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Solar Panel Tracking System based on ATmega328 Microcontroller

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Abstract-This paper is based on solar panel tracking system based on microcontroller. Solar tracking enables more energy to be generated because the solar panel is always able to maintain a perpendicular profile to the sun's rays. Development of solar panel tracking systems has been ongoing for several years now. As the sun moves across the sky during the day, it is advantageous to have the solar panels track the location of the sun, such that the panels are always perpendicular to the solar energy radiated by the sun. This is a solar tracking system which can be used as a power generating method from sunlight.

Index Terms-Solar system; solar panel; microcontroller AT89C51; LDR; stepper motor.

1. INTRODUCTION

Renewable energy is rapidly gaining importance as an energy resource as fossil fuel prices fluctuate. The system will tend to maximize the amount of power absorbed by Photo Voltaic systems. It has been estimated that the use of a tracking system, over a fixed system, can increase the power output by 30% - 60% [6]. The increase is significant enough to make tracking a viable preposition despite of the enhancement in system cost. It is possible to align the tracking system normal to sun using electronic control by a micro-controller. Design requirements are: i). during the time that the sun is up, the system must follow the sun‘s position in the sky. ii) It should be totally automatic and simple to operate [6]. The operator interference should be minimal and restricted to only when it is actually required. This system is tracking for maximum intensity of light. When there is decrease in intensity of light, this system automatically changes its direction to get maximum intensity of light.

We are using two sensors in two directions to sense the direction of maximum intensity of light. The difference between the outputs of the sensors is given to the micro-controller unit. Here we are using the micro-controller for tracking and generating power from sunlight. It will process the input voltage from the oscillator circuits and control the direction in which the motor has to be rotated so that it will receive maximum intensity of light from the sun.

The block diagram of the system is shown in Fig. 1

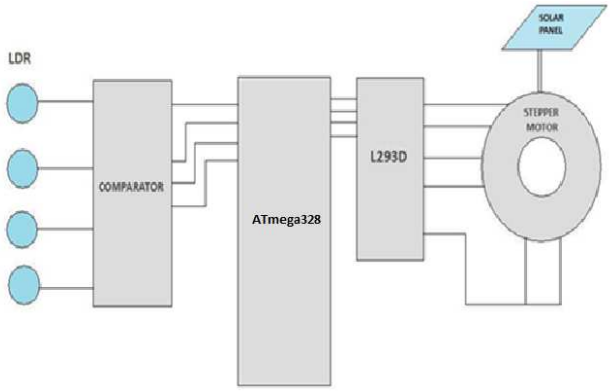

Fig. 1: Block Diagram

2. METHODOLOGY

In the hardware setup of the system, the LDRs must be placed on the surface of a large curvature. And the mechanism should be done so that any immediate two LDRs remain active at a time. And the stepper motor will follow the bit pattern of the, and the solar panel connected on the shaft of the stepper will always face the sun normally. The LDR combination plays the vital role. Actually these combinations of signals are fed to the microcontroller ATmega328 and this directs the stepper motor associated to it. The required bit pattern is shown in Table 1.

Table 1: Desired Bit Pattern

LDR 1	LDR 2	LDR 3	LDR 4
1	1	0	0
0	1	1	0
0	0	1	1
1	0	0	1

When the stepper motor gets the last bit sequence according to the table, the stepper motor will move to its initial position again follow these steps again, as the sun traverse from the beginning in next day.

The working of solar panel tracking system is Explained with help of flowchart shown on Fig 2.

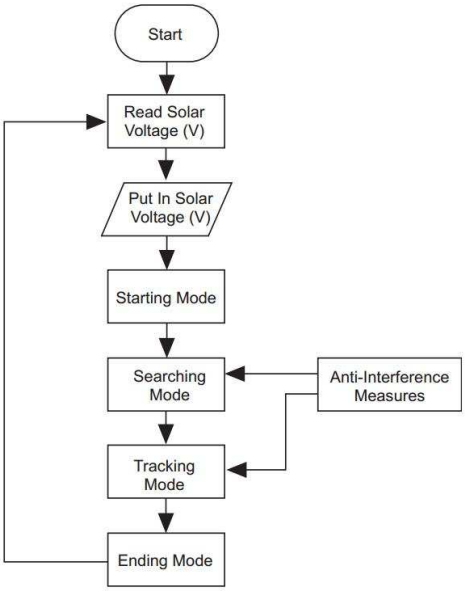

Fig. 2: Flowchart of tracking system

3. COMPONENTS USED

The major components of this system are as follows.

1. *Microcontroller (Atmega328)*
2. *Comparator LM324*
3. *LDRs*
4. *Motor driver L293D*
5. *Stepper motor*

Other auxiliary components are-

1. *Resistor (10KΩ, 1KΩ, 330Ω)*
2. *Capacitor (100µF, 330pF, 22µF)*
3. *Diode (1N4148, 1N5819)*
4. *5V and 6V power supply*

4. SYSTEM DESCRIPTION

The complete circuitry of this project mainly can be shown in three parts. These are:

1. **The sensor and comparator section:** Fig 3, show how we are getting the output from the LDR through a comparator LM324 by comparing with the reference voltage set by the potentiometer, and given to the Port 1 of ATmega328is shown. Firstly four LDR are connected to the comparator. we are getting output of the LDR through 1KΩ resistance. The output from this LDR is given to the comparator LM324. Four LDR are used here and all of them connected in this similar way. The output of LDR is given to the inverting terminal of the op-amp of the comparator. LM324 has four comparators in it.

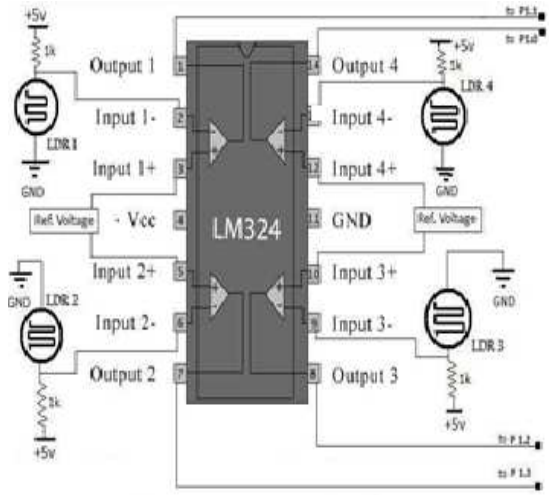

Fig.3: LM324 and comparator circuit

2. **Microcontroller: Microcontroller:** This is the heart of the circuit which performs all commanding and controlling operations. Microcontroller now days are becoming more popular because of several advantages over microprocessor. ATmega328 microcontroller is used to drive unipolar stepper motor as per the signaling provided by LDR.
3. **Oscillators:** Two oscillators would be used for generating square waves. The sensors are connected to these two oscillators which generate square pulses in accordance to the intensity of the light falling on the two sensors. The outputs of these two oscillators are given to the microcontroller for comparison**.**
4. **Stepper Motor:** A unipolar stepper motor is being used for rotation in one direction only. The stepper motor covers an angle of 1.8 degrees per step. The output of the microcontroller is given to this motor through motor driver circuit and hence the motor is rotated accordingly, pointing in the direction of maximum intensity of sunlight.

5. **Motor Driver:** The unipolar motor driver circuit is used for controlling the rotation of the stepper motor. This circuit has transistors in Darlington pair with free-wheeling diodes.

In two phase mode, successive pairs of adjacent coils are energized in turn, motion is not as smooth as in one phase mode, power consumption is more

important but it produces greater torque As in one phase mode, applying the steps in order makes the stepper motor run clockwise and reversing order makes it turn counter-clockwise. The diagram of two phases is shown in Fig. 4.

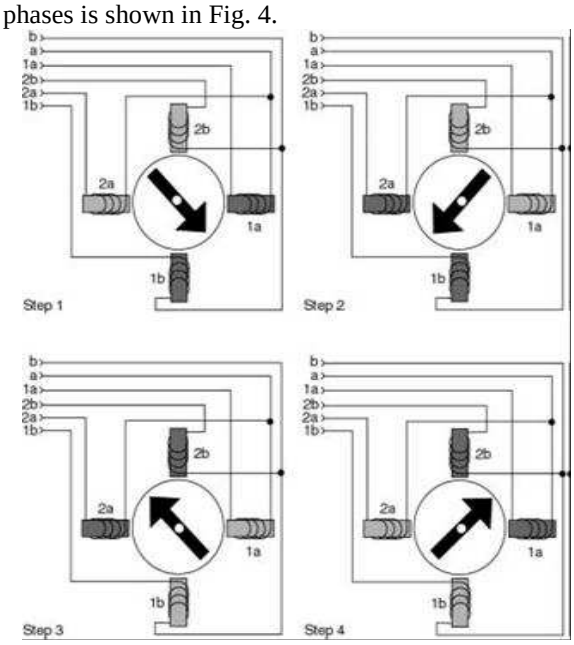

Fig. 4: Two phases on steps

Step Angle: Step angle of the stepper motor is defined as the angle traversed by the motor in one step [3]. To calculate step angle, simply divide 360 by number of steps a motor takes to complete one revolution. As we have seen that in half mode, the number of steps taken by the motor to complete one revolution gets doubled, so step angle reduces to half. As in above examples, Stepper Motor rotating in full mode takes 4 steps to complete a revolution, So step angle can be calculated as Step Angle ø = 360° / 4 = 90° and in case of half mode step angle gets half so 45°.So this way we can calculate step angle for any stepper motor[3]. In morning when sun rises in the east 1st and 2nd LDR getting maximum intensity of light the motor rotates in a specified angle. Then sometimes latter 2nd and 3rd LDR will get maximum light then stepper motor rotates next specified angle. Similarly next 3rd and 4th LDR will get maximum light. After sunset in the west stepper motor return back means solar panel will be at initial position.

The photographic view of the hardware is shown in Fig 5.

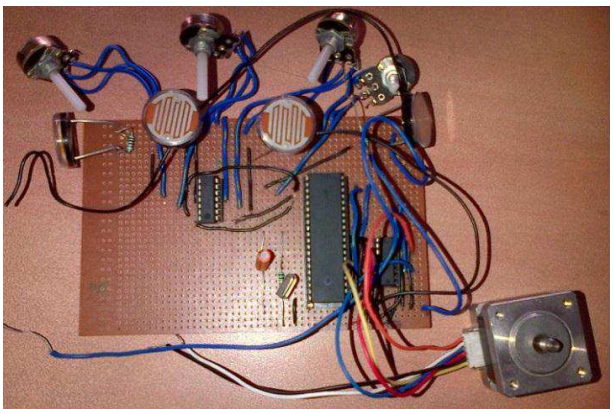

Fig. 5: Hardware setup of tracking system

6. CONCLUSIONS

The original purpose of this project is the power generation by setting the equipment to get maximum sunlight automatically. Although due to resources constraints we just accomplished the tracking part of the system.In this project a solar tracker has been developed to increase the amount of power generated by the solar panel as the sun traverses across the sky. An ATmega328 microcontroller was used to control the movement of the solar panel. The system is designed to be autonomous; such that energy generated by the solar panel would be used to charge two lead acid batteries. In this project some difficulties regarding the placement or the LDRs is faced, so that at a same time more than two LDR do not get activated. All the readings are taken very carefully during the project to eliminate the errors as many as possible. Solar Energy is one of the most popular renewable sources nowadays. It is being widely used also, and within some more years it will be very popular that it will be used for many purposes, in industries and household as well. So it is most important fact to utilize the maximum energy of the sun so that maximum power can be generated. The thought behind this project is also derived from this fact. In many places experiment is being done on this fact how it is possible to make full use of the day light. In many places application of this project can be seen also. This project has got a bright future scope further. Accuracy of this solar panel can be increased further and number of steps can be increased as well to get more accurate desired output. Timer circuit can also be integrated with this so that this system responses more accurately. Even in a cloudy day when intensity of sunlight may vary at different time of a day, the timer circuit can be more that handy to drive the solar panel correctly in that low light. As per energy concerned solar energy is one of the most promising energy which is going to be a main source of energy in near future.

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REFERENCES

[1] Design of a Solar Tracker for PV Power plants, Tiberiu Tudorache, Liviu Kreinder, 21 Electrical Engineering faculty, University politechnica of Bucharest, Romania.

[2] Use of solar tracking system for extracting solar energy, Gabri Deb and Arijit Bardhan Roy, International Journal of Computer and Electrical Engineering, Vol. 4 No. 1Feb. 2012.

[3] Solar Tracking System : More Efficient use of Solar Panels, J. Rizk and Y. Chaiko, World Academy of Science, Engineering and technology, Vol. 2 No 3 May 2008.

[4] Kais I. Abdul-lateef, A Low cost single-axis sun tracker system using pic microcontroller, Diyala journal of engineering sciences, vol. 05, no. 01, pp.65-78, june 2012.

[5] Meghana Sharma, An Efficient Low Cost Solar Tracker Using Microcontroller,‖ IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE), Volume 9, Issue 4 Ver. V (Jul – Aug. 2014), PP 37-40.

[6] Mostefa Ghassoul, Design of an Automatic Solar Tracking System to Maximize Energy Extraction,‖ International Journal of Emerging Technology and Advanced Engineering, Volume 3, Issue 5, May 2013.

[7] http://www.hbeonlabs.com/reports/Time Operated Solar Tracking System_Report.pdf

[8] http://www.icee.usm.edu/ICEE/conferences/asee2007/papers /1213_A_MICROCONTROLLER_BASED_SOLAR_PANE

[9] B.Suchitha Samuel, J.Mrudula, ―Design of Intelligent Solar Tracker Robot for Surveillance,‖ International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 2, Issue 10, October 2013.

[10] Bhavesh Pandey1, Anita Agrawal, ―Automatic Sun Tracking System Using PSoC,‖ International Journal of Innovative Research in Science, Engineering and Technology, Vol. 1, Issue 1, November 2012.

[11] Sobuj Kumar Ray, Md. Abul Bashar, Maruf Ahmad & Fahad Bin Sayed , ―Two Ways of Rotating Freedom Solar Tracker by Using ADC of Microcontroller ‖, Global Journal of Researches in Engineering General Engineering‖, Volume 12 Issue 4 Version 1.0 Year 2012.

[12] Mazidi Md.Ali, Mazidi J.G.,―The 8051 Microcontroller and Embedded systems‖, Pearson Education, 2nd edition.