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Dual Axis Solar Tracking

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ABSTRACT

Solar energy is fast becoming a very important means of renewable energy resource. With solar tracking it will become possible to generate more energy since the solar panel can maintain a perpendicular profile to the rays of the sun. The aim of this paper is to present a unique solar tracking technique which can be used to extract maximum power from the photovoltaic cell by using a close loop control system along with a 4 LDR sensors which is strategically designed to generate feedback signal in order to track the sun angle. By using the close loop system the tracker will be able to keep the solar panel align to the sun light irrespective to the change in the intensity of light.

Keywords : Solar Panel, Driver Circuit, LDR Sensors, PMDC motors, Relays.

I. INTRODUCTION

The operating principle of the device is to keep the photovoltaic modules constantly aligned with the sunbeams, which maximizes the exposure of solar panel to the Sun's radiation. The system utilized an ATmega328P microcontroller to control motion of two PMDC motors, which rotate solar panel in two axes. The amount of rotation was determined by the microcontroller, based on inputs retrieved from four photo sensors located next to solar panel.

Our tracker is a **dual axis tracker**, meaning it tracks in both X and Y. To put it into even more simple terms, it goes left, right, up, and down. This means once you have your tracker set up you will never need to change or adjust anything, since anywhere the sun moves your tracker will follow. This method gives the best results for power generation. Solar panels are used for converting solar energy into electrical energy, photovoltaic cells or solar cell, are placed in a matrix like pattern on the surface of solar plate. Solar energy can be used in both the ways that is indirectly and directly.Dual axis tracking system has both vertical axis and a horizontal axis so can be used to track the sun motion anywhere in the upper sky. This tracking system is used for the control of astronomical telescopes. Dual axis tracking system track the sun both North to South and East to West for efficient power output.

II. LITERATURE REVIEW

Title	Author	Content
Arduino based Two Axis Solar Tracking by using Servo Mechanism	V. Brahmeswara Rao K. Durga Harish Kumar K. Deepak N.V.Upendra Kumar	The variation in the solar energy occur daily due to variation in day night cycle. In this paper they proposed dual axis solar tracking system by which it is possible to catch maximum amount of solar energy by using Arduino as main processing unit
Designing a Dual Axis Solar Tracking System For Maximum Power	Vijayalakshmi. K	The mainpurpose is to present a control system which will cause better alignment of photovoltaic array with sun light and to harvest the solar power.
The Implementation of Solar Tracker using Arduino with Servomotor	P. Ramya R. Ananth	This aim is to consume the maximum solar energy through a solar panel. Power output from solar cell will be maximum when it facing the sun that is the angle between its surface and sun rays is 90 degree.
Solar Tracker for Solar Panel	Oloka Reagan Otieno	Arduino Uno which is an ATMEL microcontroller based Board, has been used as the main controlling unit.

III. METHODS AND MATERIAL

a. Solar PV Panel

A solar cell is an electronic device which directly converts sunlight into electricity. Light shining on the solar cell produces both a current and a voltage to generate a electric power. We are using Solar Panel of rating 6V, 3W it works on the principle of photovoltaic effect. It takes heat energy from the sun and converts it into power.

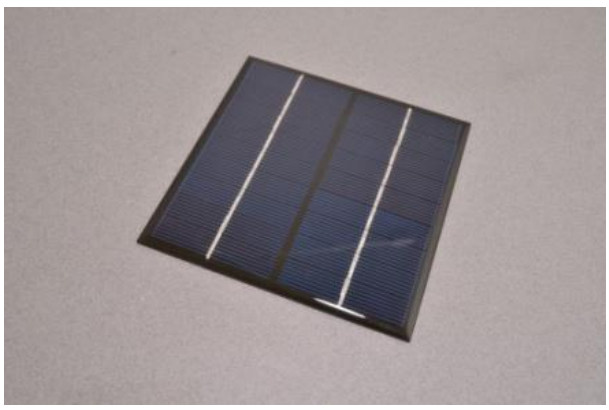

Figure.1: Solar PV Panel

b. LDR Sensors

We are using 4 LDRs used to detect the sun position and give its output to the arduino which helps in sun tracking system. They are made up of semiconductor materials having high resistance. LDRs works on the principle of photo conductivity. Resistance of these LDRs decreases when light falls on it.

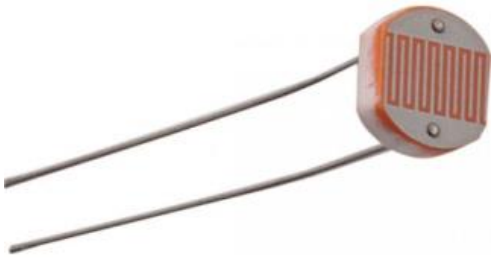

Figure.2: LDR Sensor

c. Motor Driver Circuit

We are using ULN2003IC driver circuit. The ULN2003IC is a high voltage and high current Darlington array IC. It contains 7 open collector Darlington pairs with common emitters. These circuit act as a current amplifier since it takes low current control signal and provides high current signal is used to drive the motor.

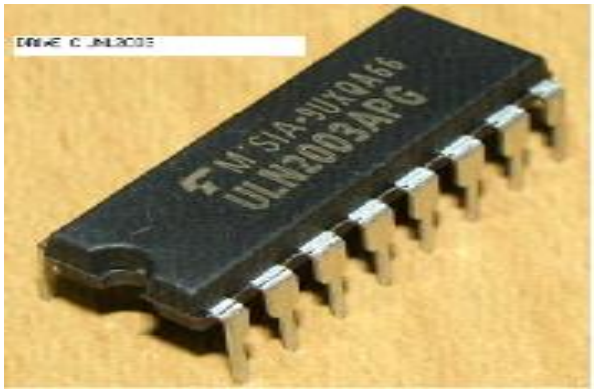

Figure.3: Motor Driver Circuit

d. PMDC Motors

A PMDC (Permanent Magnet DC) motor consists of a small DC motor, feedback potentiometer, gear box, motor drive electronic circuit and electronic feedback control loop. It is more or less similar to the normal DC motor. PMDC Motors is used to rotate regarding step angle. It divides full rotation into various equal steps.

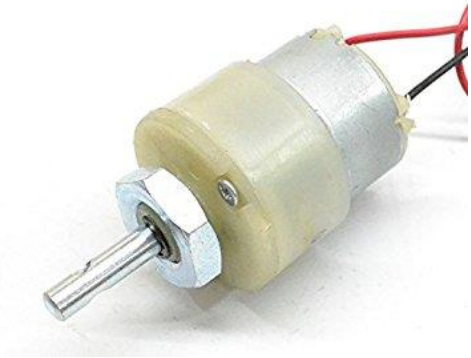

Figure.4: PMDC Motors

e. Relays

Relay is one of the most important electromechanical devices highly used in industrial applications specifically in automation. It is used for electronic to electrical interfacing i.e. it is used to switch on or off electrical circuits operating at high AC voltage using a low DC control voltage.

Figure.5: Relays

f. Arduino Uno

It is a microcontroller board based on the ATmega328P. Arduino is an open source prototyping

platform. Arduino has a 14 digits input-output pins, 6 analog inputs, 16MHz crystal oscillator, and USB connection. It contains everything needed to support the microcontroller, simply connect it to a computer with USB cable or power it with an AC to DC adapter or battery to get started.

Figure.6: Arduino UNO

g. SMF Battery

We are using 12V SMF (Sealed Maintenance Free) battery

Figure.7: SMF Battery

IV. PROPOSED SYSTEM

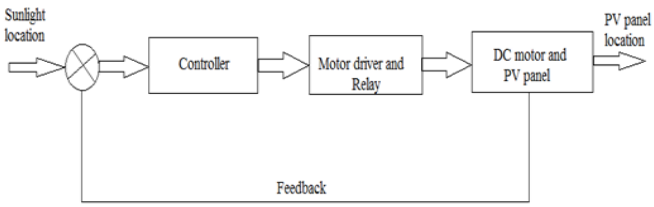

Figure.8 : Block Diagram of Dual Axis Solar Tracking

The block diagram of dual axis solar tracking system is illustrated in figure 8. The sensor based feedback controller consisting of the LDR sensors, differential amplifier, and comparator. In the tracking operation, the LDR sensor measures the sunlight intensity as a reference input signal. The unbalance in voltages generated by the LDR sensor is amplified and then generates a feedback error voltage. The error voltage is proportional to the difference between the sunlight location and PV panel location. At this time the comparator compares the error voltage with a specified threshold. If the comparator output goes high state, the motor driver and a relay are activated so as to rotate the dual axis tracking motor and bring the PV panel to face the sun. Accordingly, the feedback controller performs the virtual function PV panel and sun light are constantly monitored and send a differential control signal to drive the PV panel until the error voltage is less then a pre specified threshold value.

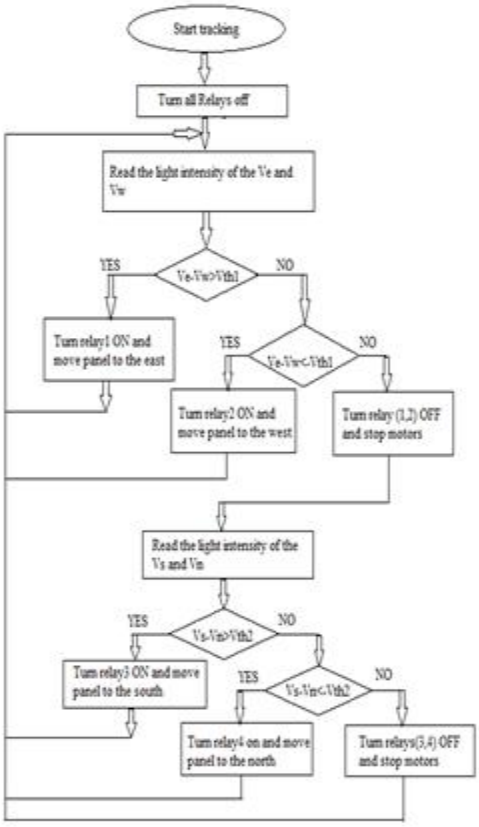

Figure. 9: flow chart algorithm

Figure.10: Connections of all the Circuits

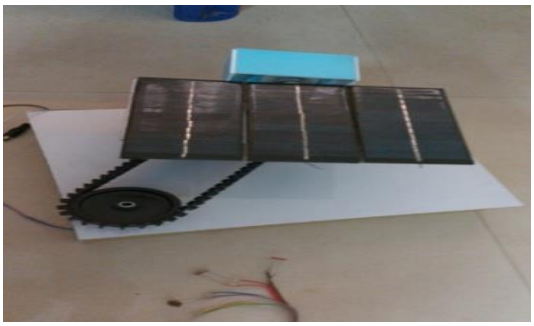

Figure.11: Connection of PMDC Motor to Solar Panel

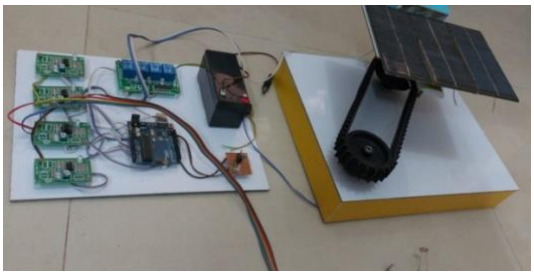

Figure.12: final outcome project model

V. RESULTS AND DISCUSSION

In this approach, when source light falls on the panel, the panel adjusts its position according to maximum intensity of light falling perpendicular to it. This was achieved through using light sensors that are able to detect the amount of sunlight that reaches the solar panel. The values obtained by the LDRs are compared and if there is any significant difference, the reactivation of the panel using a servomotor to the point where it is almost perpendicular to the rays of the sun. Maximum energy of sun is attained by the solar panel which makes it efficient approximately 40%. LDRs are used to track the sun positioning and motors are used to rotate the solar panel which makes sun beam to be in alignment with the panels.

This was achieved using a system with three stages. Each stage has its own role. The stages were;

1. An input stage that was responsible for converting incident light to a voltage.
2. A control stage that was responsible for controlling actuation and decision making.
3. A driver stage with the servomotor. It was responsible for actual movement of the panel.

VI.CONCLUSION

In this approach, the dual axis solar tracker tracks the position of sun and maximizes the solar power. As compared to single axis, dual axis system provides high abundant electrical energy output when compared to the fixed mount system. The dual axis solar tracker is having more efficiency. This system is simple, understandable and user friendly.

VII.REFERENCES

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