Modern Solar Tracking system with additional production of energy using Thermo electric generator

Anitha.R, Sathish Kumar.P, Komalachitra.S

***Abstract*— This project deals with a LDR based solar panel tracking system with thermo electric generator. Solar tracking enables more energy to be generated because the solar panel is always able to maintain a perpendicular profile to the sun's rays. Thermoelectric generators are devices which convert heat (temperature differences) directly into electrical energy, using a phenomenon called the"thermoelectric effect". This will tend to maximize the amount of power absorbed by PV systems. It has been estimated that the use of a tracking system, over a fixed system, can increase the power output by 50% - 60%.**
The collected power will be converted to be suitable for the load attached to it. The information will be displayed through LCD monitor.

***Index Terms*— LDR, PIC Micro controller, PV modules,TEG.**

I. INTRODUCTION

Renewable energy is rapidly gaining importance as an energy resource as fossil fuel prices fluctuate.

One of the most popular renewable energy sources is solar energy which is widely available at free cost. Many researches were conducted to develop some methods to increase the efficiency of Photo Voltaic systems (solar panels). One such method is to employ a solar panel tracking system with Thermo Electric Generator.

Solar energy is the energy extracted from the rays issued from the sun in the form of heat and electricity. This energy is essential for all life on Earth. It is a renewable resource that is clean, economical, and less pollution compared to other resources and energy. Our paper includes the design and implementation of a microcontroller-based solar tracking system. Solar tracking allows more energy to be produced because the solar panel is tracking the maximum power point of the sun's position.

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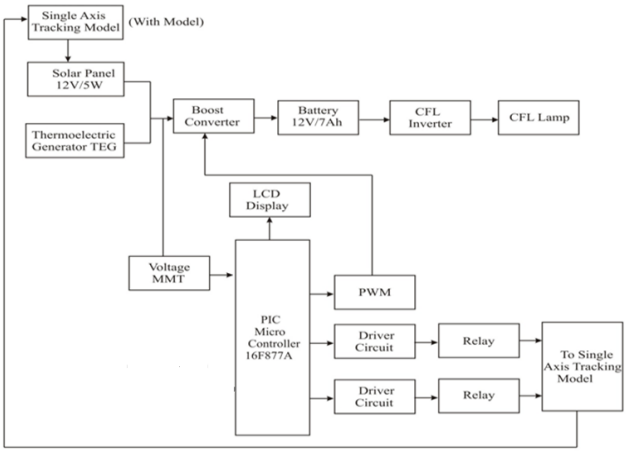
II. BLOCK DIAGRAM



The operation of power supply circuits built using filters, rectifiers, and then voltage regulators. A power supply can be built using a transformer connected to the ac supply line to step the ac voltage to a desired amplitude, then rectifying that ac voltage, filtering with a capacitor and RC filter, if desired, and finally regulating the dc voltage using an IC regulator. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milliwatts to tens of watts.

III. THERMO ELECTRIC GENERATOR

Thermoelectric generators are devices which convert heat (temperature differences) directly into electrical energy. Their typical efficiencies are around 5-8%. Recent devices use semiconductor p-n junctions made from bismuth telluride (Bi_2Te_3), lead telluride (PbTe), calcium manganese oxide, or combinations thereof, depending on temperature.

The idea is to increase the efficiency of the combined solar/thermoelectric system to convert the solar radiation into useful electricity.Thermoelectric generators are devices which convert heat (temperature differences) directly into electrical energy. The thermoelectric effect is the direct conversion of temperature differences to electric voltage and vice-versa.

A thermoelectric device creates voltage when there is a different temperature on each side. Conversely, when a voltage is applied to it, it creates a temperature difference. At the atomic scale, an applied temperature gradient causes charge carriers in the material to diffuse from the hot side to the cold side. This effect can be used to generate electricity, measure temperature or change the temperature of objects. Because the direction of heating and cooling is determined by

the polarity of the applied voltage, thermoelectric devices can be used as temperature controllers.

The term "thermoelectric effect" encompasses three separately identified effects: the Seebeck effect, Peltier effect and Thomson effect. Textbooks may refer to it as the Peltier–Seebeck effect.This separation derives from the independent discoveries of French physicist Jean Charles Athanase Peltier and Baltic German physicist Thomas Johann Seebeck. Joule heating, the heat that is generated whenever a voltage is applied across a resistive material, is related though it is not generally termed a thermoelectric effect. The Peltier–Seebeck and Thomson effects are thermo dynamically reversible, whereas Joule heating is not.

Thermoelectric efficiency depends on the figure of merit, ZT. There is no theoretical upper limit to ZT, and as ZT approaches infinity, the thermoelectric efficiency approaches the Carnot limit. However, no known thermoelectrics have a ZT>3. As of 2010, thermoelectric generators serve application niches where efficiency and cost are less important than reliability, light weight, and small size.

A.Functions of TEG

The TEG works on the principle of two effects.

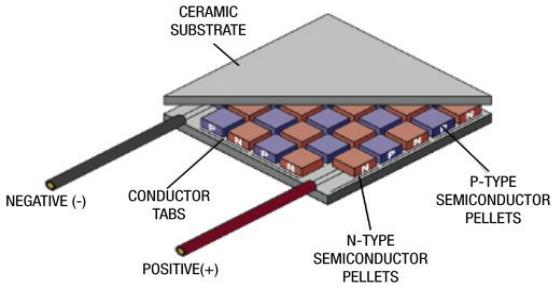
1. PELTIER EFFECT:

This effect introduces power to the module with a resultant cooling of one side and heating of the other. These types of modules are low amp (typically in the 6 amp range) and are designed for low temperature exposure of not more than 70°C to 90°C hot side. Higher temperature exposures will cause the module to either break apart, couples joints to melt and are not good power generators!

2. SEEBECK EFFECT:

This effect creates a temperature differential across the module by heating one side of the module and cooling the opposite.

Correct terminology is essential to any technology. A Seebeck Module is a power generator and a Peltier Module is a cooling module.



IV. LCD DISPLAY

Liquid crystal cell displays (LCDs) are used in similar applications where LEDs are used. These applications are display of numeric and alphanumeric characters in dot matrix and segmental displays.

LCDs are of two types:

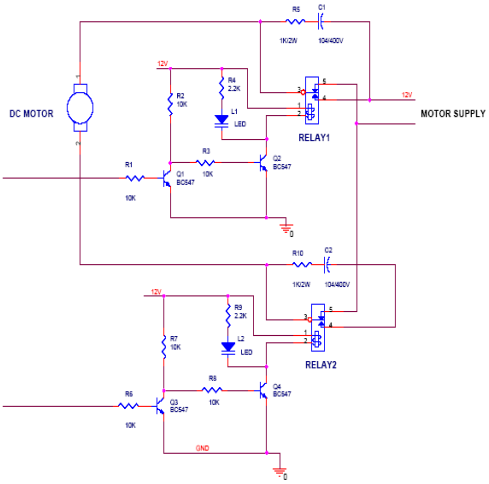
Dynamic scattering type

Field effect type

V. PERMANENT MAGNET DC MOTOR

A PM motor does not have a field winding on the stator frame, instead relying on PMs to provide the magnetic field against which the rotor field interacts to produce torque. Compensating windings in series with the armature may be used on large motors to improve commutation under load. Because this field is fixed, it cannot be adjusted for speed control. PM fields (stators) are convenient in miniature motors to eliminate the power consumption of the field winding. Most larger DC motors are of the "dynamo" type, which have stator windings. Historically, PMs could not be made to retain high flux if they were disassembled; field windings were more practical to obtain the needed amount of flux. However, large PMs are costly, as well as dangerous and difficult to assemble; this favors wound fields for large machines.

To minimize overall weight and size, miniature PM motors may use high energy magnets made with neodymium or other strategic elements; most such are neodymium-iron-boron alloy. With their higher flux density, electric machines with high-energy PMs are at least competitive with all optimally designed singly fed synchronous and induction electric machines. Miniature motors resemble the structure in the illustration, except that they have at least three rotor poles (to ensure starting, regardless of rotor position) and their outer housing is a steel tube that magnetically links the exteriors of the curved field magnets.



This circuit is designed to control the motor in the forward and reverse direction. It consists of two relays named as relay1, relay2. The relay ON and OFF is controlled by the pair of switching transistors. A Relay is nothing but electromagnetic switching device which consists of three pins. They are Common, Normally close (NC) and normally open (NO). The common pin of two relay is connected to positive and negative terminal of motor through snubber circuit respectively. The relays are connected in the collector terminal of the transistors T2 and T4.

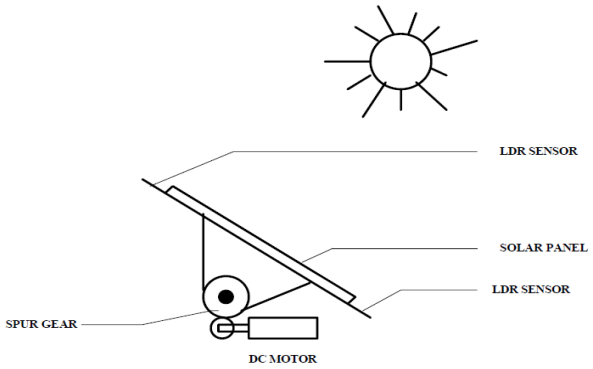
When high pulse signal is given to either base of the T1 or T3 transistors, the transistor is conducting and shorts the collector and emitter terminal and zero signals is given to base of the T2 or T4 transistor. So the relay is turned OFF state.

When low pulse is given to either base of transistor T1 or T3 transistor, the transistor is turned OFF. Now 12v is given to base of T2 or T4 transistor so the transistor is conducting and relay is turn ON. The NO and NC pins of two relays are interconnected so only one relay can be operated at a time.

The series combination of resistor and capacitor is called as snubber circuit. When the relay is turn ON and turn OFF

continuously, the back emf may fault the relays. So the back emf is grounded through the snubber circuit.
When relay 1 is in the ON state and relay 2 is in the OFF state, the motor is running in the forward direction.
When relay 2 is in the ON state and relay 1 is in the OFF state, the motor is running in the reverse direction.

VI. SOLAR TRACKING MODEL



A. Single Axis Trackers

Single axis trackers have one degree of freedom that acts as an axis of rotation. The axis of rotation of single axis trackers is typically aligned along a true North meridian. It is possible to align them in any cardinal direction with advanced tracking algorithms

B. Advantages of Single Axis Trackers

- Additional power supply not necessary
- It is elegantly simple and more reliable.
- Low additional cost.
- Trouble free operation.
- Less demanding mechanical requirements.
- Energy consumption is less.

VII. PIC CONTROLLER 16F877A

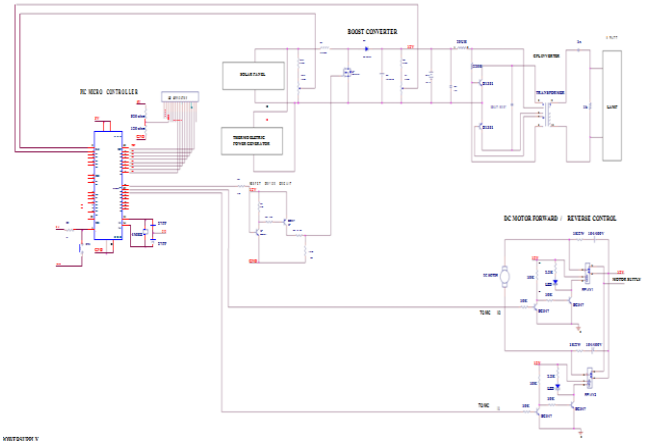
The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS (complimentary metal oxide semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory.
The main advantage of CMOS and RISC combination is low power consumption resulting in a very small chip size with a small pin count. It has immunity to noise than other fabrication techniques.

VIII. EXISTING SYSTEM

1. Earlier constant immovable solar panel was used.
2. Using Solar panel , only electric energy is produced by using only solar beam.

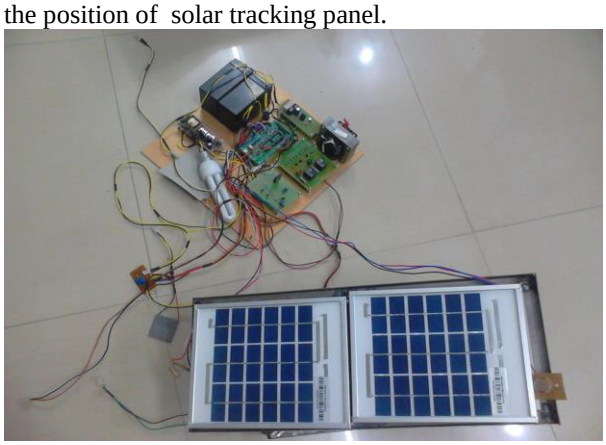
IX. PROPOSED SYSTEM

1. Production of electric energy from solar heat using thermo electric generator.
2. Utilizes more energy from solar radiation.
3. Accurate sensing can be achieved by using LDR sensor.



Initially, solar rays are absorbed by the P-V panel & it produces energy while on the other hand TEG senses the heat and converts it into electric energy.

The combination of these energies are boosted up by the DC-DC Boost converter and stores the energy in the battery. The position and angle of the solar P-V panel are adjusted by using DC motor with the help of PIC controller 16F877A . The PIC Controller provides necessary command t o adjust the position of solar tracking panel.



CONCLUSION

The proposed system was implemented in reduced complexity architecture such as a microcontroller. The control system which is the brain of the proposed system is used to turn a small PV panel in three directions to determine the maximum output current. Three photoresistors are used every 45 minutes to redirect the PV panel to het the nearest value of the maximum sun.
Solar trackers give substantial advantage for increasing collection efficiency for solar concentrating devices like parabolic collectors and PV panels.

In summer with clear sky,the efficiency of energy collection may reach 80-90%.
For heat to direct electric power conversion devices solar trackers gives substantial advantage by increasing solar collection efficiency . The solar heat can be absorbed by the Thermo electric generator.This is particularly true for direct energy conversion devices like PV panels,which presently give about 14% over all solar energy to electricity conversion efficiency. It has been estimated that the yield from solar panels can be increased by 30 to 60% efficiency by utilizing a tracking system instead of a stationary array.

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