A PROTOTYPE FOR A REAL TIME CLOCK BASED SOLAR TRACKING SYSTEM

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Abstract

Renewable Energy is making a noticeable impact especially in the lives of rural masses. Simultaneously however, its utilization for both urban and semi-urban applications is also developing day to day. The power created in such applications relies on the amount of solar energy captured by the solar panel, and accordingly the issue of building up the tracking plans is capable of the accompanying trajectory of the sun over the span of the day on a year. Maximizing power yield from a solar framework is desirable to increase efficiency. Keeping in mind the end goal to maximize power yield from solar panels, we have to track the maximum power point of the panel. Maximum power point tracking is required. In our project we are utilizing Dual axis tracking and Incremental conductance MPPT algorithm. This is more savvy arrangement than purchasing additional solar panels to create maximum power. In our project, a prototype for a Real Time Clock based solar tracking framework is portrayed, which will keep the panels aligned with the sun to give maximum efficiency.

Keywords: Sun Tracking, Maximum Power Point Tracking, Single axis tracking, Dual axis, Incremental conductance.

I. INTRODUCTION

Photovoltaic or Solar cells are semiconductor diodes that change over available sunlight into electrical power. Semiconductor is P-N intersection photodiodes with large light-delicate area. Each photodiode is a solar cell. All these solar cells are associated in a module to form a solar panel. These solar panels are cascaded together to form arrays to generate high power electricity. To attain the maximum advantage from these solar panels, we have to position them toward the path that captures the vast majority of the energy. Therefore this course relies on various factors. The solar panels are mounted at a settled tilt, but since the sun continues changing its situation because of the rotation as well as the unrest of earth, these solar panels can capture more energy if their tilt is adjusted periodically. There are three ways to increase the efficiency of a photovoltaic framework. The first is to increase the efficiency of the solar cell. The second is to increase the efficiency of a photovoltaic framework by utilizing a solar panel tracking. Third technique is to maximize the energy change from the solar panel utilizing MPPT. As the sun moves across the sky amid the day time, it is advantageous to have the solar panels track the situation of the sun, with the end goal that the solar panels are always perpendicular to the solar energy radiated by the sun. This will tend to give maximum amount of power radiated by the sun. It has been estimated that the utilization of a sun tracking framework, over a settled framework, can increase the power yield by30% - 60%. So, in order to maximize a photovoltaic system's yield power, consistently tracking the maximum power point (MPP) of the framework is necessary. The MPPT relies upon irradiance condition, the panel's temperature, and the load associated. Maximum Power Point tracking algorithms give the theoretical means to get the MPP of solar panels; these algorithms can be realized in many diverse forms of software and hardware. PV frameworks that lack MPPT rarely operate at the most effective MPP. This is the reason the rated power of the panel is almost never realized while associating a load. The goal of this project is to rapidly create, develop, and test a working answer for the MPP problem with a constrained budget.

II. BLOCK DIAGRAM ANDDESCRIPTION

A. BlockDiagram

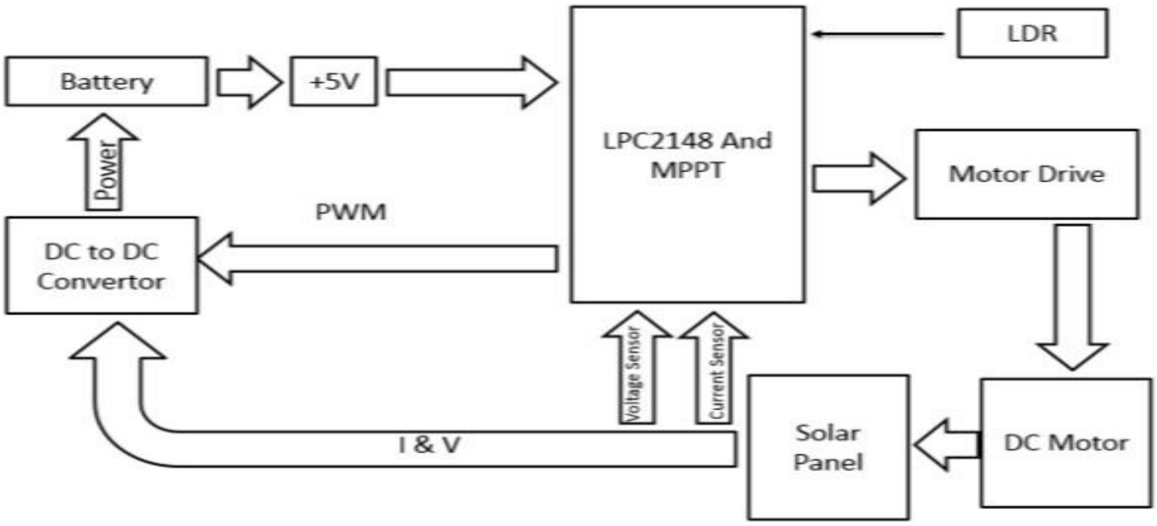


Fig 1 Blockdiagram

B. Maximum Power Point Tracking(MPPT):

At the point when a solar Photovoltaic module is utilized as a part of a system, its operating point is chosen by the load to which it is associated. Also, since solar radiation falling on a Photovoltaic module varies for the duration of the day, the operating points of module also change for the duration of the day. As an example, the operating point of a PV module and a resistive load for 12 twelve, 10am and 8 am is schematically appeared in fig. beneath meant by a, b and c. Ideally, under all operating condition, we might want to transfer maximum power from a Photovoltaic module to the load. In fig the trajectory of a point at which the solar PV module will give maximum power is also appeared. Accordingly, for maximum power transfer, instead of operating at point a, b and c the module ought to operate at point a', b' and c'. Keeping in mind the end goal to guarantee the operation of PV modules for maximum power transfer, a special technique is called as Maximum Power Point Tracking is utilized in Photovoltaic systems.

MPPT is electronic systems that operate the PV modules in a manner that allows the modules to deliver all the capable power. Maximum Power Point Tracking isn't a mechanical tracking system that physically moves the panel to make them point all the more specifically toward the sun. Maximum Power Point Tracking is a completely rely upon electronic system that varies the electrical working point of the modules so the modules are able to give maximum available power. Additional power harvested from the module is then made available to increase the battery charge current. MPPT can be utilized as a part of combination with a mechanical tracking system, however the two systems are totally extraordinary.

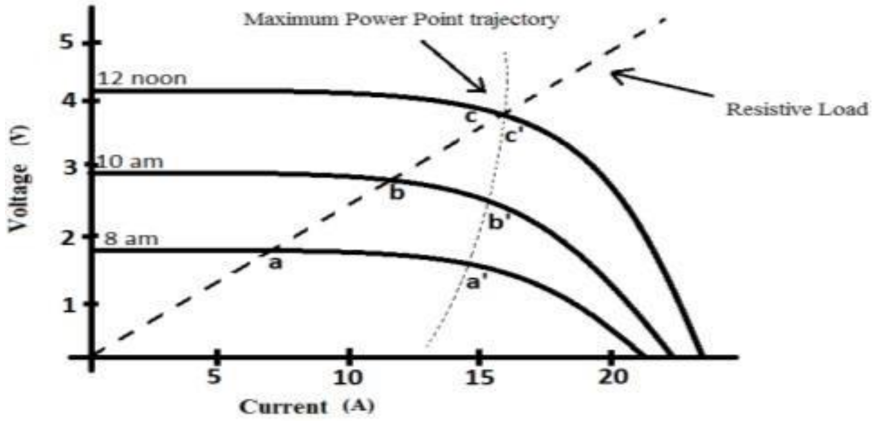


Fig 2 Current vs. Voltage MPPT graph

The maximum power tracking strategy makes utilization of an algorithm and an electronic circuitry. The technique is based on the control of impedance matching amongst load and PV module, which is necessary for maximum power transfer. This impedance matching is finished by utilizing a DC to DC converter. Utilizing chopper, by changing the Duty cycle (D) of the switch the impedance is matched. Square diagram of MPPT is demonstrated as follows.

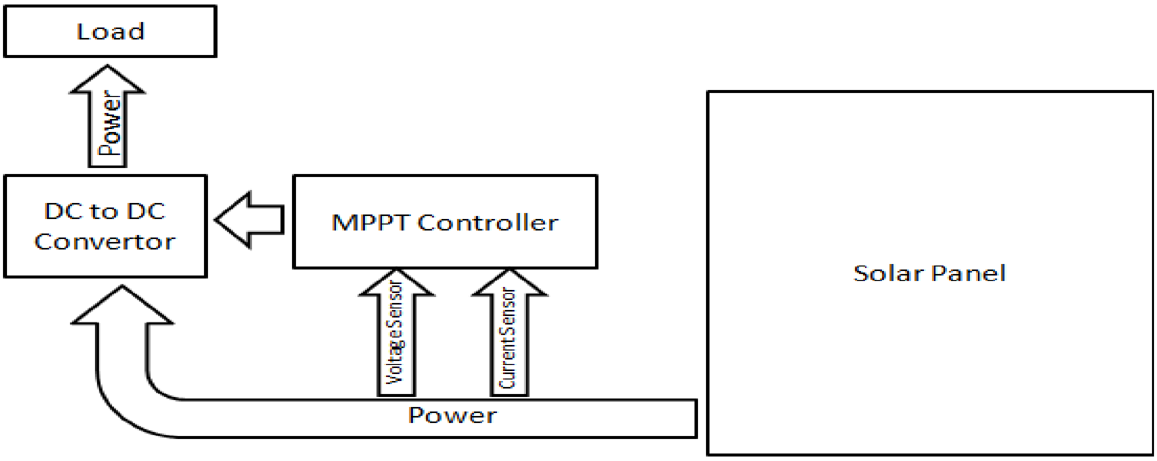


Fig.3 Block diagram of MPPT

The power from the solar module is planned by measuring the voltage and current. The duty cycle is adjusts by this voltage and current which is a contribution to the algorithm, resultant in the adjustment of the load impedance accordingly to the power yield of PV module. For instance, the related between the information voltage and the yield voltage and impedance of load reflected at the information side of a buck write DC to DC converter can be given as

Vo = Vi x D Rin = RL/D2

Here D is the duty cycle, Rin is the reflected at the input side, Vo is output voltage, Vi is input voltage.

MPPT Control Algorithm: Incremental conductance (IC):

The IC algorithm is based on the observation that the following equation holds at the MPP:

(dIPV/dVPV) + (IPV/VPV) = 0

where IPV and VPV are the Photovoltaic array current and voltage, respectively.

When the optimal operating point in the P-V plane is to the right of the Maximum Power Point, we have (dIPV/dVPV)

+ (IPV/VPV) < 0, whereas when the optimal operating point is to the left of the Maximum Power Point, we have (dIPV/dVPV) + (IPV/VPV) > 0.

The Maximum Power Point can in this manner be tracked by compare the instantaneous conductance IPV/VPV to the IC (dIPV/dVPV). Therefore the sign of the quantity (dIPV/dVPV) + (IPV/VPV) indicate the right heading of perturbation best to the MPP. Perturbation stops if there is a change in dIPV once MPP has been reached and the operation of Photovoltaic array it is maintained at this point. This is noted. For this condition, the algorithm decrements or additions Vref to track the new Maximum Power Point (MPP). The augmentation measure decides how fast the MPP is tracked.

Through the IC algorithm it is therefore in theory it is conceivable to know when the MPP has been reached, and in this way when the perturbation can be halted. The IC technique offers great performance changing according to atmospheric conditions.

C. **Light DependentRegister***:*

To track the sunlight, it is necessary to detect the situation of the Sun and for that an electro-optical sensor is required. For self-calibration, Sun tracker utilizes the electro-optical sensor. A LDR or photograph resistor is a variable resistor whose electrical resistance relies upon the light intensity falling on it. The LDR resistance increase with incident light intensity decreasing.

D. Photo voltaic panels:

Monocrystalline modules:

Monocrystalline is built utilizing just a single crystal, cut from ingots. This gives the solar panel a uniform appearance across the total module. These large single crystals are exceedingly rare, and the procedure of recrystallizing the cell is more costly to create. They are still more costly than polycrystalline, however can be upto 2% more productive.

The solar cells are monocrystalline panels are cuts cut from unadulterated drawn crystalline silicon bars. The whole cell is aligned is one course, which means that when the sun is sparkling brilliantly on them at the right angle, they are exceptionally effective. So these solar panels work best in brilliant sunshine with the sun sparkling straightforwardly on them. They have a regular blacker shading because they are absorbing the greater part of the light. Unadulterated cell are octagonal, so there is unused space in the corners when a considerable measure of cells are made into a solar module, Mono panels are slightly smaller than poly panel for the same power, yet this is just really noticeable on industrial scale installation where you may have the capacity to fit a higher overall power with monocrystalline.

E. DC to DC converter orChopper:

A chopper is a stationary gadget which is utilized to obtain a variable dc voltage from a constant dc voltage source. A chopper is also known as dc-to-dc converter.

Choppers are of two types:

I. Step-down choppers (BuckConverter)

II. Step-up choppers (Boost Converter)

In step-down choppers, the output voltage is less than the input voltage whereas in step-up choppers output voltage is more than the input voltage.

1. Principle of Step-DownChopper:

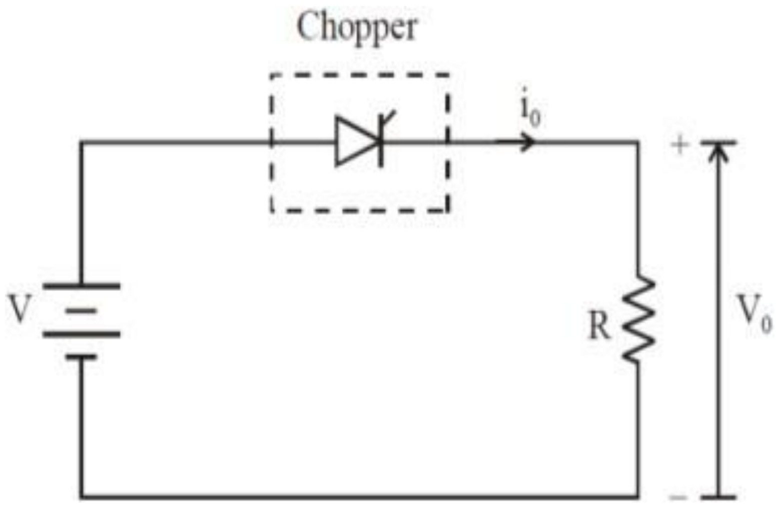


Fig 4. Step-down Chopper with Resistive Load

Figure 4 demonstrates a stage down chopper with resistive load. The thyristor in the circuit acts as a switch. Supply voltage appears across the load when thyristor is ON, supply voltage appears across the load and the voltage across the load will be zero, when thyristor is OFF. The output voltage and current waveforms are as appeared in figure

2. Methods ofControl:

The output dc voltage can be varied by the following methods.

- Pulse width modulationcontrol.
- Variable frequencycontrol.

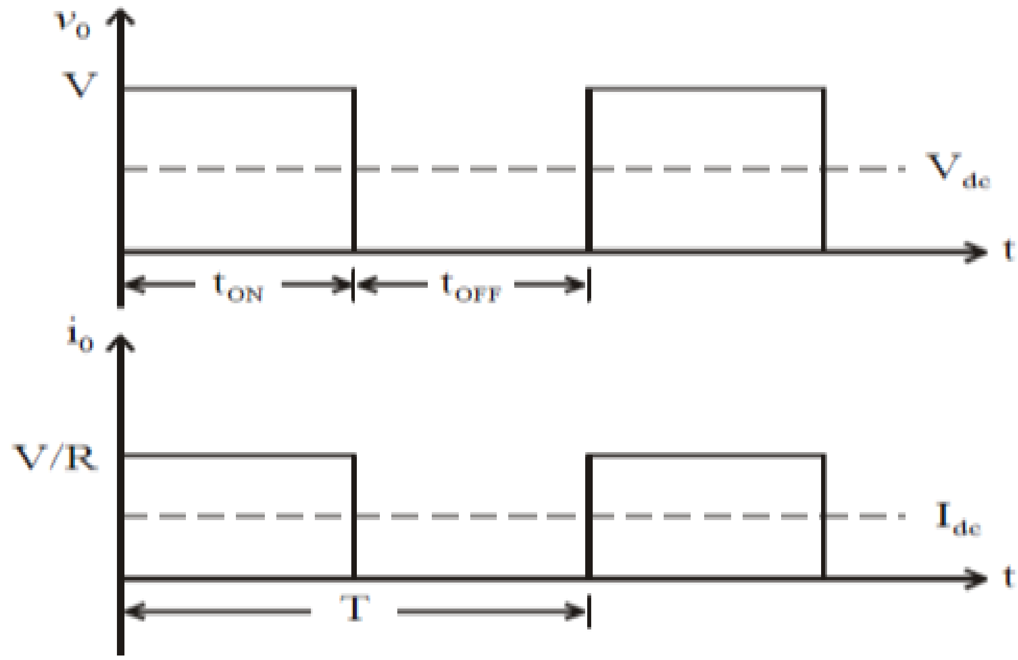


Fig 5. Output voltage and current waveforms

3. Pulse Width Modulation

In PWM the switches are turned on at a constant slashing frequency. Output waveform of chopper is constant in total time of one cycle. The average output voltage is directly proportional to the ON time of chopper. The ratio of ON time to total time is characterized as duty cycle.

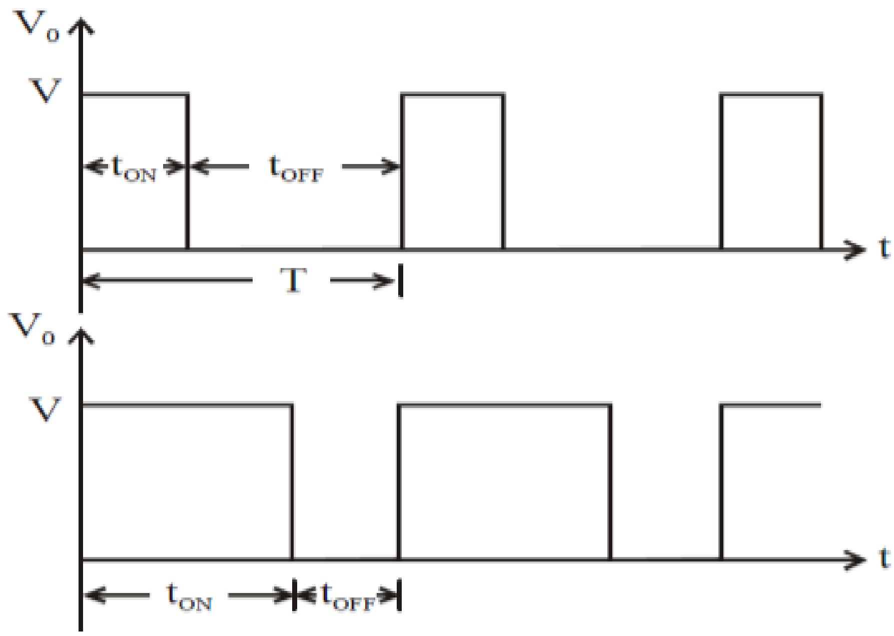
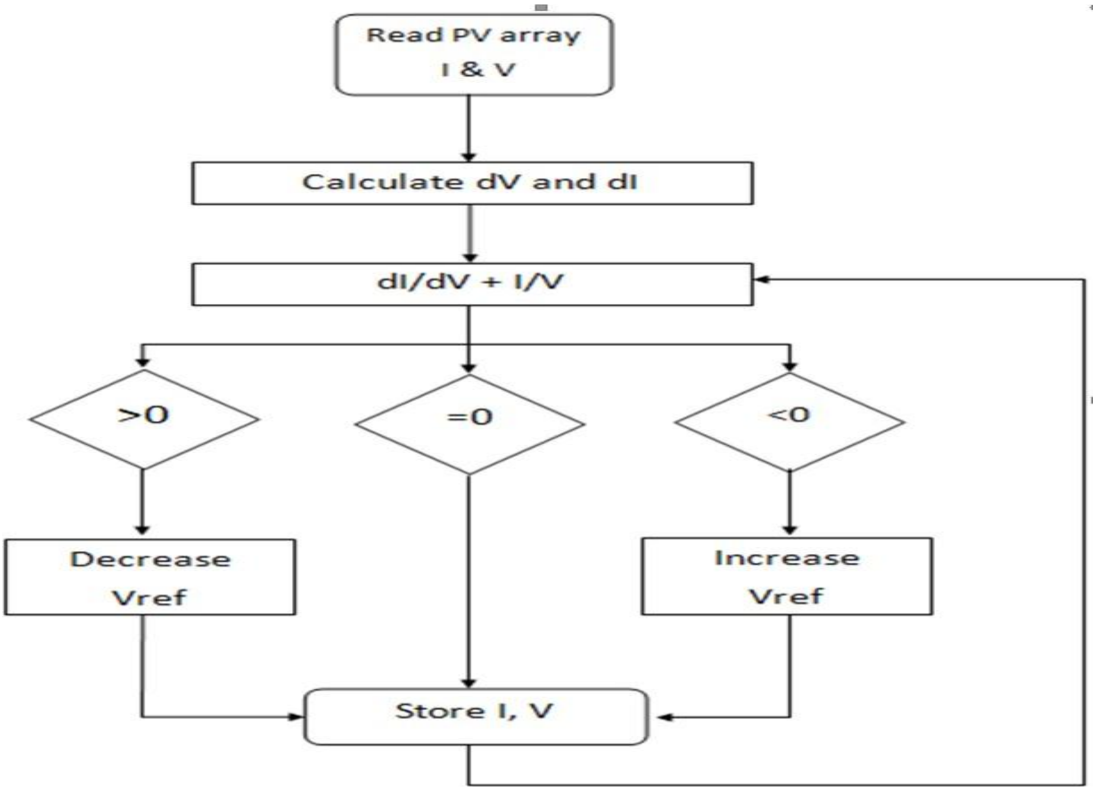


Fig 6. Pulse width modulation controller

F. Flowchart:



Flow chart 1: Incremental Conductance

G. Tracking

1) Dual AxisTracking:

In dual-axis tracking system the sun radiations are captured to the maximum by tracking the development of the sun in four dissimilar ways. The dual-axis sun tracker takes after the angular stature position of the sun in the sky in addition to take after the sun east-west development. The dual-axis works similarly as the single-axis however measures the vertical as well as the horizontal axis.

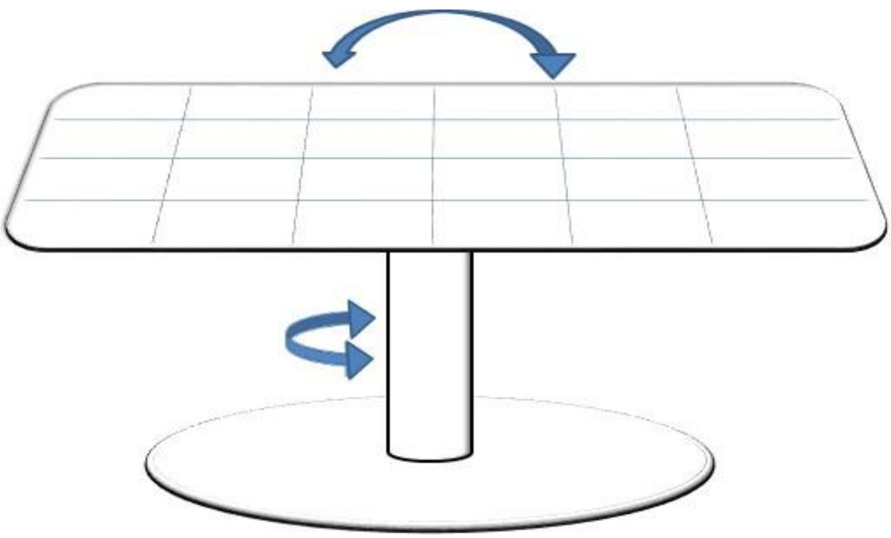


Figure 7. Dual Axis Tracker

The dual axis tracker in paper comprises of two arrangements of phototransistor sensors, two DC engines and small scale controller. Single arrangement of sensors and one engine is utilized to tilt the tracker in sun east to west heading and the other arrangement of sensors and the second engine which is settled at the base of the tracker is utilized to tilt the sun tracker in the sun north to south course. At the point when the sun moves towards the north, the tracker has to track the sun path in anti-clockwise heading along the horizontal axis (east to west). In the event that the sun moves towards the south course then the tracker has to track the sun clockwise way. The sensor detects the light from the sun and sends the signals generated by them to the smaller scale controller. The controller identifies the more grounded signal and guidelines the engine to rotate in clockwise or anti-clockwise bearing. To beat the disadvantages in the single-axis sun tracking system, a dual-axis sun tracking system was presented. The power output for the dual-axis and settled axis panel are tabulated for a single day. The average power values of the dual-axis panel creates more power than that of the settled mount.

2) **FixedMount:**

In fixed axis mount the solar panel is mounted fix. In this panel isn't moving along any axis. Panel is at its constant position so it can't capture irradiance according to the situation of sun. Power efficiency of single axis solar tracking is more than is more than fixed mount.

3) **Single-Axis TrackingSystem:**

The single-axis solar tracking system analyzed in the paper comprise of a PV panel rotating around a tilted shaft under the action of a DC Motor controlled according to the current sun position estimated by means of two light intensity sensors. The light sensor's comprises of two LDR's which is placed on either side of the panel separated by an opaque plate. Contingent upon the intensity of the sun radiation one of the two LDR's will be shadowed and the other will be illuminated. The power output for the single-axis and fixed mount panel are tabulated for a single day. The average power values demonstrate that the fixed mount axis create less power than that of single-axis panel.

III. CONCLUSION

For increasing the efficiency of solar system, we are executing dual axis tracking and Incremental Conductance algorithm. In the dual axis tracking maximum irradiance can be obtained on the solar panel therefore more will be current generate from panel. MPPT with Incremental Conductance algorithm current generated from panel is transfer to load more efficiency. Utilization of this two combination maximum power can be generated from the solar panel.

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