Design of Low Cost Solar LED Bulb for Scarcely Electrified Areas

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ABSTRACT— Attempt has been made in this work to develop a low cost solar lamp with an aim to cater to the locations which are scarcely electrified any primarily in rural areas. Reserve of fossil fuels is depleting and there is an urgent need of generating renewable energy and developing products that can suitably be supported by this clean energy. Renewable energy is alternate source of energy or non-conventional energy like, solar energy, water energy, wind energy, biomass and bio gas energy, tidal energy, Geo-thermal energy, hydrogen energy, etc. For further inquiry, a detailed socio-technical survey has been made in many parts across India and we feel the need to bring proper advancement in this technology with the help of Artificial Intelligence along with different sensors which in turn exemplifies the need of such lamps in everyday life.

Keywords:, Solar energy, LED, street light

I. INTRODUCTION

Since the source of income of rural populace is low in comparison with urban inhabitants and price of electricity is going high day by day, and conventional energy sources are also reducing down in its own pace, hence alternative energy is a moderate replacement with the involvement of substantial cost factors. Availability of solar electric products in today's market is competitive, though the products are expensive for people belong to rural areas. Projects based on solar lighting for rural populace, are studied by the authors. A short survey has been conducted by the authors by visiting the rural areas in and around the locality. The study shows the rural area is in urgent need of viable options that can replace the high-cost streetlights in order to balance out the overall economy. This lead to coming up with an idea from our end to create a solar LED lamp to make sure the expenses are quite low when it comes to electricity and power that is required to run this project. This study further shows that solar technology is indispensable due to its eco-friendly nature and independency of periodic investment but due to high cost involvement this noble venture is not working in full fledge throughout the country.Energy produced and radiated by sun is known as solar energy. This solar energy can be converted directly or indirectly into other forms of energy such as heat and electricity.

II. LITERATURE SURVEY

Mohd Rizwan Sirajuddin Shaikh, [1] proposed "A Review Paper on electricity generation from solar energy" about Solar Energy getting better by the advancement of technology. The Solar Energy is produced by the Sunlight is a non-vanishing renewable source of energy which is free from eco-friendly. Every hour enough sunlight energy reaches the earth to meet the world's energy demand for a whole year. In today's generation we needed Electricity every hour. This Solar Energy is generated by as per applications like industrial, commercial, and residential. It can easily have energy drawn from direct sunlight. So it is very efficiency & free from environment pollution for surrounding. In this article, we have reviewed about the Solar Energy from Sunlight and discussed about their future trends and aspects. The article also tries to discussed working, solar panel types; emphasize the various applications and methods to promote the benefits of solar energy

Jose Antonio Barros Vieira, [2] "A high-performance Stand-alone Solar PV Power system for LED Lighting" that this paper presents new improvements and real result of a stand-alone photovoltaic power system for LED lighting that was developed previously. The actual system, during day, charges a lead acid battery using MPPT algorithm for power transfer optimization, and, during night, it supervises battery discharge and controls the current in the power LED array. The improvements are in hardware and software. The hardware was simplified using only one DC/DC converter and only one microcontroller making it more efficient. The system board uses an ATMEL ATTINY861V microcontroller, a single-ended primary inductance converter (SEPIC), and sensors to read input and output voltages and currents to control all system.

Sreedevi Nair, [3] presented a paper titled "Economic Feasibility of Solar Powered Street light using high-powered LED – A case study" describing Trends in CO2 emissions from fuel combustion illustrate the need for all countries to shape a more sustainable energy future. According to an estimate of the share of electricity used in India, about 15% of the total electricity generated is used for lighting purposes in various sectors. Photovoltaic (PV) systems offer the possibility of exploiting sun's energy available everywhere, without polluting the environment. The long term power saving, conservation of precious natural resources, flexibility of location and elimination of the need for generating additional power are leading to the fast adoption of PV street lighting systems.
Three major types of system configuration exist for solar powered street lighting systems which include Grid connected, Stand-alone and PV hybrid systems. Grid connected systems draw power from the grid during the night and cloudy periods and feed excessive power into the grid during the sunny hours. Standalone systems are defined as autonomous systems that supply electricity without being connected to the utility grid. The present study investigates the economic feasibility of replacing grid connected street lights in the institute premises that uses non retrofit Compact Fluorescent Lamp (CFL) as light source with standalone solar powered high power Light Emitting Diodes (LEDs)

Shruti Sharma, [4] demonstrated "Solar Cells: In Research and Applications – A review" that the light from the Sun is a non-vanishing renewable source of energy which is free from environmental pollution and noise. It can easily compensate the energy drawn from the non-renewable sources of energy such as fossil fuels and petroleum deposits inside the earth. The fabrication of solar cells has passed through a large number of improvement steps from one generation to another. Silicon based solar cells were the first generation solar cells grown on Si wafers, mainly single crystals. Further development to thin films, dye sensitized solar cells and organic solar cells enhanced the cell efficiency. The development is basically hindered by the cost and efficiency. In order to choose the right solar cell for a specific geographic location, we are required to understand fundamental mechanisms and functions of several solar technologies that are widely studied.

Somsanguan Passago, [5] proposed "Research and development of renewable energy: Prototype of LED Street lighting from solar energy" on renewable energy sources being widely available in almost all types of geographical areas, as compared to other energy sources. We shall look into the passive solar techniques that include orienting a building towards the sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air. Solar Power expects to become the world's largest source of electricity by 2050, with solar photovoltaic and concentrated solar power contributing 16% and 11% to the global overall consumption, respectively. This energy supplies the combination of electric current and electric potential that deliver to the circuit. Initial Solar cell has evolved from a pure niche market of small-scale applications towards becoming a mainstream electricity source. Solar panels, also known as modules contain photovoltaic cells made of Silicon that transform the sunlight received into electricity and not heat.

PROPOSED METHODOLOGY

The low cost Solar-powered LED as an application in street light is to be done here. The block diagram consists of batteries, passive elements, diode and transistor, etc. etc.. . We all know that due to initial cost of investment being high in case of Solar panels, The idea is to bring out a solution that makes sure all of general public can make efficient use of it for their own benefits. Let us look into the major components that are being used here;

III. BLOCK DIAGRAM

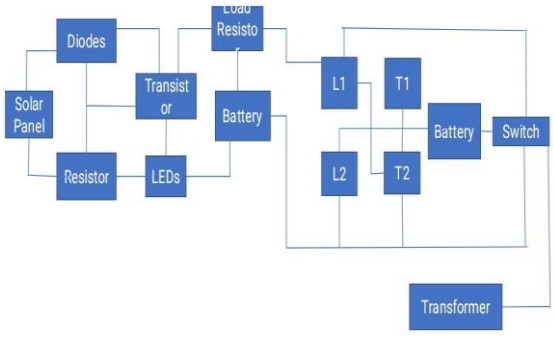

Fig.1 Block diagram

Here, the LEDs are connected in series with each other while the loads are mainly of two types here, AC & DC loads respectively wherein an LED streetlight and fan with DC motor are connected to L2, i.e. load(2) followed by the AC load of a regular bulb connected at L1, i.e. load(1). Once the panel gets fully charged during the daytime, it provides enough power to the connected batteries in order to supply required potential to the given appliances. Resistors are generally used to oppose the flow of current or in other simpler words, they possess of an inbuilt resistance towards the passage of electricity through them. As mentioned earlier, the important components revolving around this project are depicted & described briefly below.

A. Solar panel

Selecting a suitable and more importantly an affordable Solar panel has become quite understandable these days as cost-effectiveness is one of the most major concerns. Here, the solar panel is basically poly-crystalline due to its subtle yet effective advantageous uses. It traps sunlight in the daytime and once photo receptors on its surface give a signal that there is no sunlight left to receive, it starts sending power to the further parts of circuit in order to illuminate the path with the help of LED bulbs in series forming an entire Street-light.

Fig.2 Solar Panel (module)

B. Battery

The battery is used to store the energy it receives from the solar panel. It mainly serves as the reserve power during the night time when it gets discharged unlike the daytime when it is charging. Two batteries are given here, one is 3.2V and the other being 12V. Supply is given from the charging circuit to both AC & DC loads wherein there is an inverter connected in series with the bulb that'll convert DC to AC for successful operation of the particular setup.

Fig.3 battery

C. Transformer

A Transformers are used to change AC voltage levels, such transformers being termed step-up or step-down type to increase or decrease voltage level, respectively. Transformers can also be used to provide galvanic isolation between circuits as well as to couple stages

of signal-processing circuits. Transformers have become essential for the transmission, distribution, and utilization of alternating current electric power.

Fig 4 Transformer

The step up transformer is used nearby the AC load (bulb) while the step down transformer is used against the DC load. Once the inverter converts DC to AC, transformer is placed next to it to make sure power is properly supplied. That's especially important in the high-power density applications that are becoming more the rule than the exception, and for more demanding system requirements.

D. Transistor

Transistor is basically a semiconductor device that can be used in both ways, to act as a switch as well as an amplifier. It can conduct & insulate both current and voltage as per requirement. P-N-P type is used here as it is widely used as a switch, just like in this case.

Fig 5 Transistor

E. Diode

This is a two-terminal electronic component that conducts electricity primarily in one direction. It has high resistance on one end and low resistance on the other end. It has two terminals – Cathode and Anode

Fig 6 Diode

F .LEDs

A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. Color is determined by the energy required for the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.

There are several other passive elements like capacitors and inductors that are connected in the charging circuits for different purposes. Capacitor is generally used in the oscillatory circuital composition from where the positive end of supply is given to extended network on the given board

G.Final Hardware

The panel first discharges into the battery. It is then given to the rectifier circuit and transformer grid for the next phase of working into the loads here.
This is known to be a very simple and cost effective way of utilizing solar energy. It consists of one or more solar photovoltaic (PV) panels connected to an array of LEDs. Because it has no batteries, the system is low-cost and virtually maintenance free and still provides light to areas which receive little or no daylight from sunrise to sunset.
Since the PV panel is usually the major contributor to the solar day lamp's total system cost, it's desirable to make the most effective use of its output. One of the best strategies to maximize the panel's utilization is to use its output to drive multiple lighting sources. Since the light sources' combined power requirements may exceed the PV panel's output the basic solar day lamp can make use of the following features:

Each light incorporates a pyroelectric infrared (PIR) motion sensor to ensure that it is switched on only when it is needed.
Further efficiency can be achieved with the addition of a light sensor, which adjusts the LED lamp to take advantage of any ambient light available

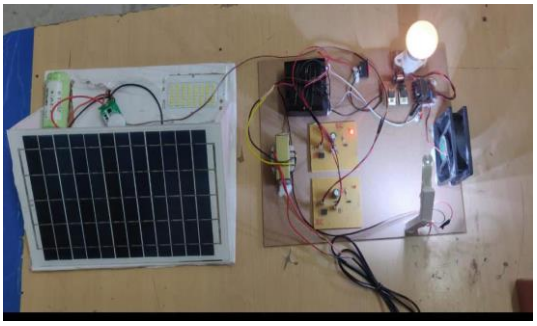

Fig 7. Hardware kit

IV.RESULTS

Here, we can clearly see that a standard solar module or a panel can generate enough output to keep the streetlight running for almost 6-8 hours until the battery charge lowers down and the entire cycle of recharging takes place in presence of the sunlight.

We can see to it that there are no obstructions in the direct contact with sunlight to make sure efficiency remains intact. Further usage

can tell that even if the initial capita is way too high, the Total Cost of Operation (TCO) turns out to be quite low here.

V.CONCLUSIONS

Solar energy is definitely going to be one of the biggest breakthrough advancements in technology for the coming future. The most abundant resource that is renewable at all times is to be harnessed properly so that everyone across this globe may get benefitted. Future scope is nearing as studies and attempts are continuously made to increase the solar power conversion capacity so that it is more usable than burdening.

VI. ACKNOWLEDGMENT

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