Maximum Power Point Tracking of Solar Panel

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Abstract **-Solar energy is very important role in renewable energy resources. The design and construction of arm microcontroller based solar panel tracking system can be designed. Solar is a nonconventional source of energy, considering solar panels so that we can fulfil our electricity need. But due to revolution of the earth, solar source, sun does not face the panel continuously hence production of electricity is less. The energy panel should face the Sun till it is present in a day. The problem above can be solved by proposed system by automatic tracking the solar energy. The 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 by using stepper motor. The system focuses on the controller design whereby it will caused the system is able to tracks the maximum heat intensity of Sunlight is hit. When the heat intensity of Sunlight is decreasing, this system automatically changes its direction to get maximum heat intensity of Sunlight. A Solar Tracker is basically a device onto which solar panels are fitted which tracks the motion of the sun across the sky ensuring that the maximum amount of heat intensity of sunlight strikes the panels throughout the day. After finding the sunlight, the tracker will try to navigate through the path ensuring the best sunlight is detected. It is completely automatic and keeps the panel in front of sun until that is visible. Its active sensors constantly monitor the heat intensity and rotate the panel towards the direction where the intensity of heat is maximum. This method can be used in residential building electrification.**

I. INTRODUCTION

Each day, the sun rises in the east, moves across the sky, and sets in the west. Whenever the sun is shining on us, it is sending energy in our direction. We can feel the heat from the sun, and we can see objects that are illuminated by the light from the sun as it moves across the sky. However, if we could get a solar cell to turn and look at the sun all day, then it would be receiving the maximum amount of heat intensity of sunlight possible and converting it into the more useful energy form electricity.

Many of residential around the world used electric solar system as a sub power at their houses. This is because solar energy is an unlimited energy resource, set to become increasingly important in the longer term, for providing electricity and heat energy to the user. Solar energy also has the potential to be the major energy supply in the future. 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. Active trackers use motors and gear trains to direct the tracker as commanded by a controller responding to the solar direction.

The solar tracker can be used for several applications such as solar cells, solar day-lighting system and solar thermal arrays. The solar tracker is very useful for device that needs more sunlight for higher efficiency such as solar cell. Many of the solar panels had been positioned on a fixed surface such as a roof. As sun is a moving object, this approach is not the best method. One of the solutions is to actively track the sun using a sun tracking device to move the solar panel to follow the Sun. With the Sun always facing the panel, the maximum energy can be absorbed, as the panel is operating at their greatest efficiency.

This project will develop a Sun tracking system specially designed for residential. Thermo coupler has been chosen as the sensor because it is commonly used in sun tracking system. Thermo coupler senses the heat intensity of sunlight and controller receives the output. Control unit decides in which direction the panel has to be rotated to get maximum heat of sunlight.

II.WORKING PRINCIPLE

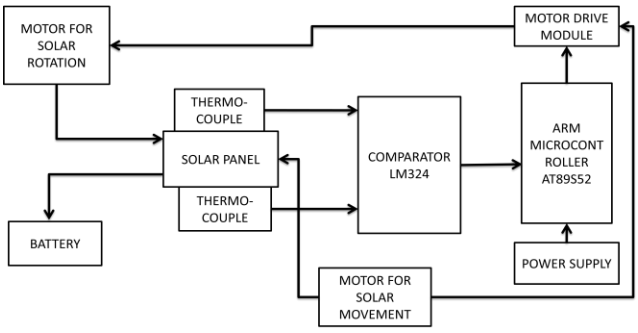

Figure.1: Block Diagram of Solar Tracking system

Figure shows the tracking device in out prototype. It is the one which follows the sun's movement throughout the day and provides uninterrupted reflection to the solar panel. The sun rays will fall on the solar panel in two ways,

which is, they will fall directly on the solar panel board and also the reflector will reflect the incident rays on the solar panel. Suppose at the time of sun rise the sun is in extreme east the reflector will align itself in some position by which the incident rays will fall on the panel. When the earth rotates and the sun gets shifted from its earlier position the reflection of the incident rays will also change. Thus, as a result the light will fall on the sensors kept on each side of the solar panel. The tracking circuit is to design that when reflection falls on the sensor attached to the right of the panel, the tracker will move towards the left, and vice-versa.

Similar is the case when the reflection falls on the sensor attached at the top of the panel, circuit will make the tracker to move downwards. One being, the normal principle of incidence and reflection on which our tracker works. And the other is the principle on which the solar panel works, which is on the incidence of the solar rays the photovoltaic cells, will produce electricity. This both principles are combined there and as a result of which we are able to fetch nearly double the output which the panel gives normally. Precisely speaking the tracker is liable for two kinds of rotations, on is on the vertical axis and other is on the horizontal axis. The earlier is for the right-left movement of the reflection and the later is for the up-down movement of the reflector, for aligning reflection on the panel.

III.OPERATION

In proposed system, solar panel is to convert the light energy into the electrical energy. The Sun change its position throughout the day, to utilize the whole light energy so to make a tracking system in which solar panel can be rotate as per the sun changes its position. The two thermo coupler Sensors to sense the heat of light and if the sun change its position then respective Sensor sense the heat and generate the highest Voltage signal and this highest voltage signal fed to the comparator IC as well as remaining sensors also give its generated voltage level to the Comparator IC. All Voltage signal of the each thermo coupler sensor that is compared with LM324and fed to the microcontroller. Microcontroller receives the voltage signal from the any i/o pin of the controller and compares the each thermo coupler output signal to with each thermo coupler sensor output. When the controller find the Highest voltage level of any thermo coupler sensor gives the instruction to the stepper motor through the motor driver circuit to rotate the solar panel on the single axis in the direction of the thermo coupler sensor which are generating highest voltage output. So the Battery can recharge appropriately through the Solar panel and can run the any electronic devices here can rotate the 12 v dc fans regularly. By using external two motor and by making connection in parallel can move the solar penal in any direction. As by rotating the solar panel in the direction of the sun we utilize the maximum energy of the sun.

A. Need of a solar tracker

Photovoltaic is the field of technology and research related to the application of solar cells as solar energy. Solar cells have many applications. Individual cells are used for powering small devices such as electronic calculators. Photovoltaic arrays generate a form of renewable electricity, particularly useful in situations where electrical power from the grid is unavailable such as in remote area power systems, Earth-orbiting satellites and space probes, remote radio telephones and water pumping applications. Photovoltaic electricity is also increasingly deployed in grid-tied electrical systems. 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.

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. This project deals with a arm microcontroller based solar panel tracking system. 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. As the sun moves across the sky during the day, it is advantageous to have the solar panels track the location of the sun, such that the panels are always perpendicular to the solar energy radiated by the sun. 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 25% - 55%. The increase is significant enough to make tracking a viable preposition despite of the enhancement in system cost. It is possible to align the tracking heliostat normal to sun using electronic control by a micro controller.

B. Components Description

The major part of this electronics system is the arm micro controller and operations are controlled by it. With the help of arm micro controller, the solar panel works according to the heat intensity of the sunlight. Another component is the rechargeable battery which is used to store energy which is received from the panel. The purpose of the charge control is to control the charging of the battery. Arm micro controller unit receives the status of the battery by the charge control unit. It has two sensors, each made up of thermo coupler. One unit consist of four thermo coupler and are placed at the four corners of the panel. Thermo coupler senses the heat intensity of sunlight and controller receives the output. Control unit decides in which direction the panel has to be rotated to get maximum heat of sunlight. The panel can be rotated in the desired direction by the stepper motor.

C. Software Required

KeilMicrovision3:- It is used to convert normal file or code into .hex file. The µVision IDE combines project management run-time environment, build facilities, source code editing, and program debugging in a single powerful environment. Microvision is easy-to-use and accelerates your embedded software development. Microvision supports multiple screens and allow to create individual window layouts anywhere on the visual surface.

PCB Wizard:-To design the circuit & print on printed circuit board. A printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features from copper sheets laminated onto a non-conductive substrate. Components like capacitors, resistors or active devices are generally soldered on the PCB. Advanced PCBs may contain components embedded in the substrate. PCBs can be single sided, double sided or multi-layer.

IV. APPLICATIONS

Applications in concentrated solar power and concentrated photovoltaic require the precise tracking of solar units to focus sunlight on the target medium. Solar trackers are devices used to orient photovoltaic panels, reflectors, lenses or other optical devices toward the sun. Since the sun's position in the sky changes with the seasons and the time of day, trackers are used to align the collection system to maximize energy production.

Solar trackers provide highly efficient, proprietary single and dual axis solar tracking systems. Single-axis solar trackers can typically increase electricity generation by 30%, while dual-axis trackers can boost electricity generation by up to 40%.

The modules or mirrors are optimally aligned with the angle of the sun's rays to constantly optimize solar energy regardless of the sun's position. These solar tracking systems have up to a one-third higher energy yield than stationary PV system depending on the intensity of the sunlight at the installation site because the closer an installation is to the equator, the more efficiently the PV tracking systems operate.

Solar tracking systems are used to continually orient photovoltaic panels towards the sun and can help maximize your investment in your PV system. They are beneficial as the sun's position in the sky will change gradually over the course of a day and over the seasons throughout the year. They can be used most effectively in areas with low horizons and locations that are shade free from dawn to dusk each day. Throughout the year the tracking array will be able to utilize the wide-open access to gain every available electron from the sun. This way, energy production is at an optimum and energy output is increased year-round. The standalone PV home kit system is a very reliable and uncomplicated source of energy production and requires little maintenance. Solar tracking systems are used to continually orient photovoltaic panels towards the sun and can help maximize your investment in your PV system. For those with limited space this means that a smaller array only needs to be installed, a advantage for those smaller sites with only a small area to place equipment, they will be able to produce maximum energy output but only need to utilize one of the smaller solar home systems.

V. RESULT

Maximum power is tracked during the peak hours of the day. The panel is made to rotate according to the intensity of light falling on it.

VI.CONCLUSION

To make single axis Solar Tracking System prototype model, the system mainly focuses on designing controller part and the main concern is to design appropriate circuits and the circuits supposed to be able to control stepper motor rotation direction without considering motor speed. The system will able to track and follow Sunlight intensity in order to collect maximum solar power regardless of motor speed. The unique of system, motor speed is not critical consideration considering because the stepper motor offers low output rated speed and high output rated torque. Therefore any types of stepper motor can be used for the system regardless of motor speed controller unit as long as the speed and torque of the motor are following the given specification. The system model can be applied in the residential area for alternative electricity generation especially for non-critical and low power appliance.

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