Utilization of Renewable Energy Resource and Implementation of an Automatic Solar System Using LDR & IC555 Timer

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Abstract: **Solar energy is the most efficient example of a renewable energy. The Sunlight is used to generate electricity by using a photovoltaic cell. Solar panel is bombarded by photons from the source of sunlight. Photons are captivated by semiconducting materials like Silicon and germanium. Electrons are excited from their outermost orbital. During excitation, the energy is dissipated as heat and returns to its orbital or it can be penetrated through the cell until it will be reached to an electrode. Solar energy is converted into a usable amount of direct current (DC) electricity by solar cell. The rechargeable battery is used to store the electricity from the solar panel for future use. In automatic solar system, a solar charge controller is chosen as it decides to switch ON or OFF the charging of battery. IC555 timer is used to design an automatic solar system. Automatic solar system is an efficient power saving concept for domestic purpose. Light is automatically switched ON when the sunlight goes below the visible region of our eyes. The light is sensed like our eyes by a sensor called Light Dependent Resistor (LDR). Light is automatically switched OFF when the sunlight comes.**

Keywords: **Solar energy, photovoltaic cell, electrons, rechargeable battery, charge controller, IC555 timer, LDR.**

I. INTRODUCTION

Renewable energies[1] are those generated from sources that do not have a finite end, or those that can be recycled typically from natural sources - like solar power, wind power water power, biomass and geothermal heat. Renewable energy replaces conventional fuels in areas like generation of electricity, motor fuels, rural (off-grid) energy services and variety of commercial and industrial uses. During recent years, due to the increase in fossil fuel consumption and the environmental problems[2] originated by the use of conventional fuels, we are returning back to renewable energy sources[3]. Most of these renewable energies rely on in one way or another on sunlight. One of the most popular types of renewable energy is solar power. The sun provides more than enough energy to meet the whole world's energy demand, and unlike fossil fuels, it won't be exhaust anytime soon[4]. Using solar panels, we can harvest energy directly from sunlight and convert it to electricity that powers our homes and businesses. Photovoltaic cells[5] in a solar panel turn sunlight into direct current electricity (DC) and once this procedure has taken place, the electricity is used, fed into the grid or stored in a battery[6]. Another kind of renewable energy that we interact with every day is the wind. Wind energy is electricity generated from a wind turbine. When the wind blows, it turns the blades of the turbine. As these blades turn, they spin generators to create electricity. The electricity is then sent to a transformer which increases the voltage and sends it to a distribution line. Next, local transformers decrease the voltage and send it to homes or businesses[7]. Like solar energy[8], wind power is pollution-free and is growing and significant renewable energy source supplying electricity to grids around the world[9]. We can generate renewable energy from moving water just like we can from moving air. Energy is generated when moving water runs through a turbine, spinning it to produce electricity (Hydroelectricity). Earth has an immense energy source contained within it. Heat trapped when our planet formed, combined with heat generated from radioactive decay[10] in rocks deep beneath the crust, results in a huge amount of geothermal heat energy. Geothermal heat energy[11] can be recovered and can be utilize for human use, and it is obtainable anywhere on Earth's surface. One last example of renewable energy is biomass. Biomass energy refers to any energy produced from recently living organic matter like plants or animals. Biomass[12] is organic substance that comes from plants and animals, and it is a renewable source of energy. Biomass contains stored energy from the sun. Plants absorb the sun's energy in a process called photosynthesis. When biomass is burned, the chemical energy in biomass is released as heat. Biomass can be burned directly or transformed to liquid biofuels or biogas that can be burned as fuels[13].

In this experiment, we used a solar panel[14] of 12v that receives solar radiation during the day time and then converts it into electrical energy which is finally stored in the battery. The charge controller[15] which was used to measure battery condition and to connect solar panel and battery with it. There are 6 ports in the solar charge controller, named S+,S-,B+,B-,L+,L-. The +ve and - ve terminals of the solar panel are directly connected to the S+ and S- terminals of the solar charge controller. The +ve and –ve terminals of a

rechargeable battery[16] are directly connected to the B+ and B- terminals of the charge controller. Controller is very important as it usually decides to switch on or switch off the lighting and charging of the battery. Solar charge controller has 3 LEDs[17] which indicates when battery is fully charged, when battery is low and when load is connected respectively. The overcharging and undercharging condition of the battery is also controlled by the charge controller. By receiving the power from solar panels it continuously charges the battery in day time and while in evening it supplies the battery power to LED light. IC 555 timer[18] is the main part of the circuit that works as a comparator. Automatic Solar System circuit depends on the working of the IC555 timer. We placed the IC555 timer in the center of a breadboard correctly. The LDR is connected with pin 2 and pin 8 of IC555 timer. A resistance of 10k is connected with pin 2 and pin 1. We have shorted the pin 8 and pin 6 by a connecting wire, and also shorted the pin 6 and pin 4 of IC555 timer. Next a connection is made in between LED and IC555 by connecting +ve pin of LED to pin 3 and -ve pin to pin 1 of IC555 Timer. Finally the +ve and -ve terminal of the 12v battery are connected with pin 8 and pin 1 of IC555 timer respectively. In this circuit the output will be produced by pin 3 and pin 1. Finally the connection of our circuit has now been completed. Here LDR is being used in this circuit to detect the presence of light and accordingly it changes its resistance value. LDR is a special type of resistor whose resistance value depends on the light. Light is automatically switched ON when the sunlight goes below the visible region of our eyes and light is automatically switched OFF when the sunlight comes.

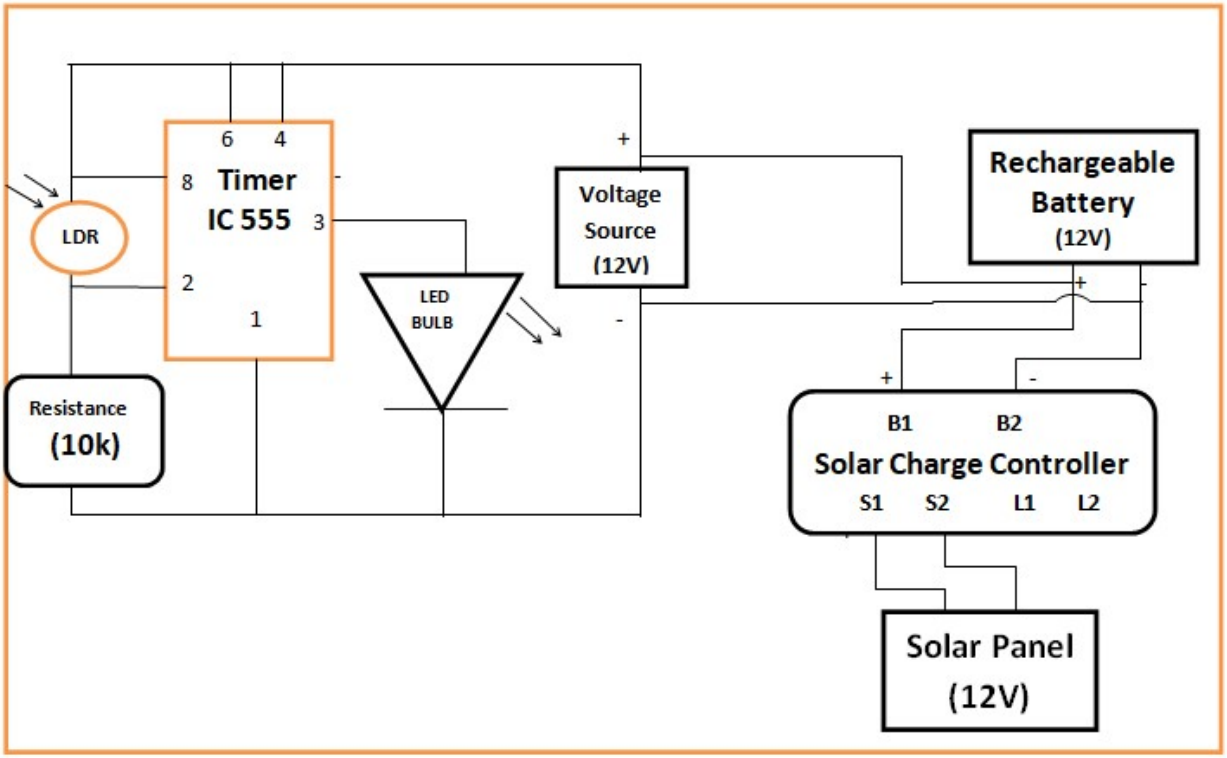

Fig-1: Schematic Diagram of Total Work

II. MATERIALS AND METHOD

2.1. Materials

A Solar panel was purchased from Swastik Enterprises company. It was used as a source or supply of Direct Current (DC) electricity. It was collected from a solar equipment shop in Kolkata. The Direct Current electricity was stored into a rechargeable battery from solar panel. The rechargeable battery was purchased from Stimulus.

A solar charge controller was used to design the automatic solar system. The switch ON or OFF and the charging of battery was controlled by the charge controller and was purchased from solar power house electronic shop in Kolkata. It was produced by New Bharat's. An IC555 timer was purchased from an electronics shop in Kolkata. It was used to create a concept of auto power saving mode. A light dependent resistor (LDR) was used to sense light. It was purchased from an electronics shop in Kolkata.

2.2. Experimental Procedure

2.2.1. Electricity generation from solar cell

A Solar cell or photovoltaic cell was used to convert the light energy into electricity by using photovoltaic effect. This process is controlled by a physical and chemical

phenomenon. The electrical characteristics such as current, voltage, resistance of PV Cell are varied when it is displayed to light. Solar cells are derived as photovoltaic because the source of light is Sun light or Artificial light. The solar cells are used as photodetector. Light or other electromagnetic radiation is detected by solar cell near visible range or measuring light intensity. The semiconductor material of the solar panel absorbed the photons which is present in Sunlight. The Solar panel was stroke by photons before photons were absorbed by the semiconductor material of the Solar panel. The electrons of the current molecular or the outermost orbital's are excited and it can be either dissipated the energy as the form of heat and returns to its orbital or transit through the cell until it was reached in electrode. The potential was cancelled by the current flows through the material and the electricity was received by that current. The most vital working principle of this process was played by the chemical bond. The silicon was used in two layers. One of the layer was doped with boron and the another was doped by using of phosphorous. The Solar cell was used to convert the Solar energy into the form of direct current electricity (DC). A rechargeable battery was used to store the electricity which was generated by the solar panel as a form of direct current electricity (DC). A solar charge controller was used to confirm charging condition of the battery.

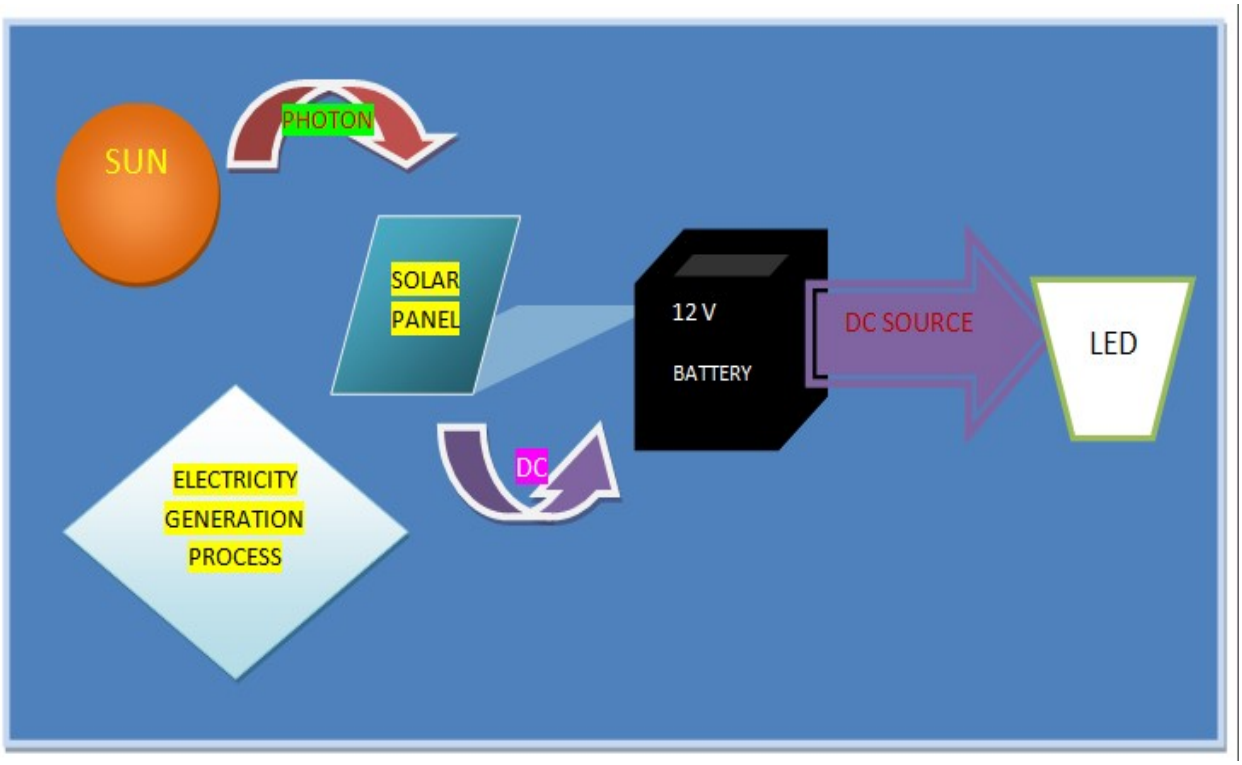

Fig-2: Process Of Electricity Generation & Storing of DC Voltage

2.2.2. Implementation of Automatic Solar System

The automatic solar system was implemented by IC555 timer and LDR after electricity is generated by Solar cell. The circuit diagram is clearly drawn in proteus software and shown in fig-3. In this system the direct current electricity was mainly used as a power supply. The total circuit was implemented on a breadboard by using IC555 timer, LDR, a 10K resistance and a LED light. The components were connected by wires. The total connection process was followed by the pin diagram of IC555 timer which is shown in fig-4. The two terminals of Solar cell was connected to charge controller and it was also connected to battery by maintaining the +ve and -ve combination. The terminals of the battery were directly connected to the circuit as DC power supply. The LDR was directly connected to PIN no.2 and PIN no.8 of the IC 555 timer. The resistance was connected to the LDR by using PIN no.2 and PIN no.1 of the timer. The terminals of the LED were connected to the PIN no.1 and PIN NO.3. of the timer. The DC power supply was connected to PIN no.4 and PIN no.6. of the timer. The DC power supply was come from 12v battery which was connected to the Solar panel and was controlled by the charge controller. The entire process can be clearly understood with the help of a block diagram in fig-5.

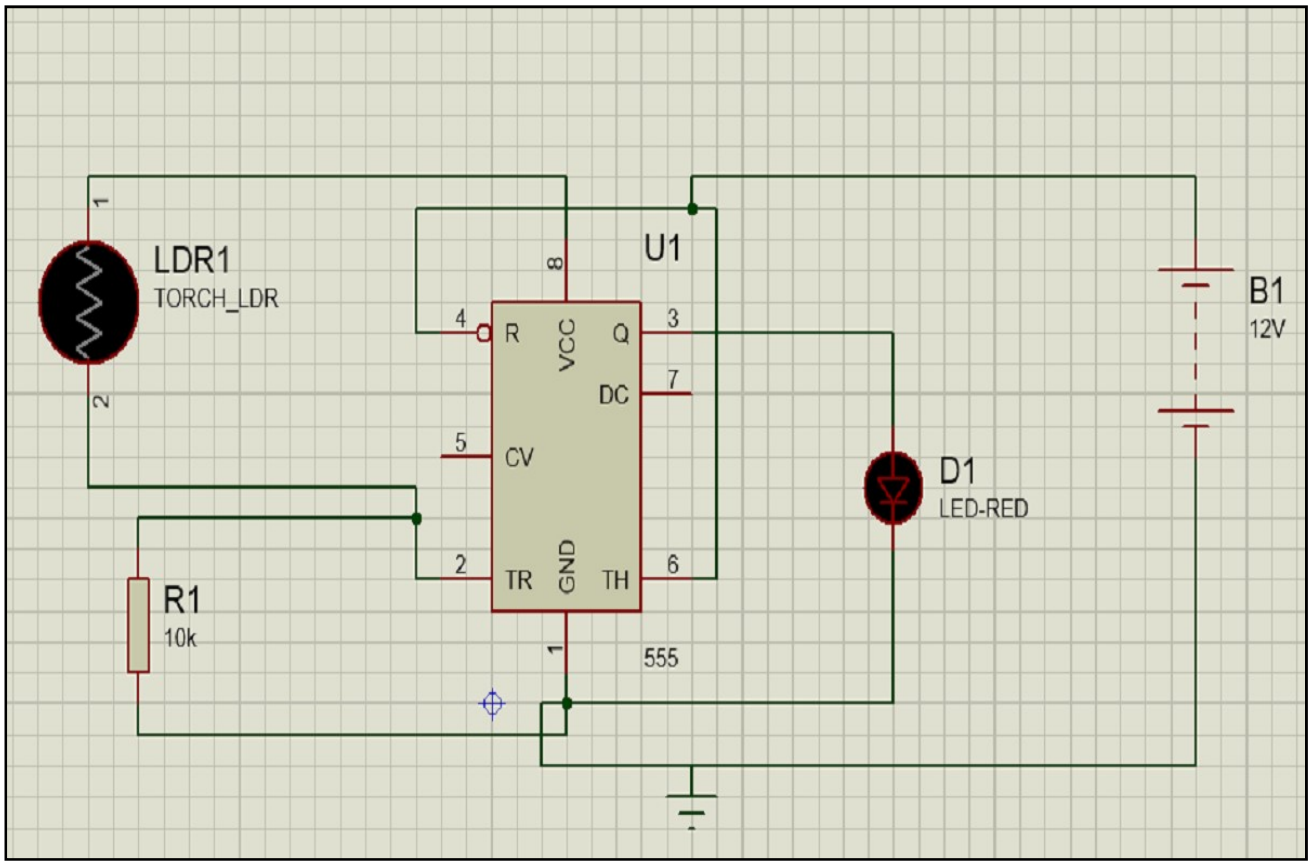

Fig-3: Circuit Diagram Of Automatic Solar System

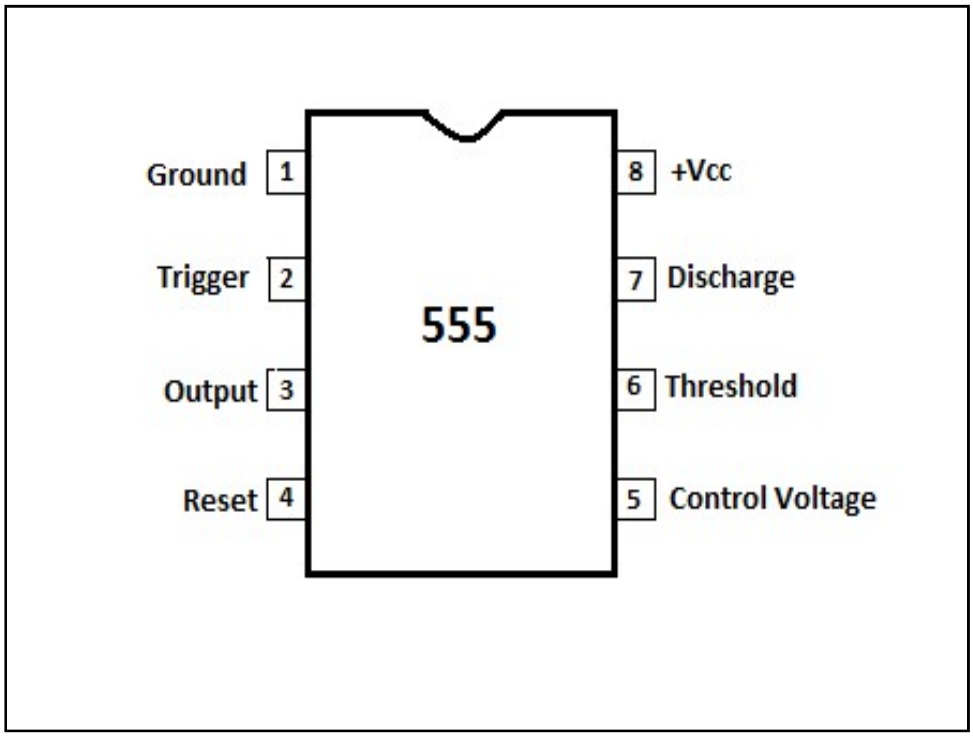

Fig-4: PIN Diagram Of IC555 Timer

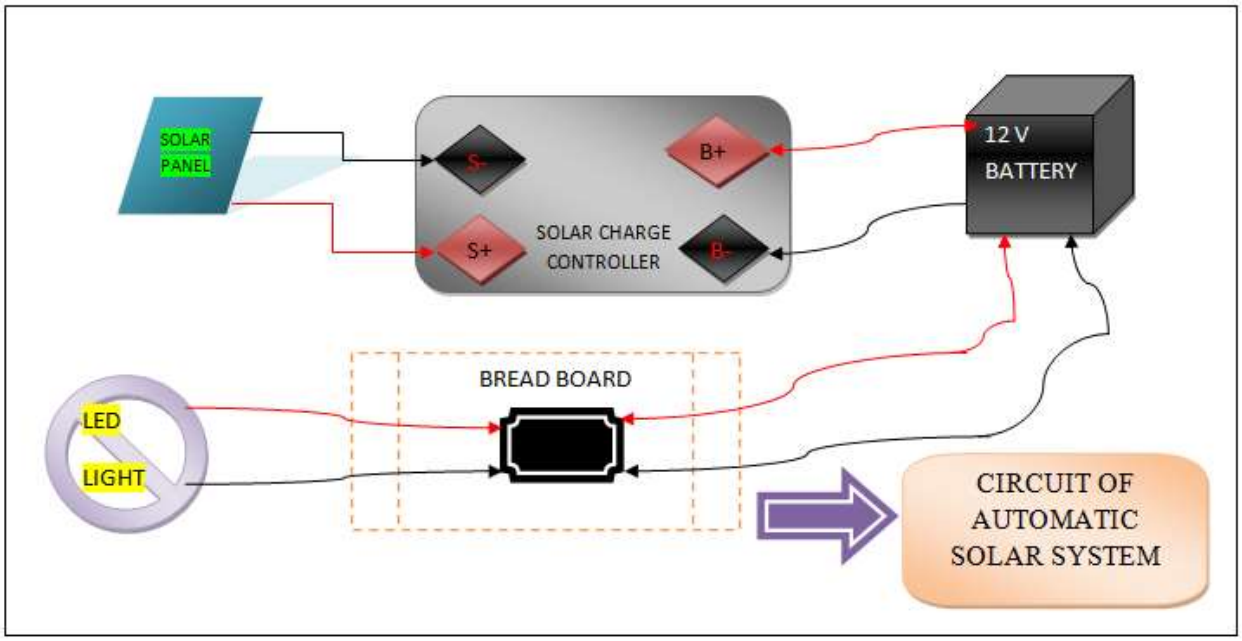

Fig-5: Block Diagram Of Automatic Solar System

III. RESULTS AND DISCUSSIONS

We have simulated the automatic solar system circuit in proteus software in two stages. In first stage, we gave the maximum resistance value of the LDR and got the desired output and in second stage we got another output from the circuit by giving minimum resistance value of the LDR. We also got the graphical representation of the different stages and calculated the voltage drops across resistance, LED and the rechargeable battery as well.

3.1. When LDR is high

When LDR is high i.e. the value of the resistance is very high and for that reason the LED is in switched off mode. In daytime when sunlight falls into the LDR, this kind of scenario will occur. The circuit diagram of this situation is clearly designed in proteus software.

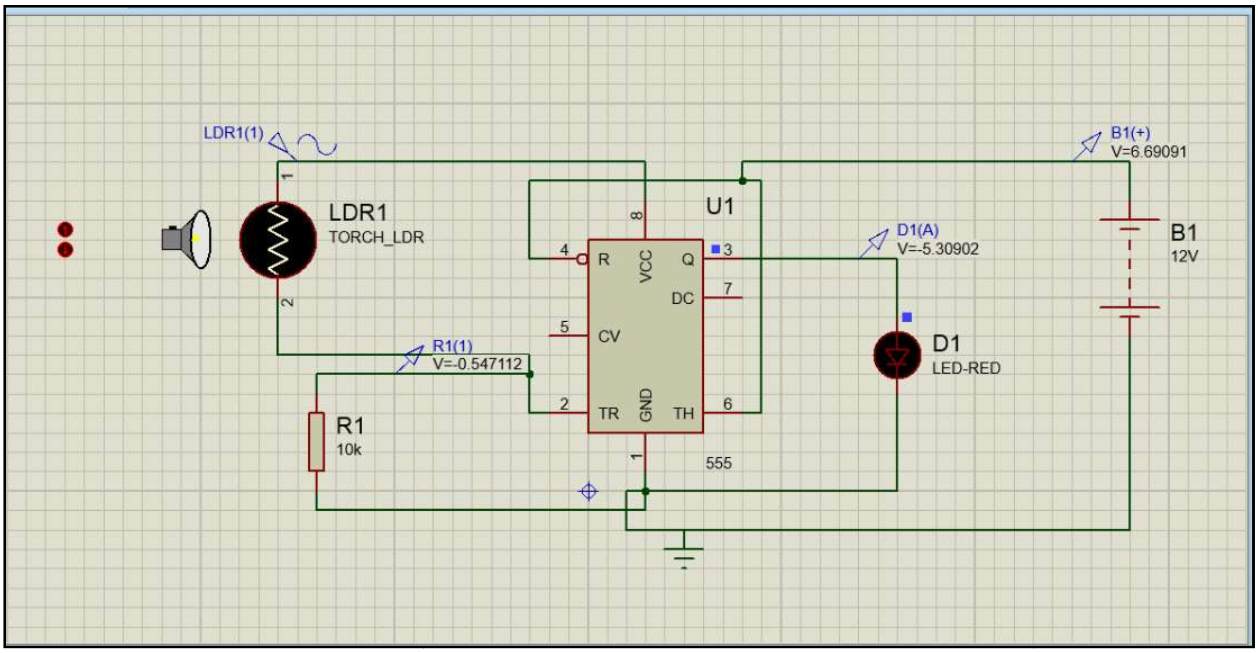

Fig-6: CKT Diagram Of Automatic Solar System When LDR Is High

We have given the sine generator through generator button in proteus into the input i.e. LDR and inserted the voltage probes into the resistance, LED, and battery and got the voltage drops across all the mentioned materials. The graphical representation is shown below.

Fig-7: Graphical Analysis Of Voltage Drops Across Solar System Equipment When LDR Is High

From fig-7, we can see four different characteristics of four different components when LDR is in its optimum resistance value. We can measure the voltage drop across resistance, LED and battery from the above graph. We are using a 12V rechargeable battery for the power supply of the electronic circuit. But in this graph we can clearly see the voltage drop across the battery lies between 6V to 8V. There is a 10K resistance used in this circuit and the voltage drop across the resistance lies between -1V to 1V. The forward voltage of The LED is 2.2V and breakdown voltage is 4V and forward current is 10mA and voltage drop we got -6V to -4V of the desired LED which is used in this circuit.

SL NO.	COMPONENTS	Voltage drop range when all circuits in working condition
1.	Battery	[6--8]V
2.	Resistance	[(-)1--01]V
3.	LED	[(-)6--(-)4]V

Table-1

3.2. When LDR is low

When LDR is low i.e. the value of the resistance is very low and for that reason the LED is in switched on mode. At night when there is no sunlight falls into the LDR, i.e. the environment is totally dark this kind of scenario will occur. The circuit diagram of this situation is clearly designed in proteus software.

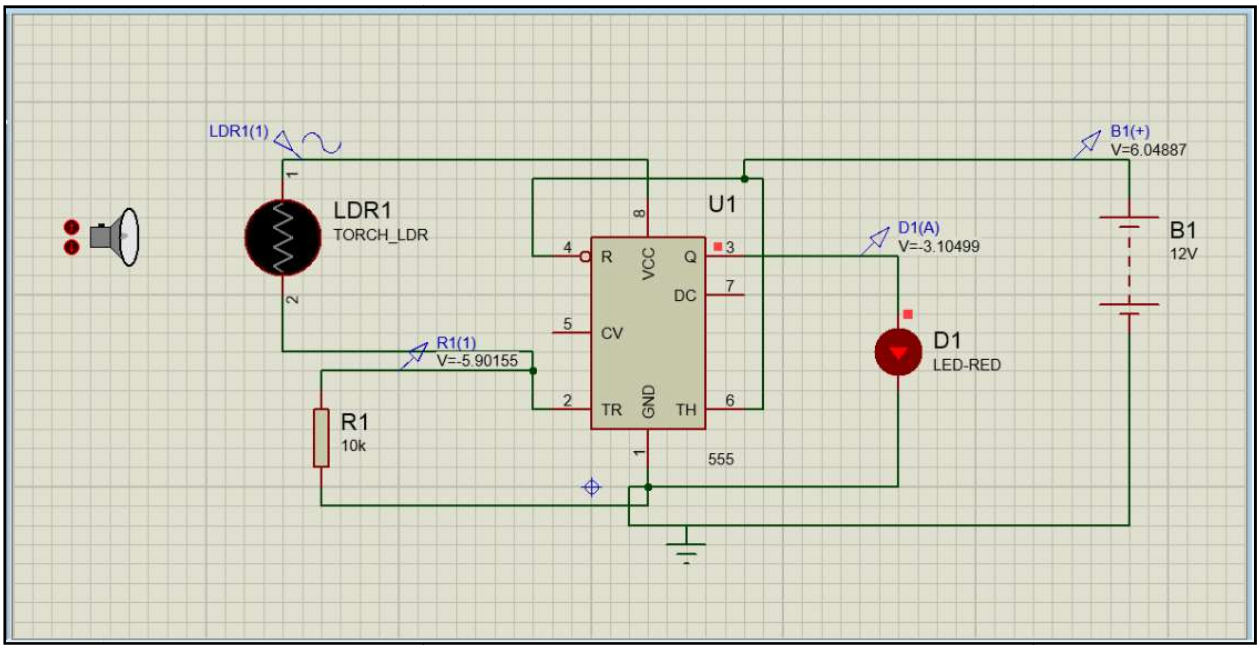

Fig-8: CKT Diagram Of Automatic Solar System When LDR Is Low

The graphical representation of this kind of scenario is shown below:

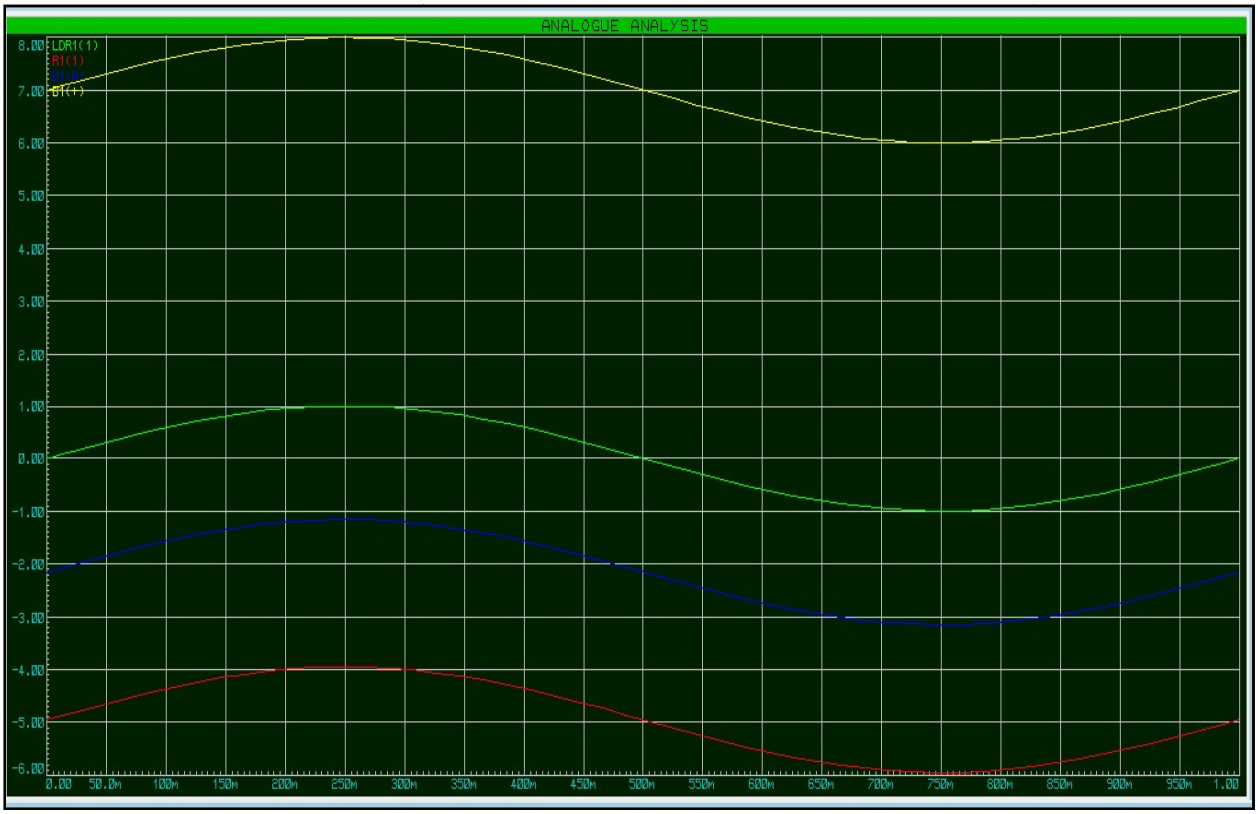

Fig-9: Graphical Analysis Of Voltage Drops Across Solar System Equipment When LDR Is Low

In this graph we can see four different characteristics of four different components when LDR is in its minimum resistance value. Here it is clearly seen that the voltage drops are different from the previous graph. The voltage drops across resistance, LED and battery lies between -6V to –4V, -3V to -1V and 6V to 8V respectively.

Table-2:

SL NO.	COMPONENTS	Voltage drop range when all circuits in working condition
1.	Battery	[6-8]V
2.	Resistance	[(-)6-(-)4]V
3.	LED	[(-)3-(-)1]V

IV. CONCLUSION

Automatic solar system was successfully operated & we have implemented in different stages depending on sunlight, we observed that when LDR is HIGH i.e. in the presence of sunlight, the LED was switched OFF due to high resistance & when LDR is LOW i.e. in the absence of sunlight, we got the desired output & the LED was switched ON due to low resistance value. Hence the power is conserved in this project. Using the solar panel, we used the best alternative source of renewable energy which is very efficient & eco-friendly. The best part is that this system is pollution-free, noise free, no transmission loss & quick responding. We can reduce energy cost & operating cost by this project. As it is consumed less power & reduced manpower, it is very much simple, efficient, fast & adaptable. Due to high initial investment, manufacturing process is very complicated to install. It is also quite expensive as there are some additional cost for rechargeable batteries. In future we can use this project for automatic street light to increase efficiency & reduce cost. Using this feature we can increase HID lamp life & also use for the automatic road traffic signals. By adding an inverter, we can run ac load like fan, ac light etc. This project has capable for providing lighting in industries, campuses, shopping malls etc. for surveillance. By this automatic solar system, it is possible to control wirelessly & drive the LED based lighting facilities with the help of IoT based devices & apps. This automatic street LED lights is used to provide some useful information adding wireless modules. This project is also implemented for the OLEDs. For future projects one may consider more sensors which are cost effective & consume power but this will be very susceptible for future use in the field of automatic solar system. Finally we can save the power for future use & we can reduce the losses of the power by implementing this project.

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