Environmental Dynamics (Eco Friendly Power Systems)

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ABSTRACT

This paper deals with the construction, design and operation of solar tracker system. It throws light on the advantages of a solar tracker system over stationary solar cell panels that are currently being used.

The world is dealing with a crisis - crisis of non-renewable sources of energy. These are not only getting exhausted fast, but also are a major contributor towards pollution (and in-turn for global warming). It is thus in the interest of our planet earth, that we come up with some new technology that is able to harness maximum renewable energy available with maximum efficiency. Microcontrollers based automatic solar trackers are presented in this paper. Light dependent sensors are used. Various mechanisms are deployed to increase the efficiency of solar trackers and to decrease its cost.

Keywords: Solar tracking system, Advantages, Microcontrollers, Light dependent sensors, Efficiency

1. INTRODUCTION

With the ever increasing demand for energy and with the ever increasing rate of consumption of fossil fuels, the existing sources of energy are fast depleting .These sources of energy are a growing concern for environment pollution .We thus need to find an alternate source of energy that will help our environment stay green. This thought long back lead to the introduction of solar energy.

Solar energy is produced by the sun. It can be harnessed like any other type of energy and used to create electricity to run homes and businesses. Buildings can also be heated by the thermal energy produced by the sun. Best of all, solar energy is free and does not compromise the environment. In order to harness the energy from the sun and turn it into electricity, it is necessary to have solar cells to collect and transform solar energy into useable electricity. These cells are typically in the form of panels that face the direction of the sun to capture most of the rays possible. This principle of conversion of sun light into electricity is known as photo-voltaic or PV conversion

Although the conversion of solar energy into electricity is not new, advances in increasing its efficiency are continuously being made by scientists. One of the advances is hence proposed in this

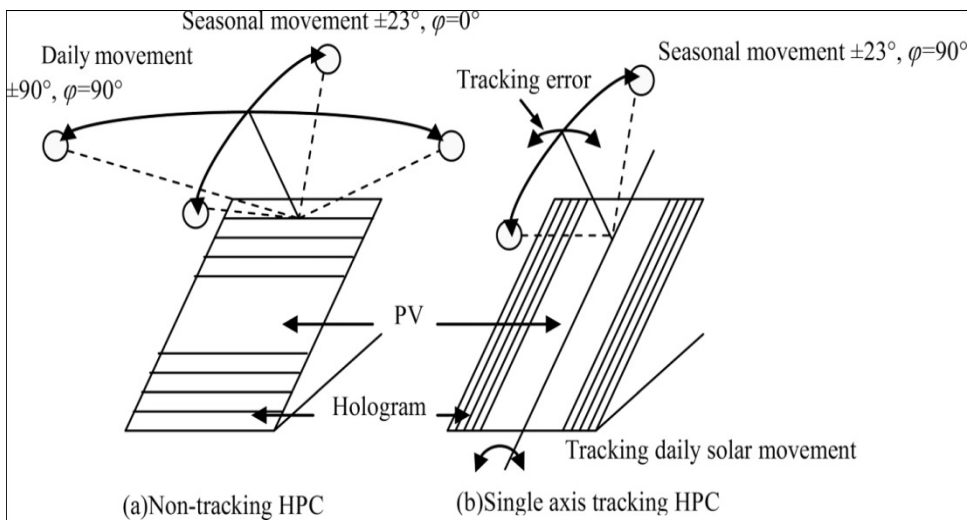
paper. The technique is commonly referred to as "Solar Tracking" and is inspired by the Sun-Flower. Solar tracking is the optimization of solar cell configuration and geometry, new materials and technologies etc.

The PV cells basically consist of a flat surface with numerous PN junctions that are connected together through electrically conducting strips. The PV panel ensures the conversion of light radiation into electricity and is characterized by a strong dependence of the input power on the incident light radiation. Solar tracker is the reliable choice, producing more solar power and bottom-line benefits than any other solar cell panel in the market. The rigorous engineering disciplines underpinning the solar tracker, it was able to establish a new standard for cost-effective, high-performing energy saving solutions.

2. ADVANTAGES OF A SOLAR TRACKER OVER A STATIONARY SOLAR CELL PANEL

Compared to a fixed panel, a mobile panel PV driven by a motor of solar tracker is constantly along the normal to the incident light of the sun. As the sun rays falls almost close to the geometric normal incident angle, the intensity of the incoming sunrays is the highest and hence the output of the solar tracker is the highest almost all the time. This therefore increases the output of the tracker.

Technical reports gathered in the USA have shown that a solar tracking system are particularly effective in summers when the increase in the output energy may reach as high as 50% more compared to efficiency obtained by the use of stationary solar panel during the same time of the year. Similarly in autumn the output is 20% higher.

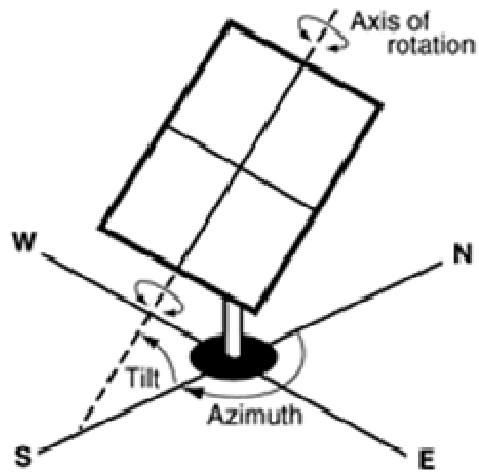


3. CLASSIFICATION

Solar tracking systems are of several types and can be classified according to several criteria.

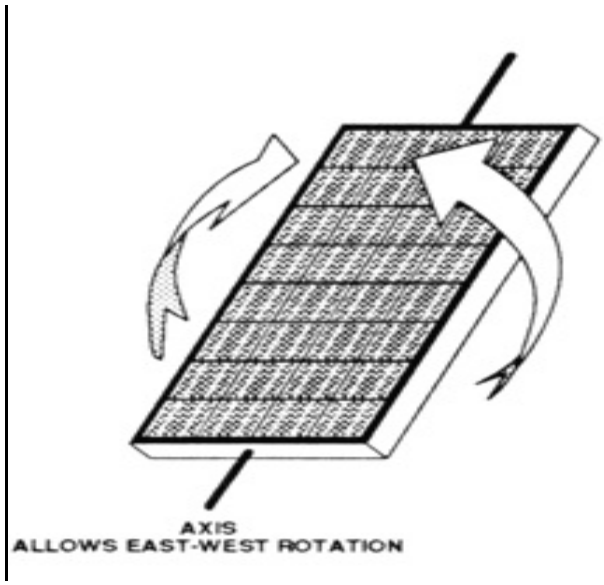
One of the classifications can be made depending upon the number of axis of rotation i.e. single axis of rotation and double axis of rotation. Now solar tracking devices involve a lot of moving parts and control systems that tend to be expensive, hence single axis tracking systems seem to be the best solution for small PV plants. This is because Single axis trackers will usually have a manual elevation (axis tilt) adjustment on the second axis which is adjusted at regular intervals throughout the year. Although double axis tracking system is appropriate while being used in big tracking systems, in this project we have used a single axis rotation system.

Single axis trackers-A single axis tracker have one degree of freedom that acts as an axis of rotation. This axis of rotation is aligned along the true north median.



Tilted one-axis tracking system

With the help of coding of microcontroller it is possible to align them in any cardinal direction. Another method of classification is depending on the orientation type according to which we can make solar tracking systems that orient the PV panels based on a previously computed sun trajectory in comparison with the panels with an online orientation system that reacts to the instantaneous solar light radiation.



4. DESIGN OF THE PROPOSED TRACKING SYSTEM

The solar tracking system that we are working on should satisfy the following requirements-

1. Minimum energy consumption
2. Optimum performance-cost ratio
3. Reliability in operation under different perturbation conditions i.e. - dust, wind, rain, temperature variations.
4. Simplicity in operation.
5. Possibility of system integration in a monitoring and control centralized structure, which means a digital solution.

Considering the above mentioned requirements, the chosen PV panel has the following components-

- A DC electric motor, voltage mode driven with current monitoring without movement sensors (speed or position).
- a motor control system of intelligent(drive type) that is completely digital, that allows the implementation of the digital control of the motor as well as the implementation in a dedicated motion control language of the PV panel orientation application.
- A measurement system for light intensity applied to the PV panel which represents the sensor that commands the solar panel movement.

The chosen technical solution offers the following important advantages-

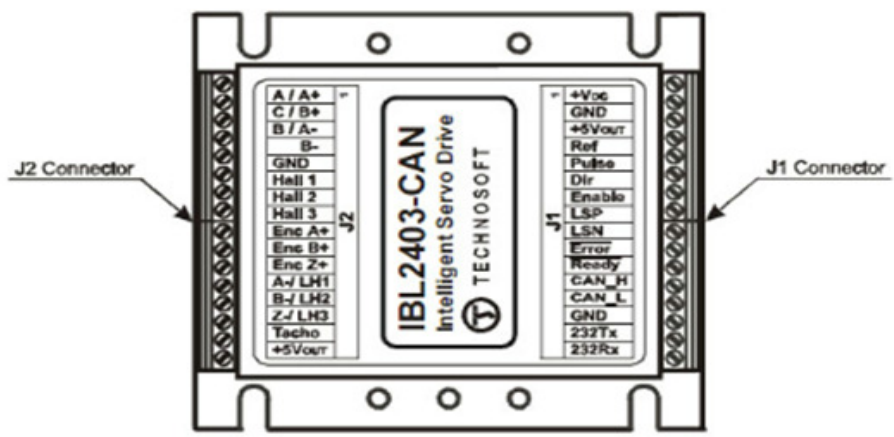
- Simplicity of power scheme with DC motor and H bridge converter (4 transistors) for the motor drive.

- Use of a compact drive equipment, with a high degree of integration and intelligence, that incorporates in a single module both the power converter and its command system, motion command unit (motion controller), and specific automation elements (of PLC type).
- Use of an innovative solution, simple and reliable for the measurement system of light signal intensity dc motor parameters.
- 1. rated voltage-24v.
- 2. rated current-3a.
- Maximum speed-3000rpm.
- Gear box with a speed reduction ratio of 1:20.

5. ROLE OF AN INTELLIGENT DRIVE UNIT IBL2403 [5]-

To command the DC motor, we have used the intelligent drive unit IBL2403 (designed by Techno soft [10])

The intelligent drive unit is a completely digital system that executes using DSP technology, dedicated to command of dc electric motors, sinusoidal or trapezoidal commutated brushless motors or stepper motors.



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6. SENSORS

To command the PV panel, we have used two light intensity sensors in this project. These sensors are executed using two luminescent diodes of LED type that are strategically placed such that the signals they generate are correlated with the light intensity applied to the PV panel.

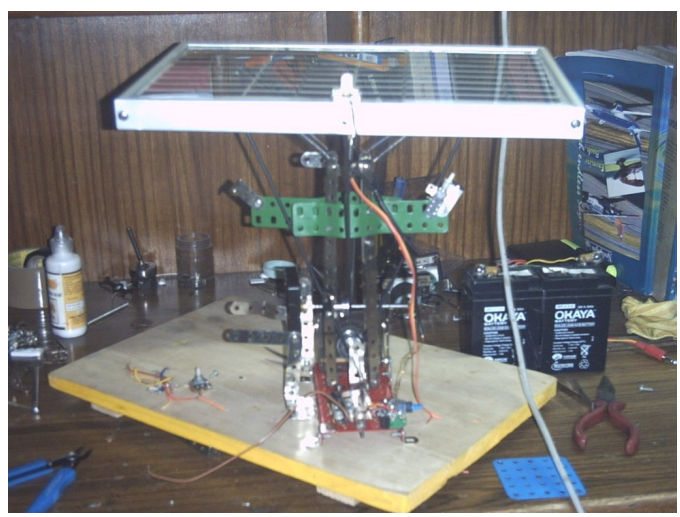
Now, two LEDs are placed normal to the panel surface and are separated by an opaque plate. The opaque plate in required so that the light sensors place themselves in a position from where the intensity of the incoming sunrays falling on both the sensors is equal. By this way we enable the PV plate to receive sunrays at an angle normal to the PV plate by which we are able to achieve maximum intensity.

BENEFITS

- DURABLE
- STREAMLINED DESIGN
- QUALITY.
- MINIMAL MAINTAINANCE

7. CONCLUTION

- Based on the obtained results we can conclude that the proposed solution for a solar tracking system offers several advantages concerning the movement command of the PV panel:
- An optimum cost/performance ratio, which is achieved via the simplicity of the adopted mechanical solution and the flexibility of the intelligent command strategy.
- A minimum of energy consumption, due to the fact that the panel movement is carried out only in justified cases, eliminating unnecessary consumption of energy, and due to the cutting of the power circuits supply between the movement periods of the PV panel.
- A maximization of output energy produced by the PV panel, through an optimal positioning executed only for sufficient values of light signal intensity.
- A guarantee of the panel positioning starting from any initial position of the PV panel.
- The elimination of unnecessary movements, at too small intensities of the light signals or at too small differences between the signals received from the two LEDs.



8. ACKNOWLEDGEMENT

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