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Automatic Solar Tracking System with Power Generation for AC Load

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ABSTRACT -

Renewable energy sources are becoming one of the top priorities in today's world due to their many benefits. In particular, solar energy is evolving into an inexhaustible and non-polluting energy source to meet our growing energy needs. However, solar panels, which are the basic components of solar-energy conversion, are fixed at a certain angle and cannot track the direction of sunlight with daily and seasonal changes. This limits the area of sunlight exposure on the solar panels and the efficiency of the solar tracking system connected to the solar panels. Renewable energy sources are becoming one of the top priorities in today's world due to their many benefits. In particular, solar energy is evolving into an inexhaustible and non-polluting energy source to meet our growing energy needs. However, solar panels, which are the basic components of solar-energy conversion, are fixed at a certain angle and cannot track the direction of sunlight with daily and seasonal changes. This limits the area of sunlight exposure on the solar panels and the efficiency of the solar tracking system connected to the solar panels.

Keywords: Solar tracker, LDRs, Stepper motor, AT89S52, Solar panel, Inverter, AC loads etc.

I. INTRODUCTION

It turns out that the efficiency of solar panels improves by 30-60 percent when a mobile solar tracking system is used instead of a fixed array of solar panels. Therefore the design and implementation of an energy efficient solar tracker is a challenge due to the instability of the solar panels. The angle of inclination of the sun's rays along the solar panels constantly changes due to the movement of the sun from east to west by rotating the earth independently of weather conditions. Also, on cloudy days the situation becomes completely awful. In addition, the rotation of the earth changes the distance between the earth and the sun, which changes the pattern of the incoming sun's rays.

All of these factors must be taken into account when designing a solar tracking power generation system to achieve maximum efficiency. We decide to develop a solar tracking system using a combination of microcontrollers, stepper motors and light dependent resistors (LDR) with the primary goal of improving the energy efficiency of solar panels. Most solar street lights are fixed these days, we would like to add a dual axis solar tracking system to detect this problem statement. The main component of this tracker is the AT89S52 microcontroller, which is programmed to detect sunlight with the help of LDRs and then activates the stepper motor to place the Solar panel in order that it gets most daylight. To meet. Therefore this system can achieve maximum brightness and reduce the cost of power generation by requiring a minimum number of solar panels with proper orientation to sunlight.

II. PROBLEM STATEMENT

Many areas use fossil fuels as a major source of electricity generation. This means that individuals are subject to the limitations and contaminants that come with it. For conventional electricity, extensive and expensive infrastructure must be established, which means that in developing countries electricity is limited to a single bulb or new buildings. The project proposes a system that can increase solar power generation by 30-40% by using an 8051 microcontroller to operate the control circuit, which allows two stepper motors to power the solar panel. Uses to make a good orient.

III. SCOPE OF PROJECT

The project explored the use of solar panels along with two stepper motors to track the sun in horizontal and vertical directions due to its high speed and low power consumption, so that maximum light occurs on the panel at any time of the day. Four light sensors mounted on the solar panel were able to detect sunlight, i.e. one pair for each axis motion. The voltages on the two relative sides of the solar panel were compared and the microcontroller used their difference as an error, allowing the stepper motors to adjust the position of the solar panel until the two LDR voltage inputs were equal by the corresponding angle. Have to walk around. Since LDRs produce analog output voltages and the microcontroller on the raspberry can only read digital outputs, an external analog-to-digital converter is implemented in the system. The stepper motor was driven by the motor driver IC as the microcontroller could not handle the power requirements of the stepper motor. This way the solar tracker will fine tune its operation.

IV. OBJECTIVE

- Our projects are aimed at increasing the use of solar panels by solar panels. A digital based automatic sun tracking system has been proposed for this purpose.
- Light the solar panel automatically tracks the sun from east to west for maximum light intensity.

V. LITERATURE REVIEW

To date, several groups have successfully reported the design and performance of a microcontroller-based solar tracking system. Auto tracking of 8051 microcontroller based solar tracker and manual tracking by "sun tracking software" using a combination of LDRs, OPT couplers, stepper motors, relays, analog to digital converters, etc.

[1]. Anuraj et al reported implementing a solar tracking system using ATMEGA 16, which improved power efficiency by up to 20%

[2]. By Tudora et al. Design and implementation of solar tracker system for photovoltaic (PV) power plants. The operation of the tracker is based on a DC motor controlled by an intelligent driver circuit that moves the mini PV panel, which absorbs the differential signal from two efficient light sensors. Tracking implementation of a solar tracker prototype with two degrees of freedom-azimuth and vertical-design was reported using the PIC 16F84A microcontroller.

[3]. Wang et al. The novel design of a dual-axis solar tracking PV system using feedback control theory, four-quadrant light dependent resistive (LDR) sensors and simple electronic circuits is proposed. Tracking is achieved with the help of a dedicated dual-axis AC motor and stand-alone PV inverter.

VI. BLOCK DIAGRAM

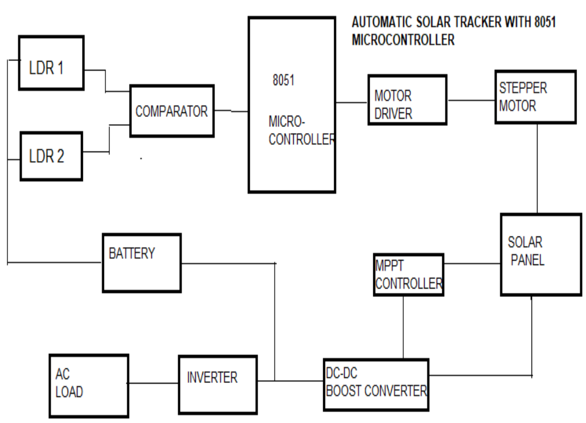

Fig.1. Block Diagram of System

VII. WORKING PRINCIPLE

For maximum application of this project in the installation of hardware, the LDR should be placed on the surface of the large curve. And immediately the two LDRs must have a mechanism that is active at the same time. And the stepper follows the bit sample of the motor and the sun panel attached to the shaft of the stepper constantly faces the sun generally. LDR combination plays an important role. In fact combinations of these signals are given to the microcontroller 8051 and specify the motor connected to it.

The solar panel is connected to the stepper motor with its rotating mechanism. Solar tracking works this way. And it helps to increase the efficiency of the solar panel. The solar panel generates energy and shops it inside the battery. It is used to operate the AC load with the help of MPPT, Inverter and Boost Converter.

VIII. COMPONENTS

The main operating components of this system are:

- Photovoltaic Solar Panel
- Microcontroller 8051
- Comparator LM324
- Gears Mechanism
- LDRs
- Motor driver IC L293D
- Stepper motor
- MPPT
- Boost converter
- Inverter
- Battery
- AC Load

IX. ADVANTAGES

1) Increases the average voltage output of the solar panel compared to the fixed panel.

2) Helps protect the solar panel from dust.

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3) High power generation throughout the day.

X. RESULT & DISCUSSION

The designed model was tested in the laboratory with the help of a mobile flashlight. When the flash light was started from the east direction where LDR1 was placed the comparator differential output was found to be positive and greater than the threshold value. As we moved from east to west, than the comparator output value kept decreasing until a point where output of the comparator was zero, at this point the flashlight was normal to the solar panel. As we moved further west we saw that the comparator output started increasing in the negative direction. In the prototype 8051 was used as microcontroller, OPAMP was used as comparator, l293d was used as dc motor driver and dc 12v motor was used.

EXPERIMENTAL RESULT

Table 1: Output Voltage and Current for a Fixed and a Tracking Solar Panel.

Time	Fixed Solar Panel		Tracking Solar Panel	
	Output Voltage (Volts)	Output Current (Ampere)	Output Voltage (Volts)	Output Current (Ampere)
8.00 hrs	10.8	0.21	11.9	0.37
9.00 hrs	10.9	0.45	11.8	0.47
10.00 hrs	11	0.48	12.2	0.51
11.00 hrs	11.4	0.50	12.3	0.53
12.00 hrs	11.8	0.52	12.8	0.56
13.00hrs	12.3	0.51	12.7	0.55
14.00hrs	12.8	0.50	12.6	0.53
15.00 hrs	11.5	0.43	11.9	0.49
16.00hrs	11.4	0.37	11.5	0.42

We know that Output Power of DC equipment is given as:

$$Pout = Voltage * Current$$

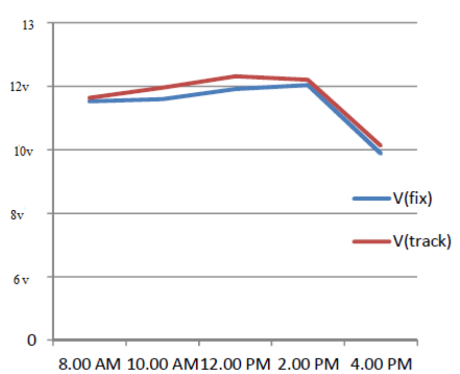

Fig.2. Comparison of Voltage O/P between fixed solar panel and tracking solar panel

The line graph representation above in Figure 2 shows the comparison between the output voltage of the fixed solar panel (VFix) and the tracking solar panel (Vtrack), shown in volts on the x-axis and y-axis volt every 2 hours.

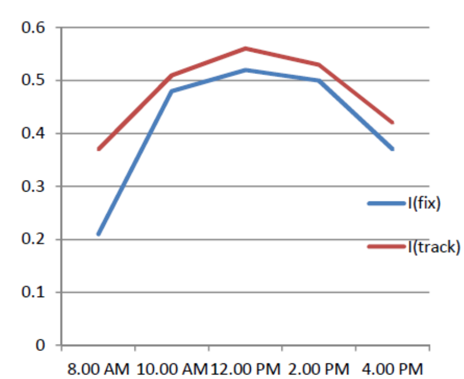

Fig.3. Comparison of Current O/P between fixed solar panel and tracking solar panel

The above line graph representation in Fig.3. Shows comparison between output current of a fixed solar panel, I(fix), and a tracking solar panel, I(track), Every 2 hour interval is shown in Iout on the X-axis and on the Y-axis in amperes.

To calculate percentage increase in the power output due to the tracking solar panels with respect to fixed solar panels we have the following formula:

$$\left(\left(\frac{Power\ Output\ of\ Tracking\ Solar\ Panel}{Power\ Output\ of\ Fixed\ Solar\ Panel}\right) - 1\right) * 100$$

As shown in the table both the single and the dual axis has its share of advantages and disadvantages, in fact dual axis has greater efficiency, but owing to the lesser cost in designing the single axis tracker, not very major changes in the output of the solar panels due to two trackers in northern parts of the country experiencing bright sunny days and that depending upon the seasonal variation we can manually orient the solar panel due north during the summer and south during winter every 6 months with minimal fuss, we chose to design single axis tracking system.

XI. CONCLUSION

This project provides an interesting and simple attempt to implement Dual Axis Solar Tracker using LDR and microcontroller. The use of gears instead of linear actuators helps to increase overall tracker efficiency. The design helps to extract maximum energy from solar radiation by tracking using a dual axis tracker. This is possible if the solar panel is always in proper alignment with the incident rays of the sun. The proposed method offers the following features:

- A simple and economic implementation.
- An ability to simultaneously adjust panel along both the axes.
- Ability to adjust the tracking accuracy.
- Provides efficient tracking even under diffuse weather conditions.

XII. REFERENCES

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