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ANALYSIS OF SOLAR ENERGY BASED STREET LIGHT WITH AUTO TRACKING SYSTEM

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ABSTRACT: The vital input for the growth of any nation is energy. In India, so many types of energies playing a major role. It has been inevitable to seek no polluting renewable energy sources for the power generation. So renewable energy technologies range from the well established, such as hydro power to the emergent. Each technology has its own individual measurement and requirements. Among all energies solar energy is the most abundant stream of energy. It is available directly as solar isolation and indirectly as wind energy. Solar energy has the sources of renewable energy. Its potential is 178 billion MW which is about 20,000 times the world's demand. Sun sends out energy in the form of electromagnetic radiation. Solar cells are used for the generation of electrical energy. The solar cells receive the solar energy. The solar cells operate on the photo-electric energy by using solar cells principle. The energy from the photovoltaic cells is used to switch on the lights. At present solar electric power generation systems are having fixed solar panels whose efficiency of generation is less. This paper presents the analysis of street light with auto tracking system. Thus by using this auto tracking system we can increase the conversion efficiency of the solar power generation.

Keywords: Solar power generation, solar panels, solar cells, photovoltaic cells, Auto tracking.

I.INTRODUCTION

The oil crises in the early 70's and the steadily increasing environmental concern have initiated a major concern for the exploitation of renewable sources of energy for the generation of electric power. Most promising among them appear to be the wind and at a second level, the solar energy. Solar cells are used for the generation of electrical energy. The solar cells receive the solar energy. The solar cells operate on the photo-electric energy by using solar cells principle. The energy from the photovoltaic cells is used to switch on the lights. At present solar electric power generation systems are having fixed solar panels whose efficiency of generation is less. The aim of this paper is to introduce the solar auto tracking to the existing fixed solar panels, thus we are maintaining the constant maximum power output. Thus by using this tracking system we can increase the efficiency of the solar electric power generation. The control system will rotate the panel up and down also right to left according to the angles as if panel aligns vertically with the solar position. This approach will provide the maximum utilization of the sun ray to gain the maximum energy.

II.SOLAR POWER GENERATION

The most popular non conventional power resources are solar energy or solar heat to electricity. The sun is a continuous fusion reactor in which hydrogen combine to form helium and evolving huge amount of heat energy as per the following reactions.

$$4_1H^1 \rightarrow {}_2He^4 + 26.7Mev$$

This heat energy from the sun is emitted in the universe and the earth by transmission of tiny bundles of energy particles called photons which move with finite speed (almost speed of light) and energy. When photons strike an atom, they interact with the electrons by transferring their energy and hence they are absorbed. The sun rays are composing if the different wavelength spectrums from the low to the very high ranges, but ultraviolet radiation, other low and very high range wavelength radiations are absorbed by ozone, oxygen, nitrogen, watervapour etc lying above the earth's atmosphere. Thus the sun ray consists of wavelength of radiation between 0.29µm to 2.3µm (approximately).

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The conversion of sunlight into electricity is done, either directly using the photovoltaic (PV) or indirectly using concentrated solar power. Photo voltaic convert light into electric current using the photoelectric effect. Concentrated solar power system uses lens or mirrors and tracking system to focus a large area of sunlight into a small beam. The concentrated heat is then used as a source for a conventional power plant. Various techniques are used to track the sun and focus light. In all of these systems a working fluid is heated by the concentrated sunlight and is then used for the power generation of energy.

III.PHOTOVOLTAIC CELL

Solar panels are firmed out of solar cells that are connected in series. When connected in series, in parallel increases the overall current. Each individual solar cell is typically made out of crystalline silicon, although other types such as ribbon and thin film silicon are gaining popularity.

A PV cell consists of layered silicon that is doped with different elements to form a pn junction. The p-type side will contain extra holes or positive charges, the n-type side will contain extra electrons or negative chargers. This difference of charge forms a region that is charge neutral and acts as a sort of barrier. When the p-n junction is exposed to light, photons with the correct frequency y will form an extra electron /hole pair. However, since the p-n junction creates a potential difference, the electrons can't jump to the other side only the holes can. Thus, the electrons must exit through the metal connector and flow through the load, to the connector on the other side of the junction. Since the PV cells generate a current, cells/panels can be modeled as DC current sources. The amount of current a PV panel produces has a direct correlation with the intensity of light the panel is absorbing. The simple diagram is given below.

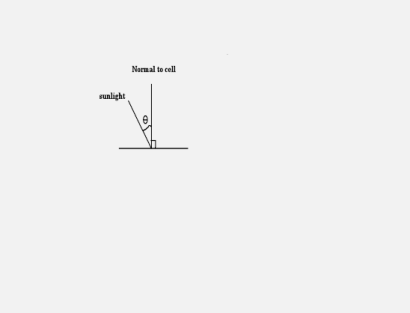

Fig. 1 PV cell Graph

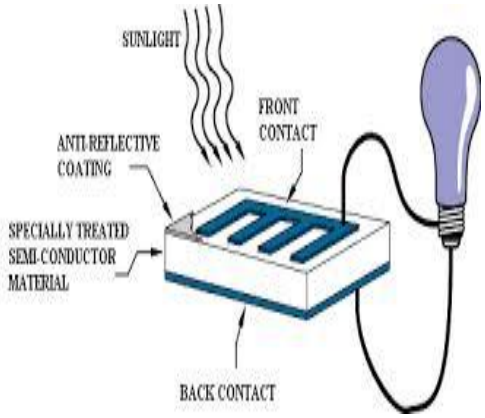

Fig. 2 PV cell

The normal to the cell is perpendicular to the cells exposed face. The sunlight comes in and strikes the panel at an angle. The angle of the sunlight to the normal is the angle of incidence (θ). Assuming the sunlight is staying at a constant intensity (λ) the available sunlight to the solar cell for power generation (W) can be calculated as,

$$W=A\lambda\cos(\theta)$$

Here, A represents some limiting conversion factor in the design of the panel because they cannot convert 100% of the sunlight absorbed into electrical energy. By calculation, the maximum power generated will be when the

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sunlight is hitting the PV cell along its normal and no power will be generated when the sunlight is perpendicular to the normal. With a fixed solar panel, there is significant power lost during the day because the panel is not kept perpendicular to the sun's rays. A tracking system can keep the angle of incidence within a certain margin and would be able to maximize the power generated.

IV. SOLAR COLLECTORS

The solar collectors concentrate sunlight to heat a heat transfer fluid to a high temperature. The hot heat transfer fluid is then used to generate system that drives the power conversion subsystem, producing electricity. The solar collector is the key element in a solar energy system. It is also the novel technology area that requires new understanding in order to make captured solar energy a viable energy Source for the future.

Fig. 3 Solar collectors

The function of solar collector is simple; it intercepts incoming isolation and changes into a usable form of energy that can be applied to meet a specific demand.

V.TRACKING ARRAYS

Arrays that track, or follow the sun across the sky, can follow the sun in one axis or in two. Tracking arrays perform best in areas with very clean climates. This is because following the sun yields significally greater amounts of energy when the sun's energy is predominantly direct. Direct radiation comes straight from the sun, rather than the entire sky.

Normally, one axis trackers follows the sun from the east to west throughout the days. The angle between the modules and the ground does not change. The modules face in the "compass" direction of the sun, but may not point exactly up at the sun at all times.

Two axis trackers change both their east-west direction and the angle from the ground during the day. The modules face straight at the sun all through the day. Two axis trackers are considerably more complicated than one axis types.

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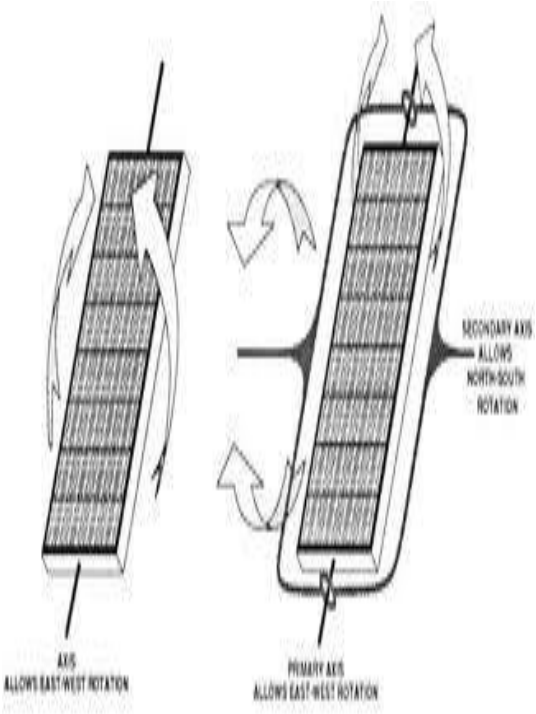

Fig. 4 Tracking Arrays

VI. SOLAR PANEL

Fig. 5 Solar Panel

The solar panel's output is rated in watts. This rating is the amount of power the solar panel would be expected to produce in Standard Testing Condition (STC) of sunlight intensity 1000w/meter at 25 degrees centigrade. Obviously, it differs with geographical locations receive differing quantities of average peak sun hours per day. Therefore it is so important to ensure that your panels are directed to where the sun will shine on them the most and with no shading .The rating terminal voltage of a solar panel is usually between 17-22 volts, but through the use of a regulator, this voltage is reduced to around 13 or 14 volts as required for safe battery charging. Solar panel output is affected by the solar cell operating temperature. Panels are rated at a nominal temperature of 25 degrees Celsius. The output of a solar panel can be expected to vary by 0.25% for every 5 degrees variations in temperature. As the temperature increases output decreases.

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VII. SOLAR REGULATORS

The purpose of the solar regulator (also called as charge controller) is to regulate the current from the solar panels to prevent the batteries from overcharging which can damage them (caused by gassing and loss of electrolyte).

Fig. 6 Soalr Regulators

A solar regulator senses when the batteries are fully charged (or filling up) and either battery, it also prevents back feeding into the solar panel at night (which charges the battery). Most solar regulators also include a low voltage disconnect feature which will switch off the supply to the load if the battery voltage falls below the cut-off voltage. This prevents the battery from permanent damage and reduces life expectancy. Solar regulators are rated by the amount of current they are able to receive from the solar panel.

VIII. SOLAR ENERGY BASED STREET LIGHT WITH AUTO-TRACKING SYSTEM

Maximizing power output from a solar system is desirable to increase the efficiency. In order to maximize the power output from the solar panels, one needs to keep panels aligned with the sun. As such a means of tracking the sun is required. This is a far most cost effective solution than purchasing additional solar panels. It has been estimated that the yield from solar panels can be increased by 30 to 60 percent by utilizing a tracking system instead of a stationary array. This paper describes an automatic tracking system which will keep the solar panels aligned with the sun in order to maximize efficiency.

IX. BLOCK DIAGRAM

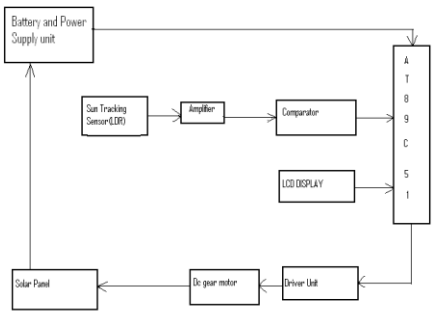

Fig.7 Block diagram

The sun tracking sensor is the sensing device, which sense the position of the sun at the time to time continuously and it gives the sensing output to the amplifier based on light density of the sun. Here the sun tracking sensor is LDR (light dependent resistor). The amplifier unit is used to amplify the LDR signals, which makes the low level signal into high level signals and this output is given to the comparator. The LM324 IC is used as an amplifier. Comparator compares the signals and gives the command to the AT89C51 microcontroller.

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Microcontroller is the control unit, which gives the control command to the driver unit based on the comparator output. The driver unit controls the input to the dc gear motor. When the driver unit drives the dc gear motor and rotates the motor shaft. DC gear motor is the electric drive, which drive the solar panel based on movement of the sun. Solar panel is the device consisting of PV cells arrays. This is used to collect the solar energy from the sun and converts the solar energy into electrical energy. This energy is to store the battery. Power supply unit supplies power to the all control unit.

X. CIRCUIT DIAGRAM

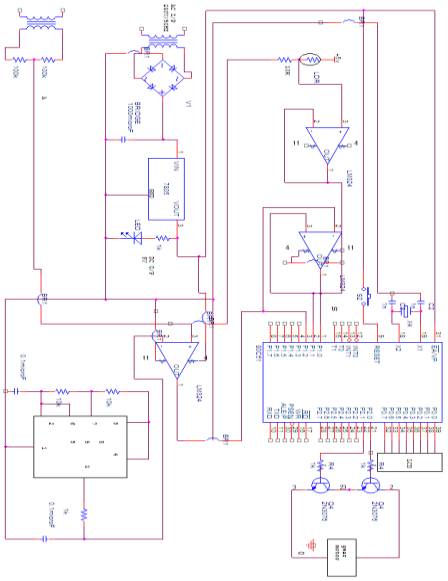

Fig. 8 Circuit Diagram

XI. ANALYSIS

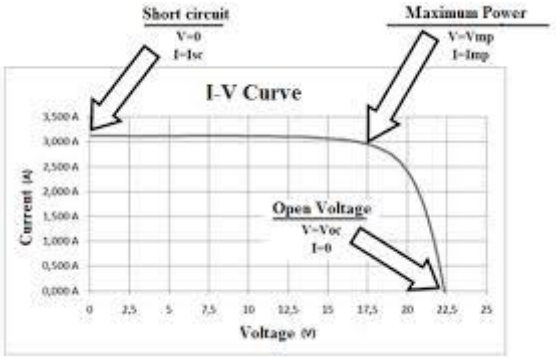

Fig. 9 Voltage- Current Curve

XII.CONCLUSION

The system presented in this paper will be an efficient method to use the solar energy in remote areas. This system consumes very low power and high efficient lightning. We employ the auto sun tracking system; this can improve the energy stored in battery. This system does not affect the environment because it is pollution free. Our system also consisting of automatic ON, OFF control of the LED lamp, so there is no manual operation and it is not required operators.

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