Abstract: This paper presents an efficient solar tracking system. The solar panel is parabolic in shape and based on the Scheffler dish principle. Parabolic solar collectors are 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 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 thus controlling the motor. By using this technique, the system have good accuracy [4].

SURVEY:

In [8] Chih-Wei Chien1 et al. presented the origami 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 one-dimensional translational motion for solar tracking.

Mayank Kumar Lokhande [2] presented the main objective of this project is to development of an automatic solar tracking system whereby the system will cause 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 compared to 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.” Presents The 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] Raúl Gregor, et.al. Presents on 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 system focused 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 determine 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
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].

**HARDWARE SPECIFICATION:-**

**LDR:-**

- Wide spectral response.
- Low cost.
- Wide ambient temperature range.
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 (I²C™) bus and a Universal Asynchronous Receiver Transmitter (USART).

DC Motor: -
Specifications:
- DC supply: 4 to 12V
- RPM: 30 at 12V
- No Load Current: 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

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.
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.

![Flowchart](attachment:flowchart.png)

**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.

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:


[4] Francisco Duarte1, Pedro Dinis Gaspar1 and Luís Carrilho 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).


[7] Emmanuel B. Balogun1, Xu Huang2, Yun-Chuan Lin4, Mingyu Liao5 “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.


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