the increasing energy demand, now we are trending towards the use of renewable energy sources. However, for proper utilization of available energy, we need to focus more on reducing wastage of electricity.In most areas, generally, the control of street lights is done manually. In this system, a person switches on these street lights in the evening and switches them off in the morning. However, the manual control method has some disadvantages, viz. If a person forgets to turn on the street lights in the evening, there is a high chance of an accident, and if the street lights are not turned off in the morning, electricity is unnecessarily wasted. Besides, if no one passes on the road at night, electricity is wasted.By virtue of this, we have designed "Solar Powered Smart Street Light Control System" with the aim of saving electricity, using renewable energy sources and eliminating manpower. This paper deal with the "Solar Powered Smart Street Light Control system" demonstrates the operation of automatic street light control using renewable (solar) energy source by reducing the wastage of electric energy.

Introduction:

Due to the increase in urbanization and the improvement of the urban life, the demand and use of street lights is increasing day by day.Street lights have become a primaryrequirement in today's transportationworld for safety purposes as well as to avoid night time accidents. Despite this, in today's busy life no one can bothers to turn it off/on unless required.The enregy consumption of street lighting is about 10-38 percentage of total energy consumption in large cities [1-2]. Street

lighting is especially critical concern for public authorities in developing countries where it is of strategic importance for social stability and economic [2].At present, the wastage of electricity from street lights has become a serious issue as far as consumption of electricity is concern. Inefficient street light systems waste important financial resources, and low intensity lighting creates unsafe conditions. The efficient technologies and system design including the use of renewable energy sources, can reduce the wastage of street light energy and also its cost.

Literature Survey:

The automated street light control system using LDR (light dependent resistor)eliminates the manual operation. When the light intensity falls below the visible regions of our eyes, the street lights turned on automatically and turn it off when sufficient light intensity is available. The working of transistor in saturation region to turned ON the lights and in cut-off region to turned it OFF at correct time usingrelay [3, 6].

Automatic street light control system is very economical, practical, environment friendly and safest way to save energy.According to statistics, more than 40% of electrical energy is consumed on roads and highways.Advances in technology and better resource planning can reduce project costs and with the use of best quality equipment reduce maintenance cost in terms of regular inspections [4].

Now solar streetlights are seenon the roads. The solar light works on the principle of Photovoltaic (PV) cells which absorb light energy inday time and converting it into electric energyand stored in the rechargeable battery. Usually solar street lights are operated at night, as natural light falls on them less intensely, and are switched off during the day where ample solar isolation from the sun is available.As the sun begins to set, the level of natural light in the atmosphere and visibility begin to decrease. The solar street light is automatically switched on by analyzing the visibility data provided by the sensor.However, when the sun rises again, the natural light in the atmosphere increases the level of visibility,it is turn it off to save energy [5-7].

By considering all these points, energy saving energy can be done by the use of renewable sources, eliminating manpower for system handlling, the street lights are to be turned off at night if obstacles (Human being, vehicles, living things etc) are not present on the road etc.

Therefore, a smart street control system has been developed which will automatically turned on the street lights if there are any obstacles (Human being, vehicles, living things etc.) on the road at night, otherwisethe street lights will turned off if obstacles are not present on the road at night. This system will turn off the street lights even if there are obstacles on the road during the day.

Block Diagram:

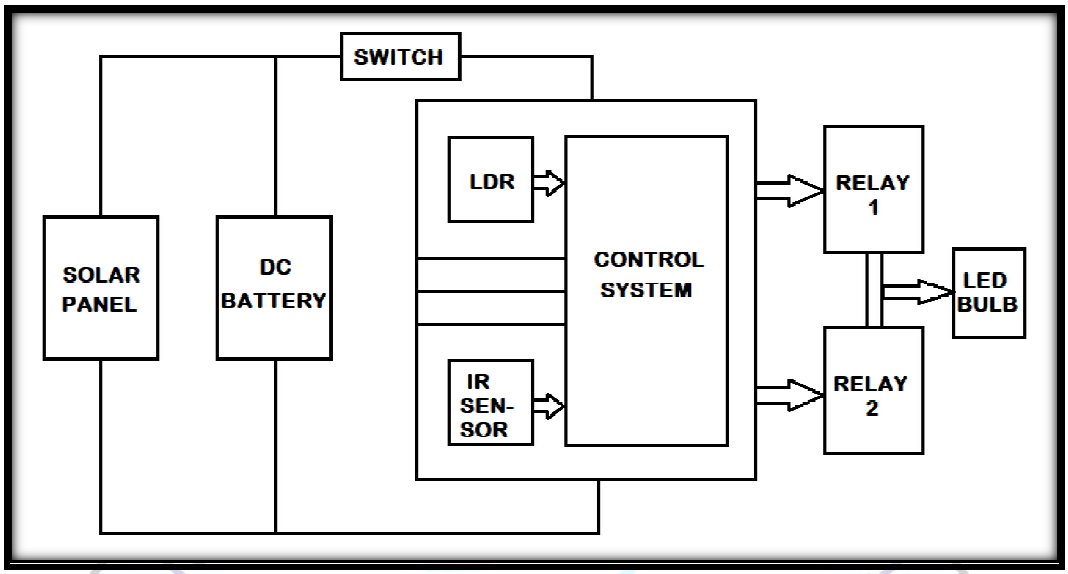

Fig. 1: Block Diagram of Solar powered Smart Street Light Control System

The block diagram of Solar Powered SmartStreet Light control system is shown in figure 1. The entire control system is operated on the renewable source,therefore it has been using solar power for their operation. In this system, the solar-panel is used for charging of battery in daytime. The stored DC power is used for the operation of control system andas an electric source for LED bulb. With the help of light dependent resistance (LDR) and IR sensor module, the ON/OFF control of street light has been operated in two different modes a) Nighttime b) Daytime with obstcles detected on the street. For ON/OFF control of street light, the transistorised control system is used and it can be controlled through the two different relays. The detailed working of smart control system is shown in the circuit description section.

Ciruit Description:

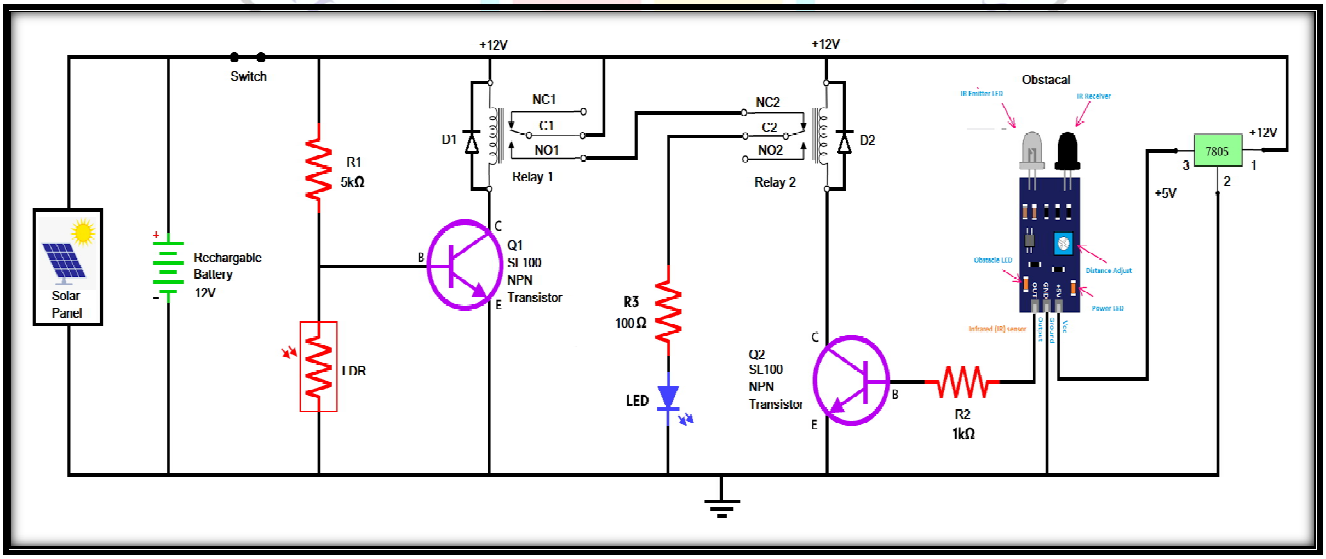

Fig. 2: Circuit Diagram of Solar powered Smart Street Light Control System

The project entitled "Solar Powered Smart Street Light Control System". It comprises of a Solar panel, Rechargeable battery, LDR sensor, Transistors, Resistors, Relays, IR Module, Regulator IC, LED, etc as shown in figure 2.

During the day, the charging of Li-ion is based on the principle of solar cells or Photovoltaic (PV) cells that absorb solar energy and convert it into the electrical energy. The converted electric energy is stored in the rechargeable battery. For storage of electric energy, three Li-ion batteries (each has 3.7V, 4.44Wh) havebeen used in series. So total voltage becomes around 12V. Henceforth the smart streetlight control system is operated on 12V DC supply. The resistor R_1 and Light dependent resistor (LDR) are connected in series across the DC supply and it act as a voltage divider circuit. It operates the transistor Q_1. The transistor Q_1 used as switch to control the action of Realy-1. Similarly, the transistor Q_2 is operated by output signal of IR sensor module. The transistor Q_2 is also used as a switch to control the action of Realy-2.

According to the condition of light intensity sensed by LDR and obstacle (Human being, vehicles, living things etc) on the road detected by IR module, the transistors switches ON or OFF the LED bulb though relays.

The smart street light control system can be explained in two different conditions.

1. Night Time

2. Day Time

1. Night Time: Once the battery is fully charged, it is used as a DC source (+12V) for this circuit.

A) During the night, the ambient light is dim, the resistance of LDR is increased and it becomes very high. So voltage drop across LDR is increased which turn-ON transistor Q_1. Now Q_1 isoperated in saturation region and it acts as an ON switch. During this time, transistor allows current through Realy-1. Due to current passing through Realy-1, common terminal C_1 break their connection from NC1 and make connection to NO1.

Along with this, if any obstacle (Human being, vehicles, living things etc) comes on the road in the range of IR sensing module, the IR sensing module generates low voltage at its output which turn-OFF transistor Q_2. Now Q_2 is operated in cut-off region and it acts as an OFF switch. During this time, transistor does not allows current through Realy-2. Due to which, the common terminal C_2 of Realy-2 break their connection from NO2 and make connection to NC2. In this sinario, the path of LED bulb is completed and connected to DC Supply and the LED bulb will be glow.

During the night, if obstacle comes in the range of IR module, LED bulb will be glow as shown in figure 3.

B) During the night, if any obstacle not comes on the road in the range of IR sensing module, the IR sensing module generates high voltage at its output which turn-ON transistor Q_2. Then Q_2 is operated

in saturation region and it acts as an ON switch. During this time, transistor allows current through Realy-2. Due to which, the common terminal C_2 of Realy-2 break their connection from NC2 and make connection to NO2. For which the path of LED bulb is not completed and it is not connected to DC Supply and the LED bulb will be turned OFF.

During the night, if obstacle is absent i.e. not comes in the range of IR module, LED bulb will be offas shown in figure 4.

The conditions of LED ON/OFF in night time is given in following table

Time Zone	LDR Resi.	Transistor Q_1	Relay-1	Obstacle	O/P of IR Module	Transistor Q_2	Relay-2	Status of LED
Night Time	High	ON (Saturation Region)	ON (Connection of C1 to NO1	Present	Low Voltage	OFF (Cuttoff Region)	OFF (Connection of C2 to NC2)	Glow or ON
Night Time	High	ON (Saturation Region)	ON (Connection of C1 to NO1	Absent	High Voltage	ON (Saturation Region)	ON (Connection of C2 to NO2)	Does Not Glow or OFF

Tab. 1: Status of Components in Circuit during the Night

Fig. 3: Setup Imageduring the Night when Obstacle is Present Fig. 4: Setup Imageduring the Nightwhen Obstacle is Absent

2. Day Time: Once the battery is fully charged, it is used as a DC source (+12V) for this circuit.

A) During the day, the ambient light is full, the resistance of LDR is decreased and it becomes very low. So voltage drop across LDR is decreased which turn-OFF transistor Q_1. Now Q_1 is operated in cut-off region and it acts as an OFF switch. During this time, transistor does not allows current

through the Realy-1. Due to which, common terminal C1 of Realy-1 break their connection from NO1 and make connection to NC1.Along with this, if any obstacle (Human being, vehicles, living things etc.) comes on the road in the range of IR sensing module, the IR sensing module generates low voltage at its output which turn-OFF transistor Q_2. Now Q_2 is operated in cut-off region and it acts as an OFF switch. During this time, transistor does not allowthe current through Realy-2. Due to which, the common terminal C2 of Realy-2 break their connection from NO2 and make connection to NC2. In this scenario, the path of LED bulb is not completed and it is not connected to DC Supply and the LED bulb will be turned OFF as shown in figure 5.

B) During the day, if any obstacle not comes on the road in the range of IR sensing module, the IR sensing module generates high voltage at its output which turn-ON transistor Q_2. Then Q_2 is operated in saturation region and it acts as an ON switch. During this time, transistor allows current through the Realy-2. Due to which, the common terminal C2 of Realy-2 break their connection from NC2 and make connection to NO2. For which the path of LED bulb is not completed and it is not connected to DC Supply and the LED bulb will be turned OFF as shown in figure 6.The conditions of LED ON/OFF in day time is given in following table

Time Zone	LDR Resi.	Transistor Q_1	Relay-1	Obstacle	O/P of IR Module	Transistor Q_2	Relay-2	Status of LED
Day Time	Low	OFF (Cutoff Region)	OFF (Connection of C1 to NC1	Present	Low Voltage	OFF (Cuttoff Region)	OFF (Connection of C2 to NC2)	Does Not Glow or OFF
Day Time	Low	OFF (Cutoff Region)	OFF (Connection of C1 to NC1	Absent	High Voltage	ON (Saturation Region)	ON (Connection of C2 to NO2)	Does Not Glow or OFF

Tab. 2: Status of Components in Circuit during the Day

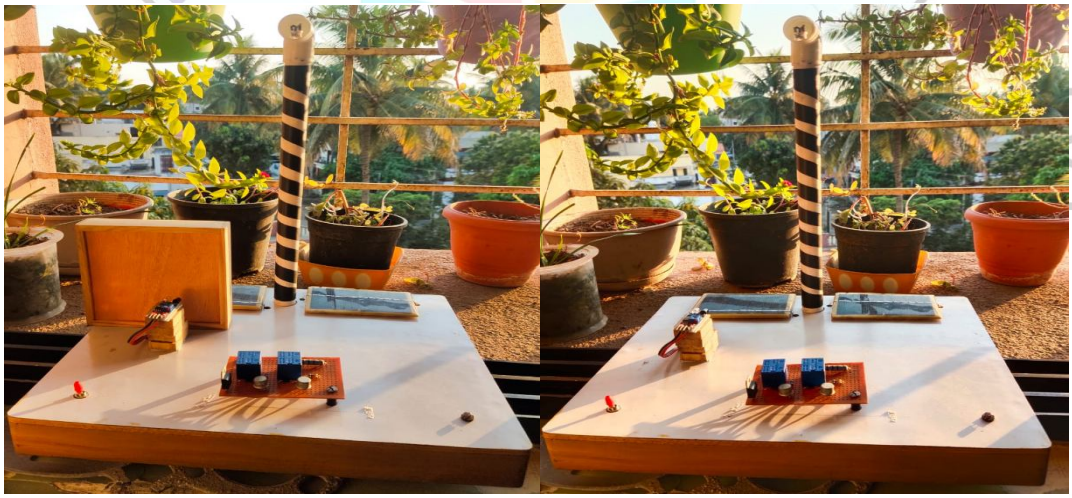

Fig. 5: Setup Imageduring the Day when Obstacle is Present

Fig. 6: Setup Imageduring the Daywhen Obstacle is Absent

Conclusion:

In this paper, Solar powered Smart Street light control system is implemented. The system included renewable source (solar panel) for conversion of light energy into electric energy. Two Sensors are used to detect ample of light and obstacles on the road for proper utilization of electric energy. The smart control system is operated in two modes, 1) During the night, if obstacle comes in the range of IR module, LED bulb will be glowotherwise it will be off.2) During the day, even though the obstacle comes in the range of IR module, LED bulb will be off.

The designed solar powered smart street light control system achieved outcomes of energy saving, use of renewable sources and eliminating manpower. The main advantage of the system is cost effective.

References:

1. Prakash V., Pavithra D., Nisha R. and Nishanthini P, "Automatic Street Light Intensity Control", International Journal of Advance Research, Ideas and Innovations in Technology (IJARIIT), Volume 6, Issue 2, 2020, Page No. 258-261.
2. Saad Mustafa, Farij Abdalhalim, Salah Ahamed and Abdaljalil, Abdalroof, "Automatic Street Light Control System Using Microcontroller" Mathematical Methods and Optimization Techniques in Engineering, ISBN: 978-960-474-339-1, 2013, Page No. 92-96.
3. Gowthami. C, Santhosh. C, Pavankumar. A, karthik. A, Ramya. K. R, "Design and implementation of automatic street light control system using light dependent resistor, "International journal of engineering trends and technology, (IJETT), May2016
4. Sakshi Shrivastav, "Automatic Street Lights" Advance in Electronic and Electric Engineering. ISSN 2231-1297, Volume 3, Number 5 (2013), Page No. 539-542.
5. Solar LED street light, 2020 https://solar-led-street-light.com/automatic-solar-street-light-project/
6. B. N. Jamadar, B. B. Vhankhande and D. S. Sutrave, "Analysis of Total Harmonic Distortion of Three-Phase Induction Motor Drive for Different PWM Techniques," 2022 Third International Conference on Intelligent Computing Instrumentation and Control Technologies (ICICICT), Kannur, India, 2022, pp. 82-88, doi: 10.1109/ICICICT54557.2022.9917623.
7. B.N. Jamadar, S.R. Kumbhar, P.M. Gavane, D.S. Sutrave, "Design and Development of Control System for Three Phase Induction Motor using PIC Microcontroller", IFAC Proceedings Volumes, Volume 47, Issue 1, 2014, Pages 807-811,