

Concentrated Solar Power Assist with Dual Axis Tracking System

Parag Gadkari, Niketan Gangade, Pramod Mishra, Aniket Palvekar, Mohit Titare

Guided By: - Ashish Dhunde

Department of Mechanical Engineering, Nagpur Institute of Technology, Nagpur-441501, Maharashtra, India

Abstract:- The energy crisis is always a big problem that the world's is facing today. From all other available resource sun energy is the most abundant and it's comparatively easy to convert it to electrical energy. Solar energy is very important means of expanding renewable energy resource. Since parabolic through collector is an important concentrated solar power technology, the aim of this paper is to present a solar energy collection technology by a concentrated solar power system. To present this efficient solar distributed generation system, a dual-axis solar tracker is designed. This system is able to track and follow the sunlight intensity in order to get maximum solar power at the output regardless motor speed.

Keyword:- Concentrated solar power, Sensors, Servo motor, Arduino board etc.

I. INTRODUCTION

The increasing demand of energy, the continuous reduction in existing sources of fossil fuels and the growing concern regarding environment pollution, have pushed mankind to explore new technologies for the production of electrical energy using clean, renewable sources, such as solar energy, wind energy etc.

Solar power is the conversion of sunlight into electricity, either directly using PV (photovoltaic), or indirectly using CSP (concentrated solar power). Concentrated solar power system use lenses or mirrors and tracking system to focus a large area of sunlight into a small beam.

Solar tracking is the most appropriate technology to enhance the electricity production of a CSP system. Solar tracking approaches two basic type one is single axis tracking system and another is dual axis tracking system. Here we are using dual axis tracking system. In dual axis mount where one axis is a vertical pivot and the second axis is the horizontal. By using combined of two axes, the CSP can always be pointed directly at the sun. So that the efficiency of the CSP always maintained at the maximum.

II. METHODOLOGY

A. Block Diagram

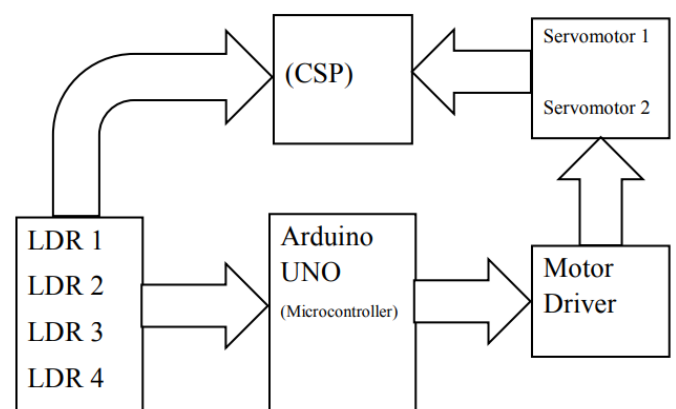


Fig. 1:- Block diagram of CSP tracking system using LDR, Motor Driver and a microcontroller

B. Hardware

The main components are

- Concentrated solar power (CSP)
- Sensor's (LDR)
- Servo motors
- Motor Driver
- Microcontroller (Arduino UNO)
- Concentrated Solar Power (CSP)

Concentrated solar power (CSP) technologies are getting more prominent than solar PV panels and wind power technologies. Concentrating solar power technologies (CSP) is used to generate heat or electricity. CSP application use lenses or mirror and tracking system to focus a big area of sunlight into a small beam. The concentrated light is then used as heat source for a conventional power plant.

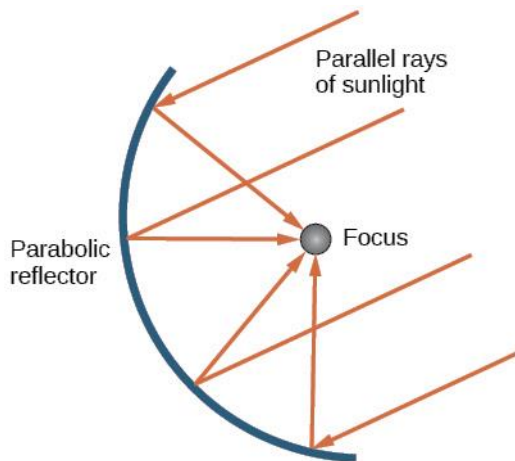


Fig. 2:- CSP system block diagram

• *Sensors*

Light dependent resistors is made of a high resistance semiconductor. A photo resistor or light dependent resistor is a component that is sensitive to light. When light falls upon it then the resistance changes. LDR's have low cost and simple in structure.

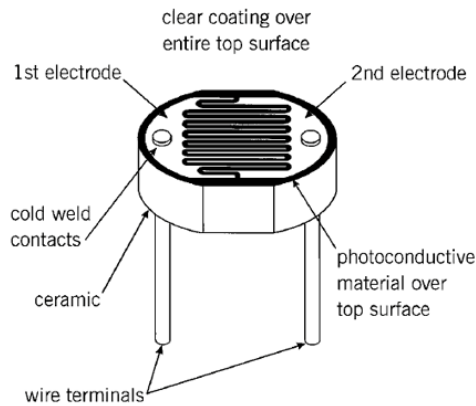


Fig. 3:- Light Dependent Resistor (LDR)

• *Servo motor*

DC motors have a very gradual acceleration and deceleration curves, therefore stabilization is slow. The only way to effectively use a DC motor for precise positioning is to use a servo. The function of servomotor is to receive a control signal that represents a desired output position of the servo shaft, and apply power to its DC motor until its shaft turns to that position.

• *Motor Driver*

L298N is a dual bridge motor driver, so with one motor driver board we can interface two DC motors which can be controlled in both clockwise and anticlockwise directions.

Features of IC L298N

1. Light weight, small dimensions
2. Super driver capacity
3. 600mA output current capability per channel
4. Motor direction indication LED
5. 4 standard mounting holes

• *Microcontroller*

The microcontroller used is Arduino UNO ATmega328P. Arduino is easy to use hardware and software. It has 14 digital input/output pins (of which 6 can be used as PWM output), 6 analog inputs, a 16MHz quartz crystal a USB connection, a power jack, an ICSP and a reset button. It can be programmed by many programming language.

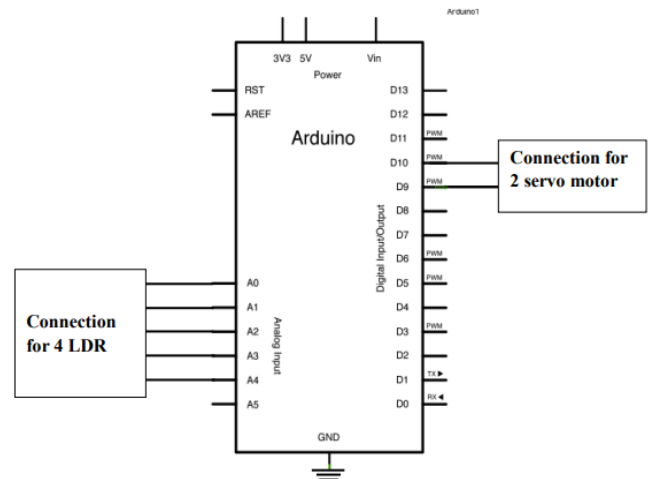


Fig. 4:- Arduino board connection

C. *Working*

The block diagram of the developed closed loop concentrated solar power tracking system describes the composition and interconnection of the system. For the closed loop tracking approaches, the solar tracking problem is how to cause the CSP to follow the sunlight as closely as possible.

The sensor based system consist of the four LDR sensor, comparator and microcontroller. In this tracking operation, the LDR sensor measure the sunlight intensity as a reference input signal. One pair sense the position of the sun in vertical axis i.e from the east and west side and other pair senses in the horizontal axis i.e from the north and south side.

A simple comparator circuit (voltage divider) is used to convert the changing value of LDR to analog voltage. After that the microcontroller is used to read the analog value of LDR's and convert it to digital via analog to digital converter that is embedded inside it. The microcontroller also is connected with motor driver (H-Bridge), to control the direction of the motor according of the LDR's readings. The microcontroller will read the analog output from the four LDR's and compare it together to decide if the motor will run CW, CCW or OFF. Thus, the design of a dual axis concentrated solar power tracking system is done and can obtain the energy from the sun very efficient.

- A simple and cost effective control implementation.
- Ability to balance the tracking accuracy.
- Applicable to moving platform with the sun tracker.
- The efficiency of dual axis solar tracking is more.
- It reduce the number of solar array to obtain the desired output power.

A variety of technologies for the solar energy are available on the market. But this tracking system which is based on dual axis has higher energy gain comparing with both fixed CSP and single axis solar tracking technologies and it is also very efficient.

REFERENCES

[1] V Sundara Siva Kumar and Suryanarayana, "Automatic Dual Axis Sun Tracking System using LDR Sensor"

[2] ShrishtiRana, "A study on automatic dual axis solar tracker system using 555 timer", International journal of technical research and application, volume 1, issue 4 (sep-oct2013) ISSN: 2320-8163

[3] CeydaAksoyTirmikci and CenkYavuz, "Comparison of solar tracker and application of sensor less dual axis solar tracker", Journal of energy and power engineering, issue June 30, 2015.

[4] SwarnavoDutta, Supantho Bhattacharya, Priyankaroy, "Artificial Intelligence based solar panel tilt angle optimization and its hardware implementation for efficiency enhancement", International Journal of Advance Research in electrical, electronics and instrumentation engineering, volume 1, Issue 10, Oct 2016 ISSN: 2278-8875

[5] Bipendra Kumar Bharti, Dilip Kumar, "Dual Axis Solar Tracking System", Imperial Journal of Interdisciplinary Research Volume 2, Issue 4 2016, ISSN: 2454-1362

[6] DivyaGnanarthnam, Sundarmurthy.S, Amitabh Wahi, "Design and implementation of a dual axis solar tracking system", International Journal for Research in applied science & engineering technology Volume 3, Issue X Oct 2015, ISSN: 2321-9653

[7] Geethumol P G, Askkar Ali P, "Design of a low cost dual axis tracking fresnel lens constructed solar pv system", International Journal on research innovation in engineering science and technology volume 2,issue 5, may 2017,

[8] V Sundara Siva Kumar, S Suryanaryana, " Automatic Dual Axis Sun tracking System using LDR Sensor", International Journal of Current Engineering and technology Volume 4, Issue 5 Oct 2014, ISSN: 2347-5161

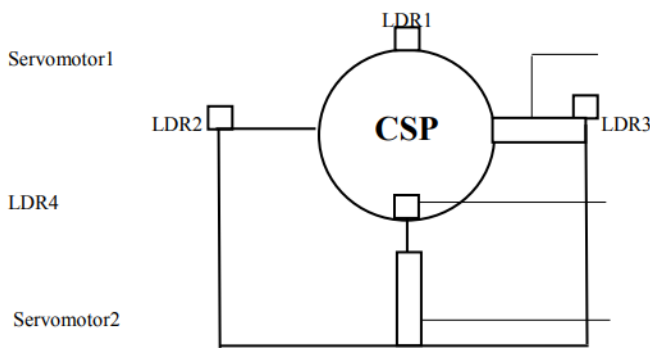


Fig. 5:-Basic diagram of dual axis solar radiation tracker

D. Advantages

- The conservation of non-renewable energy resources
- Lower amount of waste and pollution
- Offsetting greenhouse gases
- Limiting the use of conventional energy sources
- Universal application
- Generating efficiency
- Independent control

E. Limitations

- When there is cloudy atmosphere it is difficult to tracking the sun.
- Fixing arrangement of LDR at perpendicular to sun light is somewhat problematic
- LDRs are very sensitive elements and so may get damaged in extreme climatic conditions.

III. CONCLUSION

The empirical findings leads us to believe that the research work may provide some contribution to the development of solar energy application.

[9] Nader Barsoum, “Fabrication of dual axis solar tracking controller project”, Intelligence control and automation, 2011, 2, 57-68

[10] Mayank Kumar Lokhande, “Automatic Solar Tracking System”, International Journal of core engineering & management, Volume 1, Issue 7, Oct 2014, ISSN: 2348 9510.