Solar Tracking For Maximum Utilization Of Solar Energy

Lokesh M. Giripunje[1]

Gaurav Gholave[2], Kishori Ghorpade[3], Tejashri Akhade[4]

[1]*Assistant Professor, Department of Electronic and Telecommunication, DYPIEMR, Akurdi, Pune-44,*
[2,3,4] *BE Students, Department of Electronic and Telecommunication, DYPIEMR, Akurdi, Pune-44.*
Maharashtra, India

Abstract :- *This paper presents efficient solar tracking system. The solar panel is parabolic in shape and based on follows scheffler dish principle. Parabolic solar collector is made by using polished Al specular sheet material. Due to parabolic shape of dish, maximum area of solar panel is exposed to solar radiation.LDR and DC motor have been selected as driving mechanism of the system. In this project the one movement of panel / horizontal tracking (E-W) is done automatically and another movement (N-S)/vertical tracking is done manually. The system have increased efficiency and reduced cost so that it can be implemented mainly in rural area.*

Key Words: **solar tracker, LDR, Scheffler dish, DC motor**

INTRODUCTION :

The Global warming has increased the demand and request for green energy produced by renewable sources - like solar power. As India has tremendous scope of generating solar energy. Since majority of the population lives in rural areas, as 72% population living in villages and half of the villages remain without electricity so there is much scope for solar energy being promoted in this area. It's high time, that we should concentrate more on energy efficiency, conservation and renewable energy for that the solar tracking should be effective .There are two main ways to make the solar cells more efficient, either by improving the actual cell or by installing the solar panels on a tracking system that follows the sun [1]. Solar tracker is an automated solar panel that actually follows the Sun to increase the power. The sun's position in the sky varies both with equipment over any fixed position [2]. The solar panels must be perpendicular to the sun's rays for maximum energy generation. Deviating from this optimum angle will decrease the efficiency of energy generation from

the panels [3]. LDR or light dependent resistor has been chosen as the sensor because LDR is commonly used in sun tracking system. This is because LDR is sensitive to the light. The resistance of LDR will decreases with increasing incident light intensity.

To rotate the appropriate position of the panel, a DC geared motor is used. The system is controlled by DC-geared motor driver and a microcontroller as a main processor [2].

A microcontroller adjust the structure position (inclination and direction) according to information gathered by sensors, and thuscontrolling the motor. By using this technique, the system have good accuracy[4].

SURVEY:

J.Rizk,et.al.[1],Presents "Light sensor for Solar Trackers, a way in which the efficiency of solar power collection can be increased. It is to increase the efficiency of solar power conversion by increasing the amount of time that the solar panel is directly perpendicular to the sunlight. Efficiency is based on accurately positioning the solar panel throughout the day and thus stepper motors and Light Dependent Resistors (LDR) have been selected as the primary driving mechanism of this system .

In [8] Chih-Wei Chien1,et.al.Presentsa new micro-concentrator architecture based on origami concentrators is proposed for plate-plate photovoltaic applications to potentially lower the cost of electricity. The fabrication of the concentrators adopts the origami technique, allowing the use of thin-film processing technologies. The concentrators are lightweight, flexible, and requiring only aonedimensional translational motion for solar tracking.

Mayank Kumar Lokhande,[2]Presents The main objective of this project is to development of an automatic solar tracking system whereby the system will caused solar panels will keep aligned with the Sunlight in order to maximize in harvesting solar power. The system focuses on the controller design whereby it will caused the system is able to tracks the maximum intensity of Sunlight is hit.

In[9] A Two-Axis Soft Robotic Platform for Solar Tracking and Building-Integrated Photovoltaic Applications. This paper present SoRo-Track, a two-axis soft robotic actuator (SRA) for solar tracking and building-integrated photovoltaic applications. SRAs are gaining increasing popularity comparedto traditional actuators, such as dc motors and hydraulic or pneumatic pistons, due to their inherent compliance, low morphological complexity, high power-to-weight ratio, resilience to external shocks and adverse environmental conditions, design flexibility,ease of fabrication ,and low cost.

In [7] Emmanuel B.Balogun1,et.al. Presents a robust real-time online solar photovoltaic monitoring system is carefully designed for the solar photovoltaic energy industry via cloud computing technology broadcasting instant and exact energy harvested from installed solar photovoltaic modules onsite. Remote monitoring for both the stationary positioned and hybrid solar photovoltaic tracking modules is achieved via the web on mobiles, tablets, PCs and notebooks through installed applications. The introduction of these robust adaptive devices have significantly increased the optimisation, performance and the high concentration of energy harvested in hybrid solar photovoltaic tracking system based on the developed tracking movement models.

In[11] The paper named"Photovoltaic energy for the fixed and tracking system based on the modeling of solar radiation."PresentsThe objective of this is to estimate the photovoltaic energy on inclined panels for a given site. Its characterization is based on measurements carried out on horizontal plane. A comparison of different models of the diffused radiation released with respect to the monthly and annual energy balance is presented. An optimization of the inclination angle (tilt angle) by maximizing the annual photovoltaic energy is proposed.Unfortunately, these systems have a cost, use energy to move the panels.

In[6]Ra´ulGregor,et.al. Presentson one hand, a novel design of a biaxial solar tracking system (azimuth and elevation angle) for PV power application and on the other, the set-up of the control systemfocused on increasing the efficiency of the PV generation system across the implementing of a digital Proportional-Integral-Derivative (PID) position control scheme to achieve the maximum power point tracking(MPPT),ensuring the maximum energy available from the photovoltaic panels.

PROPOSED WORK:-

The primary task of this project is to build an actual solar panel mount with a sun-tracking system to be installed outdoors.Based on the background information of the various types of solar trackers, it has been decided that active tracking with a dual-axis set-up will be used. The reason for this choice is active tracking is a fairly effective method to track the sun and a dual-axis tracking system has the capability of increasing the yield of electrical energy output from the solar panels.

For the purpose of clarity, the east-west of the tracker will be called the "horizontal tracking" while the angular height tracker will be referred to as "vertical tracking".

An active,which consists of the sensor system to determine the position of the sun and a control system which reads data from the sensors to command the movement of the tracker. The sensor system consists of two sensors: one to deter-mine the position of the sun in the sky and another to determine the position of the sun's movement from east to west. Each sensor consists of two Cadmium Sulphate(CdS) light dependant resistors (LDRs).

The LDRs were placed as shown in **Figure 1**; a shadow will fall on one of the LDRs when the sensor is not pointing directly towards the sun resulting in difference of the level of resistance between the two LDRs. This difference will be detected by the microchip in the control system and will move the tracker accordingly so that both LDRs are pointing towards the sun.

To decide how the tracker would move, it is important to consider the movement of the sun in the sky throughout the year. The sun path diagram of **Figure 2** shows the annual variation of the path of the sun in Pune,India.From the sun path diagram, the movement of the sun

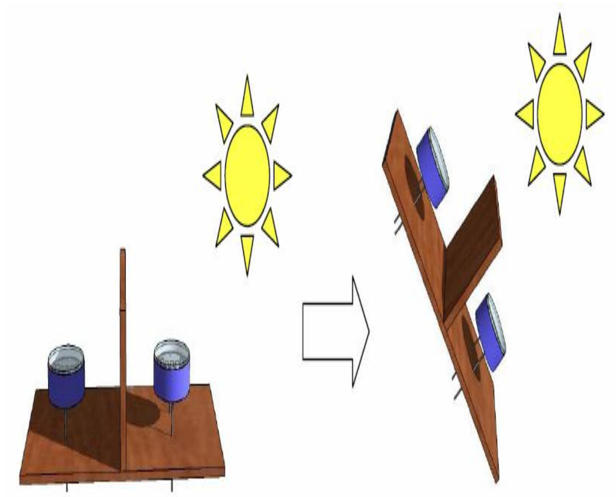

Figure 1. Sensor response once a shadow is cast on one LDR

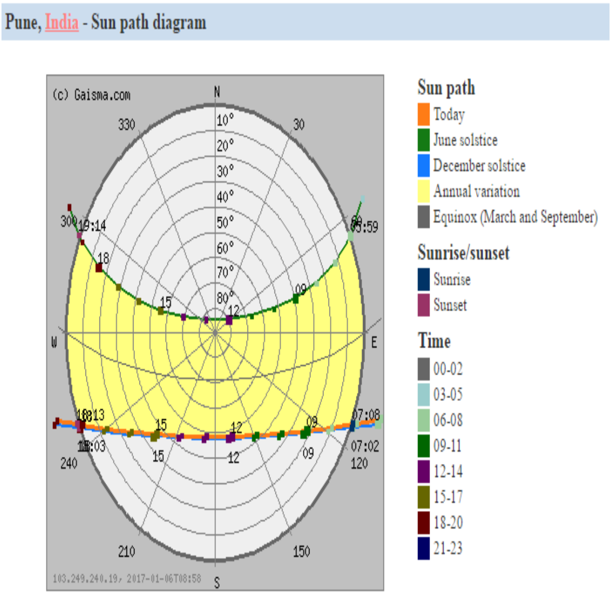

Figure 2. Sun Path In Pune

in the sky throughout the year in Pune can be divided into three different scenarios. As the sun rises from the East to sets to the West, the sun path may move in the Southern or Northern region, or it may move almost directly overhead. limit switches are added to the system. When the limit switch is triggered at the end of the day, the tracker will move back to its original position.

Scheffler-Type Solar Concentrator (STSC)

The use of solar concentration with a fixed absorber can improve and facilitate the development of distributed power generation technology using a Scheffler-type solar concentrator STSC, It involves the interception of the open circular area with a small side section of a parabola, and a reflector in the form of such a section directs the solar radiation to a fixed focal point, The system uses a dual-axis tracking system, which consists of a daily tracking mechanism that moves the reflector mounted on a carriage in proportion to the solar motion and other time-tracking mechanisms,which provides for rotation of the reflector that is synchronised with the movement of the sun during the day. This angular movement of the reflector is performed around an axis oriented to maintain a fixed focal point normal to the incidence for the area of the aperture for the reflector[6].

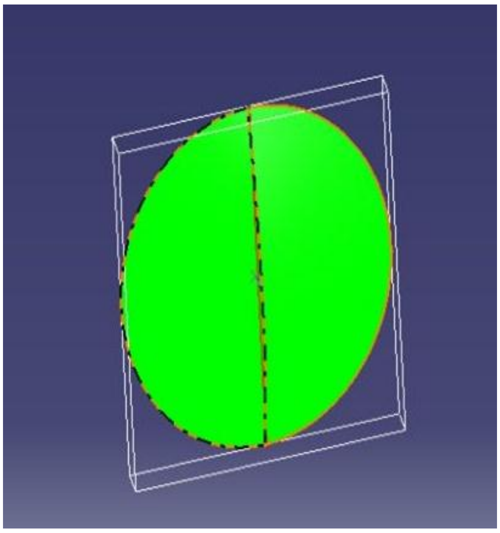

Figure 3.Scheffler-Type Solar Concentrator (STSC)

HARDWARE SPECIFICATION:-

LDR:-

- Wide spectral response.
- Low cost.
- Wide abient temperature range.

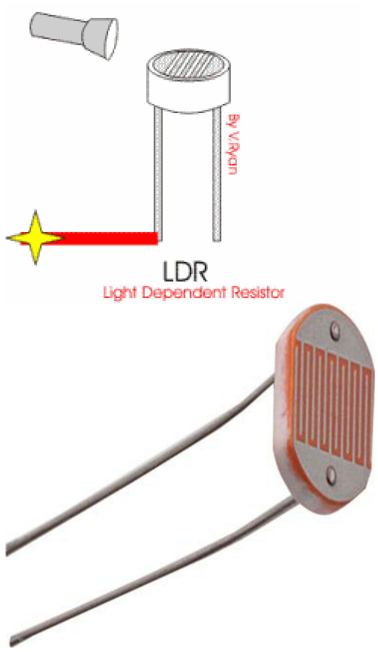

Figure 4. LDR

Microcontroller:-

Specifications:

The PIC16F877A features are 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I^2C™) bus and a Universal Asynchronous Receiver Transmitter (USART).

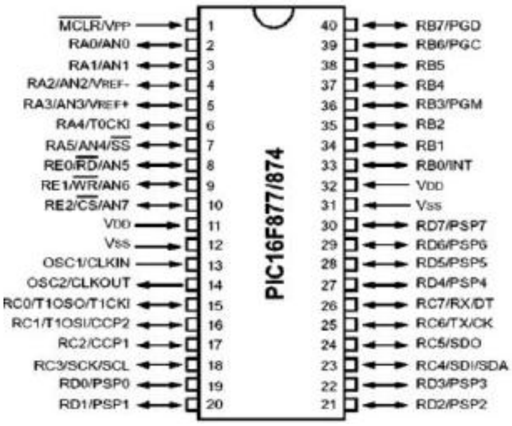

Figure 4. PIC16F877

DC Motor:-

Specifications:

- DC supply: 4 to 12V
- RPM: 30 at 12V
- No Load Curent: 50mA at 12V
- Load Current = 300mA(max) at 12V
- Torque: 5kg-cm at 12V
- Total length: 46mm
- Shaft length: 22mm
- Gear assembly: Spur
- Gear head diameter: 37mm
- Motor diameter: 36mm
- Motor length: 25mm
- Brush type: Precious metal
- Output shaft: Centred
- Shaft diameter: 6mm

Figure 5. DC Geared Motor

Driver IC L293d:-

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.

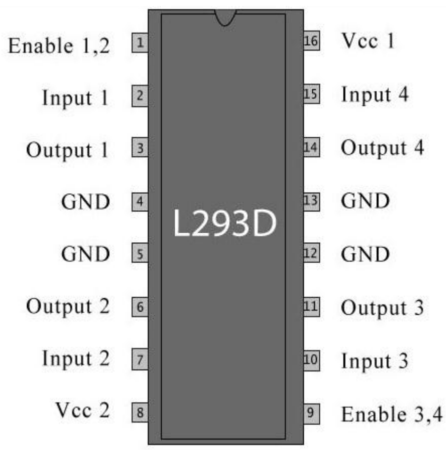

Figure 6. Motor Driver IC L293d

OPERATION OF THE SOLAR TRACKER:-

The operation of the solar tracker is easy to understand, it works by using a PIC16F877A which compares the ADC values which proportional to light intensity illuminated onto the LDRs in each sensor module. PIC16F877A have ADC modules to get digital values. Each LDR have bridge circuit produce analog voltage which proportional to light intensity. That analog voltage connected to the ADC module of Microcontroller. The logic that works on the Microcontroller to get the analog values as inputs and compare two analogue values form LDRs belongs to each sensor and find which LDR is under shadow. Then rotate motors which belongs to each sensor until minimize the difference between two ADC values with an error margin of ±5 points. Simultaneously two motors are rotate according to minimize the difference between two ADC values.

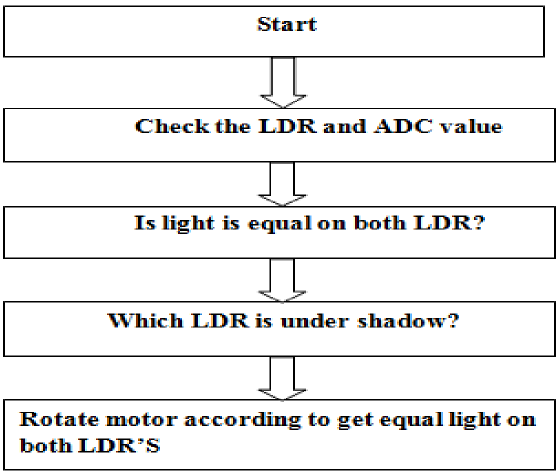

Figure 7. flow chart

In the figure ,if one of the sensors comes under a shadow, then the PIC will detect this change through ADC values and thus it will actuate the motor to move the sensor module to a position where equal light is being illuminated on both of them

The PIC is programmed so that it can obtain analog voltages which proportional to light intensity from the each bridge circuit of LDRs and to move motor either clock wise or anti clock wise depending on which LDR is under shadow. The basic concept of the software design is illustrated in the below flowchart

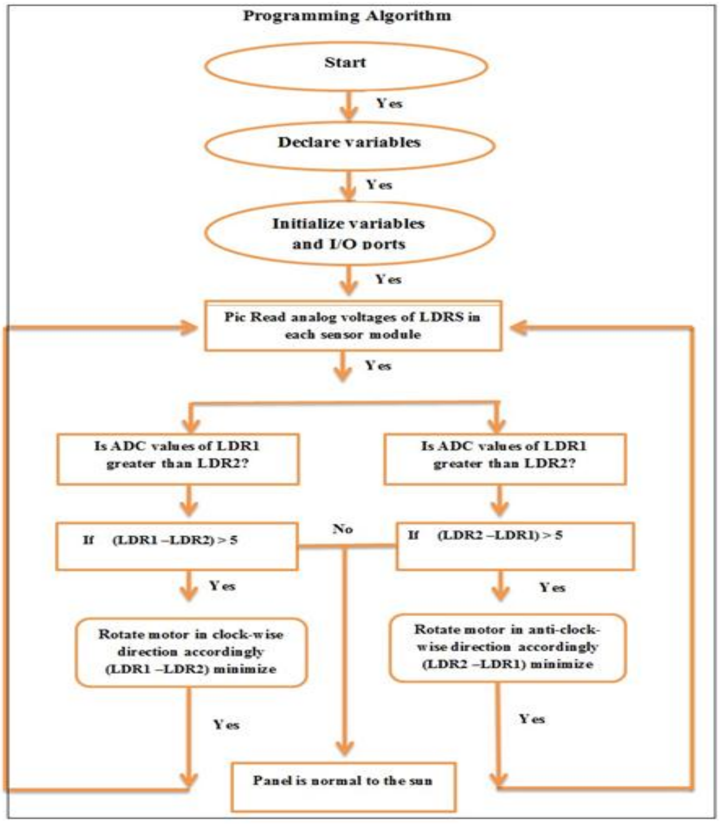

Figure8: Flowchart

CONCLUSIONS:-

Renewable energy solutions are becoming increasingly popular. So that we are trying to develop a solar tracker system which will able to track and follow Sunlight intensity in order to collect maximum solar power regardless of motor speed. The constructed system model can be applied in the residential area for alternative electricity generation especially for non-critical and low power appliances.

ACKNOWLEDGEMENT :-

We have taken efforts in this project. However, it would not have been possible without the kind support and help of many individuals and organizations. We would like to extend our sincere thanks to all of them. We are highly indebted to **Mr. Kiran Nawathe(P.R.E.M.Industry,Pune)** for their guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project.

REFERENCES:-

[1]J.Rizk,A.Hellany,M.Nagrial,"Light sensor for Solar Trackers" recent researches in environment, energy planning and pollution.

[2] Mayank Kumar Lokhande," Automatic Solar Tracking System"International Journal Of Core Engineering & Management (IJCEM) Volume 1, Issue 7, October 2014

[3] ShrishtiRana ," A Study On Automatic Dual Axis Solar Tracker System Using 555 Timer " International Journal of Technical Research and Applications e-ISSN: 2320-8163, www.ijtra.com Volume 1, Issue 4 (sept-oct 2013).

[4] Francisco Duarte1, Pedro Dinis Gaspar1 and LuísCarrilho Gonçalves1,"Two axis solar tracker based on solar maps, controlled by a low-power microcontroller" Electromechanical Engineering Department – Engineering Faculty University of Beira Interior Edifício 1 das Engenharias, Calçada do Lameiro, 6201-001 Covilhã (Portugal).

[5] Nader Barsoum, " Fabrication of Dual-Axis Solar Tracking Controller Project",*Curtin University*, *Sarawak*, *Malaysia Received January* 28, 2011; *revised March* 21, 2011; *accepted March* 24, 2011.

[6]Ra´ulGregor, YoshihicoTakase, Jorge Rodas "A Novel Design and Automation of a Biaxial Solar Tracking System for PV Power Applications"

[7] Emmanuel B.Balogun1, Xu Huang2, Yun-Chuan Lin4, MingyuLiao5 "A robust real-time online comparative monitoring of an azimuthal-altitude dual axis GST 300 and a 450 fixed solar photovoltaic energy tracking systems"

[8] Chih-Wei Chien1, Kyusang Lee1, "Flat-Plate Photovoltaics with Solar-Tracking Origami Micro-Concentrator Arrays" University of Michigan, Ann Arbor, Michigan, USA.

[9] Bratislav Svetozarevic1, Zolt´an Nagy1, "SoRo-Track: A Two-Axis Soft Robotic Platform for Solar Tracking and Building-Integrated Photovoltaic Applications"

[10] Joshua Morse,* Mark Campanelli,† and Keith Emery†, "Sensitivity of Concentrating Photovoltaics to Solar Tracking Error" *University of Rochester, Rochester, New York, 14627, USA.

[11] A. Bouabdallah, s. Bourguet, J.C. Olivier, "Photovoltaic energy for the fixed and tracking system based on the modeling of solar radiation" Universite, IREENA St-Nazaire, France.