# FABRICATION OF SOLAR PANELWITH SUN POSITION TRACKING SYSTEM

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**Abstract**

*This project proposes an algorithm for detection of the position of the sun and implementation of this control algorithm on a single axis solar tracking system. The tracker consists of a photovoltaic panel and moves its surface approximately to the right angle to the sun to obtain maximum possible photon energy and convert it to electrical energy. Solar power is one of the most modern sources of renewable energy. Energy from sun is unlimited. But the main challenge remains in maximizing the amount of energy in an efficient manner in order to capture the rays from the sun for converting energy directly to electricity. One way to increase efficiency is by implementing a solar tracking system for solar panels. This is done so that the rays from the sun fall perpendicularly on the solar panel and thus ensures the capture of maximum available solar energy. The tracker periodically follows the path of the sun throughout the daytime in such a way that the panel surface is always faced to the sun. All the works of solar tracking system performed up to these days are based on almost the same theory of position sensing. Traditionally, tracking is performed by use of various types of sensors that detects position of sun. This project paper proposes a unique solar tracking algorithm instead of traditional algorithm. Unlike the use of photo-conductors, light detecting resistors, photo-transistors or photodiode, those cannot operate independently and requires voltage biasing this new type of sensing algorithm is based on generated voltage in solar panel. The solar panel generates voltage as rays of light fall on it. The generated voltage varies with the change in incident angle of light. Thus the path of sun is detected by detecting the relative change in solar. incidence angle. Also, the thesis suggests use of low power microprocessor (such as, ATmega32) to maintain the overall operation. Hence the proposed design simplifies the operation of solar tracking and reduce operation and maintenance cost.*

## Introduction

From many centuries, sun has been the primary source of energy for the globe. Technically, solar energy can be defined as Electromagnetic energy transmitted from the sun (solar radiation). The amount of energy that reaches the earth is equal to one billionth of total solar energy generated. But is that small? No. The amount of energy which strikes the surface of the earth in one day exceeds daily consumption by 10,000 to 15,000 times. In other words, the amount of solar energy intercepted by the earth every minute is greater than the amount of energy the world uses in fossil fuels each year. Moreover, of all the renewable energy sources available, solar energy has the smallest environmental impacts. Electricity produced from photovoltaic cells does not result in air or water pollution, deplete natural resources, or endanger animal or human health. In spite of these benefits, man is not able to use this energy completely and economically. Two billion people in the world still have no access to electricity. For most of them, solar energy would be their cheapest electricity source, but they cannot afford it. This is because the price of electricity produced from solar cells is still significantly more expensive than it is from fossil fuels like coal and oil. This is because of cost involved in converting the solar energy into required form of electrical energy and low efficiency of solar system i.e., the output from the solar system is not completely sufficient for our needs.

**Solar Irradiance**

Solar irradiance is the measure of the power density of sunlight. Its unit is W/m2 and is an instantaneous quantity. The irradiance received by the earth from solar radiation is 1367 W/m2 . After getting absorbed by atmosphere, as it passes through it, the radiation becomes 1000 W/m2 at surface. Solar radiation is affects the solar cell output performance and so it is a very important factor in this field. Sunlight consist energy which has wavelengths with in a wide range of electromagnetic wave spectrum. But no solar cell can absorb energy from the whole spectrum. A solar cell is mainly designed for absorption of a portion of the total radiation spectrum. Experiment has shown that a large amount of irradiance spectral is available in the visible spectrum from 390nm to 700nm which stands in the opposition of the ultraviolet (less than 390nm) and infrared light (greater 750nm).

**Solar Tracker**

A Solar tracker is a device that keeps track of the sun. It follows the path of the sun throughout daytime with the help of sensors. Since the sun's position in the sky changes with time and the altitude angle and azimuth angle varies continuously, solar trackers are used to align the energy collecting system. Solar trackers are used for solar panels in solar power plants where energy generation is desirable up to maximum limit. So, in solar tracking systems, solar panels are mounted on a structure which moves to track the movement of the sun throughout the day. Concentration of heat energy by optical devices (mirror, prism and lens) also requires solar tracking.

**Types of Solar Tracker**

Solar tracking system is classified by its degrees of rotation. According to degrees of rotation trackers can be grouped into two primary categories

- Single Axis Solar Tracker
- Dual Axis Solar Tracker

**Single Axis Solar Tracker**

A single axis solar tracker follows the movement of sun either horizontally or vertically. As the name suggests, this type of tracker has only one axis for rotation. The horizontal type solar tracker is used in tropical regions where the sun gets very high at noon, but the days are short. On the other hand, the vertical type solar tracker is used in areas with high latitudes where the sun does not get very high, but summer days can be very long. In concentrated solar power applications, single axis trackers are used with parabolic and linear Fresnel mirror designs.

**Dual Axis Solar Tracker**

A dual axis solar tracker has two degrees of rotation. It can track sun both horizontally and vertically. This type of tracker can be used anywhere in the world and ensures maximum efficiency in gaining solar energy. Concentrated Solar Power (CSP) applications using dual axis tracking include solar power towers and dish systems. Dual axis tracking is extremely important in solar power tower applications because the angle error is crucial for longer distances between the mirror and the central receiver located in the tower structure. Design for dual axis tracking system is complex than single axis tracking and operation is more energy consuming. However, for large scale solar energy production dual axis tracking is more economic.

**Design of a Low-Cost Parabolic Concentrator Solar Tracking System Tubular Solar Still Application**

Alhadri et al developed a simple and low-cost solar tracking system for parabolic concentrator (PCST) assisting tubular solar still (TSS). A single-axis solar tracking mechanism is developed based on two small light-dependent resistors (LDRs) shielded by a blank sheet which keeps the two cells shielded from sunlight. When the sunlight moves, one of the two LDRs will gain some light activating a switch to turn on the driving motor moving the system in the opposite direction till the LDR shielded again. By this simple mechanism, the two LDRs are shielded from sunlight all the time and consequently, the solar collector is always facing the sunlight. A simple parametric study is also conducted for an efficient PCST-TSS device with higher freshwater productivity. The performance of the most promising five design categories is compared. Results showed that the lowest cost tracking system was 34.6% lower than the highest one. Moreover, the lowest CPL was $0.0074/L which is 43.1% lower than the highest CPL category.

**Results and Discussion**

**Panel Unit**

The sensor unit consists of a 5 Watts monocrystalline photo voltaic panel. The panel generate voltage as light is incident on it. A small portion of the generated voltage can be measured by a microcontroller. Using these measurements and running the analysis tracking of sun is possible. The specification of this solar panel is

- Maximum Power Output 5W
- Open Circuit Voltage 10.8V
- Short Circuit Current 0.68A
- Voltage at MPP 8.6V
- Current at MPP 0.58A
- Cell Type Mono Crystalline

This type of sensor can be used with the solar tracker can be used in solar based power plant, where the tracker, placed at a position, tracks the sun and conveys the data of required rotation to the solar panels of the plant and then all the panels are oriented to the specified direction. For a single solar panel, the sensor panel can be attached to the main panel along with tracking mechanism. The most important advantage of 16 using this type of sensing algorithm is that unlike traditional photo-sensors such as- LDR, photo-transistors or photo-diode, it does not require additional biasing circuitry with external voltage [6]. Rather, it is independent of any external circuit and device. Thus, energy wastage can be saved to a large extent.

**Motor Unit**

The variable reluctance stepper motor is preferred for solar tracker design due to its micro-stepping facility. The solar tracker designed here can rotate by 7.5° per step if pulses for half stepping are applied. The pulse sequence for CCW rotation is 1, 1-2, 2, 2-3, 3 and 3-1. Repetition of the same sequence continues the rotation. Reversion is also possible by reversing the controller pulse sequence. The motor must deliver sufficient torque to withstand the maximum wind speed and the weight of the structure. Hence torque calculation for the motor is performed. To calculate the torque required to withstand the wind velocity a maximum velocity of 49.71Mph (80km/h) is considered. The weight of the panel is 1.3 kg and the structure supporting the panel weighs about 4.7 kg. Hence, the proposed model weighs 6kg.

- Surface area of the panel, A = 0.0621m2
- Wind pressure, P = 0.00256 × 49.712 Psf =30.865kg/m2
- Drag coefficient, Cd = 2.0 for flat panel
- Force due to wind, Fw = A × P × Cd = 37.57N
- Gravitational force Fg = 6 × 9.8N = 58.8N
- The radius of the base structure is, r = 0.0127m
- Torque required, T= (Fw + Fg) × r = 12.5 kg-cm

**Existing System**

There are three methods of solar tracking.

- Active Tracking
- Passive Tracking
- Chronological Tracking
- Active Tracking

The position of the sun is continuously determined by the sensors during the day. The sensor triggers the motion of motor or actuator in such a way so that the solar panel will always face the sun throughout the day. Active tracking is accurate with the help of sensors. But the main problem occurs when the sensors fail to discriminate between the measurements.

**Working Principle**

Power supply gives supply to all components. It is used to convert AC voltage into DC voltage. Transformer used to convert 230V into 12V AC.12V AC is given to diode. Diode range is 1N4007, which is used to convert AC voltage into DC voltage. AC capacitor used to charge AC 23 components and discharge on ground. LM 7805 regulator is used to maintain voltage as constant. Then signal will be given to next capacitor, which is used to filter unwanted AC component. Load will be LED and resister. LED voltage is 1. 75V.if voltage is above level beyond the limit, and then it will be dropped on resister. In this project we use 89C51 controller. LDR is connected to controller port 3(p1.2). Switches are connected to controller port 1 and 2. Driver we use ULN2003 is connected to controller port 2.1 and 2.2. Relay is connected to driver port 15 & 16. It is used to control the motor. Motor is connected to relay. LCD is also interfaced to controller. It is used to display the short messages.

**Conclusion**

A solar tracking system, comprising: a first set of solar heat gain transducers that produce respective first electrical output signals to drive a reversible first motor for changing a vertical angle of a solar collector; a second set of solar heat gain transducers that produce respective second electrical output signals to drive a reversible second motor for changing a horizontal angle of the solar collector; each of the transducers having a thermistors in thermal contact with a thermal mass, where in the thermal mass comprises a mass of conducting material to elevate in temperature while illuminated by the sun, and wherein the thermistors senses the temperature of the thermal mass and produces a corresponding one of the electrical output signals proportional to the temperature; and each of the transducers having the thermistors and the thermal mass contained in a solar energy collecting and heat insulating enclosure that is solar energy transparent..

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