

Testing of a Microcontroller Based Solar panel Tracking System

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Abstract: *The sole objective of the present study is to obtain a more electrical power by tracking the solar panel. In view of the present energy crisis, the world over, the study undertaken is of current interest. Solar energy is rapidly gaining a wide popularity as an important means of expanding renewable energy resources. So it is imperative to those who are engaged in engineering fields to be aware about the technologies associated with this area of research. This paper comprises the testing results of a microcontroller based solar tracker at Etawah in Uttar Pradesh, India. In order to maximize the power output from the solar panels, we need to keep the panels aligned with the sun. As per the earlier investigators the yield from the solar panels can be increased by 30-60% by utilizing a tracking system instead of a stationary array. The testing result presented in this paper is in good agreement with the earlier investigators. This paper also summarizes the need of tracking the sun. The future scope of the work presented here is also highlighted in this paper. The microcontroller used in this paper had to be able to convert the analog photocell voltage into digital values and also provide four output channels to control motor rotation.*

Key Words: *Sun: Solar Tracking, Microcontroller*

I. Introduction

India is the Sunny region of the world. Most of the part of India receives 4-7 kiloWatt hours of solar radiation per square meter per day with 250-300 sunny days in a year. The highest radiation energy is received in western Rajasthan while the North Eastern region of the country received the lowest annual radiation. Annual solar radiation at the earth's surface is over 10000 times total primary global energy consumption. Total global primary energy consumption is less than the solar radiation incident at the earth's surface in one hour. According to market economy, the increasing worldwide demand for energy, forces a continuous rise on the price of fossil combustibles. In fact, it is expected in the near future, that the demand for energy will grow faster than the finding out of new available fossil resources. This market behavior brings a positive challenge to the scientific community as more funds are allocated for the research and development of new alternatives to the usual main energetic sources (i.e. Fossil combustibles). In fact it is expected in the near future, that the demand for energy will grow faster than the finding out of new available fossil resources (1). In this context we have assisted, in the last decades, to a concentrated focus on renewable energy research. Among these renewable energetic sources, the International Scientific community has devoted intense effort to wind, solar photovoltaic and Biomass. Many researches, Photovoltaic research at the National Renewable Energy Laboratory (NREL), focuses on boosting solar cell conversion efficiencies, the new MIT (Massachusetts Institute of Technology) research is based on findings that carbon nano-tubes are going on to develop some methods to increase the efficiency of Photo Voltaic Systems (Solar Panels). Some investigations and hardware developments on wave energy have been led by Great Britain and Portugal (2). It is therefore urgent to improve the production efficiency of the electricity from the sun as this energetic source is the most powerful in our planet, and it is expected that the sun will become the main electricity generation source by the year of 2100, according to the study presented by the German Advisory Council on Global Change (3).

Energy and environment are closely linked. The conventional source of energy based on fossil fuels is a major source of environmental pollution and global warming effect. It has therefore become imperative to think about a source of energy, which are environmentally sustainable and will not be passed with time as in the case of fossil fuels. Solar energy is considered as one of the most viable option which can fulfill the requirements mentioned above. It is clean, abundant and everlasting. Solar energy experienced by us as heat and light can be used through two routes: thermal route, uses the heat for water heating, cooking, drying, water purification, power generation and other applications and the photovoltaic route convert the light in solar energy into electricity, which can be used for number of purposes such as lightening, pumping, communication and power supply in different areas. Energy from the sun has many features; which makes it an attractive and sustainable option, global distribution and pollution free nature. Photovoltaic (PV) or solar electric cells are solid state devices that convert solar energy directly into electricity. It has no moving parts, requires no fuel and creates virtually no pollutants in operation. By using this technique it is possible to recover lost battery capacity and to increase the charge reception of battery.

Renewable energy solutions are becoming more and more popular nowadays. Photovoltaic (Solar) systems are one of these examples. Maximizing power output from a solar system is desirable to increase efficiency. In order to maximize power output from the solar panels, one needs to keep the panels aligned with the sun. As such, a means of tracking the sun is required. The sole objective of the present study is to develop an automatic tracking system which will keep the solar panel aligned with the sun in order to maximize efficiency. There are three ways to increase the efficiency of a photovoltaic (PV) system (4). The first is to increase the efficiency of the solar cell. The second is to maximize the energy conversion from the solar panel. To better explain this, solar panel under an open circuit is able to supply a maximum voltage with no current, while under a short circuit is able to supply a maximum current with no voltage. In either case, the amount of power supplied by the solar panel is zero. The key is to develop a method whereby maximum power can be obtained from the voltage and current multiplied together. This maximum power point can be illustrated at voltage current (V I) characteristics of solar panel. The third method to increase the efficiency of a PV system is to employ a solar panel tracking system. Designing of solar panel tracking systems has been ongoing for several years now. 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 radiated by the sun. It has estimated that the use of tracking systems, over a fixed system, can increase the power output by 30-60% (5).

The purpose of this paper is to present the testing results of a project study through which the Electronics and Communication engineering students developed a single axis (Azimuth) solar panel tracking system to satisfy the proposed objectives of the project study under the guidance of faculty members of the Department of Electronics & Communication engineering at undergraduate level in general and the author of this paper in particular. The sole objective of the present study is to obtain more electrical energy by deploying tracking systems into the solar panels. In view of the present energy crisis, the world over, the study undertaken is of current interest.

II. Materials and Methods

The purpose of solar tracker is to accurately determine the position of the sun. This enables solar panel to interface to the tracker to obtain the maximum solar radiation. The block diagram of overall system is shown in Fig.1.

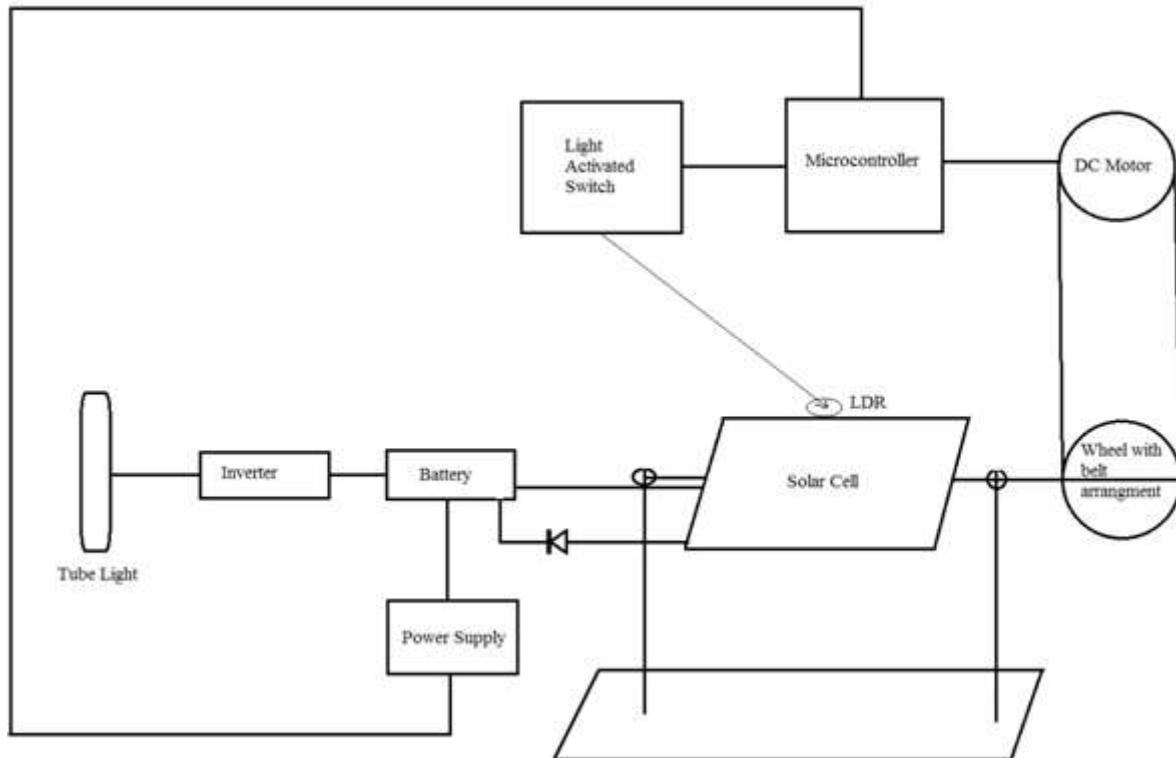


Fig. 1: Block Diagram of Microcontroller based solar tracker.

The electrical system consists of LDR (Light Dependent Resistors) sensors which provide feedback to a microcontroller. This microcontroller processes the sensor input and provides two PWM signals for the movement of Motor. The model microcontroller based solar tracker consists of a rectangular solar panel of

dimension 7x14 cm. The model consists of solar panel, LDR, ADC, Microcontroller, stepper motor and its driving circuit. The LDRs are fixed on the solar panel at two distinct points. LDR varies the resistance depending upon the light fall on it. The varied resistance is converted into an analog voltage signal. The analog voltage signal is then fed to an ADC. ADC is nothing but analog to digital converter which receives the LDR voltage signals and converts them to corresponding digital signal and the converted digital signals is given as the input to the microcontroller. Percentage increase in glow of a tube light with and without tracking system may be calculated by the following formula;

$$\% \text{ increase in glow of a tube light} = \frac{\text{time of tube light glow with tracking} - \text{time of tube light glow without tracking}}{\text{time of tubelight glow without tracking}} \times 100$$

III. Results and Discussion

Since the working model of the Microcontroller based solar tracker is mainly concern with the embedded software control, the Microcontroller (AT89C51) is the heart of this model. The Microcontroller selected for this model had to be able to convert the analog photocell voltage into digital values and also provide four output channels to control motor rotation. The detailed circuitry of Microcontroller based solar tracker is shown in Fig. 2.



Fig.2. A schematic view of the solar tracker

Since renewable energy is rapidly gaining importance as energy resource as fossil fuels prices fluctuates. At an educational level, it is therefore critical for Engineering and Technology students to have an understanding and appreciation of the technology associated with renewable energy. One of the most popular non-conventional energy sources is solar energy. The potential efforts of this study are to test a model of a microcontroller based solar tracking system in Etawah District of Uttar Pradesh. Solar tracking enable more energy to be collected because the solar panel is able to maintain a perpendicular profile to these sun rays. To compare the efficiency of solar tracker with and without tracking system a motor cycle lead acid battery of capacity 6V is used for testing the model. The solar panel is put in the sunlight on 1st May 2012 during 7am-5.30pm without tracking system and solar panel is connected to full discharge battery for charging. The solar panel used in this model rectangular in shape and the dimension of the panel is 7cmx14cm. The power collected by battery in the observation glow the tube light of 20W for 143 minutes. The experiment repeated by using tracking system on 2nd, 4th 7th May 2012 during same time interval and the power collected by the battery glows tube light of 20W for 189, 190 and 191 minutes respectively. Considered days in the testing analysis in Etawah are completely sunny days. Mean time of tube light glow with tracking is 190. These observational data are put into the efficiency calculations and the outcome of the efficiency calculations shows approximately 32.87% increase in the efficiency of battery charging.

IV. Conclusion

Testing results of the present study are quite encouraging. The calculations have indicated about 32% increases in efficiency of the battery charging when the tracker is employed. This type of the model can be implemented in most of the regions of the India as it located near the equator. Now a day there is an immense energy crisis prevailing all over the world. So the designing of solar tracker (single axis and dual axis both)

finds an important application to harvest the solar energy for the use of our daily needs in homes, Institutions, Industries and in Hospitals etc.

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