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Implementation of solar tracker using Arduino with servo motor

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ABSTRACT

With the approaching scarcity of nonrenewable resources, people are considering using substitute sources of energy. From all other available resources, sun energy is the amplest and it's comparatively easy to convert it to electrical energy. Use of solar panel to convert sun's energy to electrical is very popular, but due to alteration of the Sun from east to west the fixed solar panel may not be able to generate ideal energy. The projected system resolves the problem by providing an arrangement for the solar panel to track the movement of the Sun. This paper is based on the use of stepper motor coupled with a solar panel track the Sun so that maximum sun light is absorbed by the panel at a given instance of the day. This is an enhanced model as compared to fixed panel method that may not be so ecologically aware. Additionally, the code is written in C++ programming language and targeted to the Arduino UNO controller. The effectiveness of the system has been tested and compared with a stationary solar panel on several time intervals, and it shows the system respond the best at the 10-minutes intervals with the reliable voltage generated. Hence, the system has been known for catching the maximum sunlight source for high-efficiency solar street light applications.

Keywords: *Tracking, Nonrenewable Source, Microcontroller, Stepper Motor.*

1. INTRODUCTION

With the increase in demand for energy, the continuous fall in existing sources of fossil fuels and the budding concern regarding atmospheric pollution, mankind has been pushed to discover new expertise in the production of electrical energy using clean, renewable sources, such as solar energy, wind energy, etc. Among the non-conventional, renewable energy sources, solar energy pays for great potential for conversion into electric power, able to ensure an important need of electrical energy. The conversion of solar light into electrical energy signifies one of the most promising technologies, in constant development, being dirt free, silent and dependable, with very low repair costs and negligible environmental impact. Solar energy is unrestricted, endless, and involves no polluting filtrates or greenhouse gases emissions.

At present we are using fixed solar panels to store and provide energy to various systems, but due to the transition of the sun, the fixed solar panels are not able to absorb the maximum amount of sunlight. In this project, we are using a tracker to follow the trajectory of the sun.

The purpose of this project is to absorb the maximum solar energy through the solar panel. The main objective of this paper is to improve solar tracker. The solar tracker is used for several applications; these are solar cells, solar thermal arrays, and solar day-lighting system. As from previous knowledge, the angle of incidence lies between -90 degrees after sunrise and 90 degrees before sunset passing zero degrees at noon. This makes the solar radiations to be 0% during sunrise and sunset and 100% during noon. This variation causes solar panel to lose more than 40% of the collected energy. It shows sun's path yearly at a latitude of 30 degrees and we can estimate the exact position of the sun. Curve for relation between solar radiation and solar angle of incidence at any time of the month or a day, the position of the sun is decided by two angles in the spherical co-ordinate system- the Altitude angle which is the angle of the sun n the vertical plane in which the sun lies and the Azimuth angle which represents the angle of the projected position of the sun in the horizontal plane. Also, it shows that the sun rays received are maximum when the angle of incidence is 0 degrees i.e. the solar panel is perpendicular to the sun. The Dual Axis Solar Tracker used to solve this problem consists of two essential parts¸ the solar panel and the tracking system.

2. CIRCUIT DIAGRAM

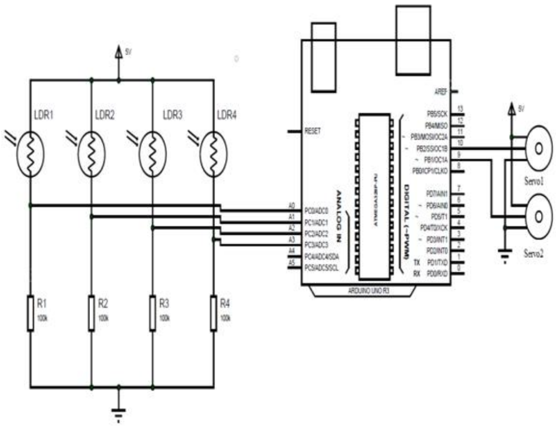

Fig 1: Circuit Diagram

The circuit diagram of the solar tracking system depicts the interconnection and composition of the system. For the tracking approach, the main objective is how to cause the solar panel to follow the sunlight as closely as possible. LDR sensor, comparator, and microcontroller constitute the sensor-based system. The LDR sensor measures the sunlight intensity as are reference input signal in this tracking system. A feedback error voltage is generated because of the unbalance in the voltages generated by the LDR. The error voltage is proportional to the difference between the solar panel location and the sunlight location. The error voltage is compared with a specified threshold (tolerance) with the use of a comparator. The motor driver is activated to rotate the dual-axis (azimuth and elevation) tracking motor and bring the solar panel to face the Sun if the output of the comparator is high. The solar panel and sunlight are repetitively monitored by the feedback controller and the controller sends a differential control signal to guide the solar panel until the error voltage is less than a pre-specified threshold value.

3. BLOCK DIAGRAM

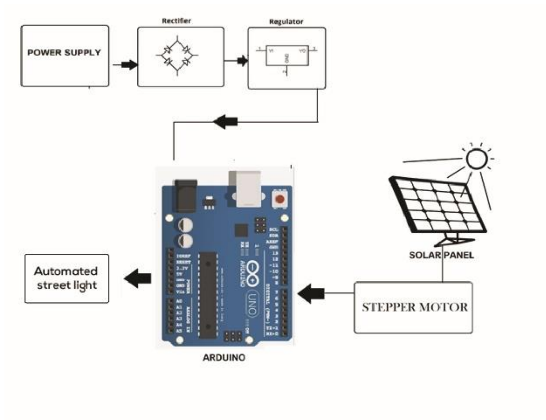

Fig 2: Block Diagram

Above block diagram depicts the implementation of Auto Smart Street Light controller with the use of sun tracking device. The Auto Smart Street Light Controller can be divided into two parts, one is IR Transmitter and other is IR receiver. The IR transmitter section is simply connected a power supply to four Infrared LEDs in parallel. The receiver section is powered by a 5V regulated power supply using a step-down transformer, four diode bridge rectifiers, a filter capacitor and a voltage regulator 7805. This 5V supply is connected to microcontroller based main circuit. In this circuit, the two Photodiode (IR receivers) are connected to IC-358. As this IC comprises dual op-amps, two inputs and corresponding outputs can drive by one. The op-amp outputs are connected to a microcontroller which is programmed as shift counter.

When we test this practically, if a car interrupts first IR sensor on road, the first section of poles will light up, and if it further interrupts the second sensor, the next section poles will light up and switch off the previous one. And an LDR is also connected to a 555-timer monostable mode circuit to control street light in night and day mode.

4. RESULT AND DISCUSSION

It is cheaper and hence can be used for industrial and commercial purposes to run various operations. Thus, the use of photovoltaic systems to generate power is one of the most efficient ways of generating power.

4.1 Universal application

The sun tracker is very versatile as it can be used for several applications and can be implemented in various parts of the world except for Polar Regions.

4.2 Generating efficiency

Over 40% increase in radiation reception from sun comparing with a fixed installation. With dual axis tracker, additional over 45%increase in radiation reception from the sun will be gained.

4.3 Independent control

The important factor concerning the system is that it can be installed anywhere, where no manual operation is involved. LDR sensors play a vital role in making the system automated by sensing the intensity resulting in the generation of the pulse, thus making the system independent.

5. CONCLUSION

In recent years, the solar tracker has played a major role in improving the productivity of solar panels, thus substantiating to be a better technological achievement. The vital importance of a dual axis solar tracker lies in its better efficiency and sustainability to give a better output compared to a fixed solar panel or a single axis solar tracker. The tracking system is designed in a certain way to absorb the solar energy from all possible directions. Generally, in a fixed solar panel, it is not possible to track the maximum solar energy. In the multi-axis tracker, the tracker moves along with the position of the sun absorbing the maximum solar energy. Hence, maximum possible energy is trapped throughout the day as well as throughout the year. Therefore, there is an increase in the output energy indicating that its efficiency more than a fixed solar panel (about 30 -40%more).

6. ACKNOWLEDGEMENT

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