Performance Investigation of Photovoltaic System Using LDR Based Solar Tracking

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Abstract:
The most encouraging renewable energy sources characterized by a huge potential of conversion into electrical power is the solar energy. India has a commissioning status of grid connected solar power projects under the JNNSM solar mission to generate the electricity with different phases, cumulative target under phase-3 (2017-2022) is 20,000(mw) and it reached 6762.853(MW) up to 31-03-2016. There are two way conversion of solar energy into electrical energy, thermal energy utilization and solar cell (PV technology). The conversion of solar radiation into electrical energy by PV effect is promising technology. It is clean, silent and reliable with least maintenance cost. The efficiency of PV panels is not more than 20%, hence attempt is always made to improve it. By using solar tracking, optimizing the solar cell technology, geometry or using reflectors, use of new materials the efficiency as well as power output may be increased. In the present study, attempt is made to enhance the power, solar tracking using microcontroller has been investigated. An smart solar tracker and diffused reflector amplified systems were designed, developed and installed to compare the power output that can be produced from them; and which system will accomplish advanced power output so as to cut the number of PV panels required at any given time especially when price tag is a major factor. For this relative study, experimental readings were concurrently taken from the panel, with solar radiation tracker and the panel with diffuse reflectors associated at 23.50 with the horizontal. Investigational results designate an appreciable growth in the overall power output of the solar panels. It is exposed that the power output of the panel with reflectors start rising from about 11 am till 2 pm, while the panel with tracking was higher at other times. The typical power output of the system for a day is about the equal.

Keywords: Solar energy, Photo Voltaic (PVT), solar tracker, diffused reflector, LDR

1. INTRODUCTION

From the several renewable energy sources, one of the most promising renewable energy sources categorized by a enormous possible of conversion into electrical power is known as solar energy. Electrical power generation by Photo-Voltaic (PVT), is reliable technology, being cleaned, silent and reliable, which has small maintenance cost and small ecological impact. The focuson the Photo Voltaic (PV) transformation systems is reflected by the continuous rise in the sales in market segment with a growth forecast for the forthcoming periods. According to recent market research projects carried out by the European Photovoltaic Industry Association (PIA), the total connected power of PV equipment increased from about 1.2 GW in 2001 up to nearly 23 GW in 2010.

The continuous descriptions of the technology strong-minded a continued surge of the conversion efficiency of Photo Voltaic panel, but nevertheless the most important part of the marketable panels have efficiencies not more than 25%. A continuous research preoccupation of the technical community involved in the solar energy coupling technology provides for various answers to improve the PV panel's conversion efficiency. Among different solution; Photo Voltaic efficiency improvement we mention: solar tracking, optimization of geometry of solar cells, augmentation of light deceiving capability, use of new materials, etc. The output power shaped by the PV panels is subject to upon the incident light radiation.

The unceasing development of relative position in-between sun & earth determines a continuously changing of incident radiation on a fixed PV panel. The point of higher received energy is gained when the direction of solar radiation is normal on the panel surface. Thus an increase of the output energy of a given PV cell can be obtained by mounting the panel on a solar tracking device that follows the sun trajectory. Unlike the classical fixed Photo Voltaic sets, the mobile ones driven by solar trackers are kept under optimum insulation for all locations of the Sun, boosting thus the PV conversion efficiency of the system. The output energy of solar trackers equipped with PV panels can show increasing order with tens of percent, especially during the summer days when the energy yoked from the sun is more important. Photo-Voltaic or PV cells, known commonly as solar cells, transfer the energy from sunlight into Direct Current. PVs offer added benefits over other renewable energy sources in that they provide noiseless and maintenance free service. The degree of accuracy between sun &tracking system must be accurate, return the collector to its original position at the end of the day and also track during period of cloud over.

Solar energy is rapidly gaining popularity as an important means of expanding renewable energy resources. As such, it is important that those in technical fields understand the technologies related with this area. This paper gives the design, development and construction of a microcontroller-based solar panel tracking setup. Solar tracking provides more power to be produced because the solar array is capable to remain aligned to the sun. A working tracking system will eventually be established to authenticate the project. Difficulties and likely enhancements will also discuss.

The components of this system are as follows.

1. Light dependent resistor,
2. Microcontroller,
3. Stepper motor.

II. SYSTEM CONCEPTS

Our aim of design and development of Solar Tracker system is to develop as well as implement a simplified diagram of a horizontal axis and solar tracker fitted to a panel. It is best capable of circumnavigating to the best angle of exposure of light from the illumination. Couples of sensors are used to point the East and West position of the light dwindling on it. Here we design a scaled prototype model that will be manufactured to test the working performance of the tracking system. The center of the energy is a motor (DC). Figure 1 shows a representation diagram of a horizontal axis solar tracker. This will control by microcontroller program. The intended algorithm will give power to the motor drive after dispensation the response signals from the sensor array.

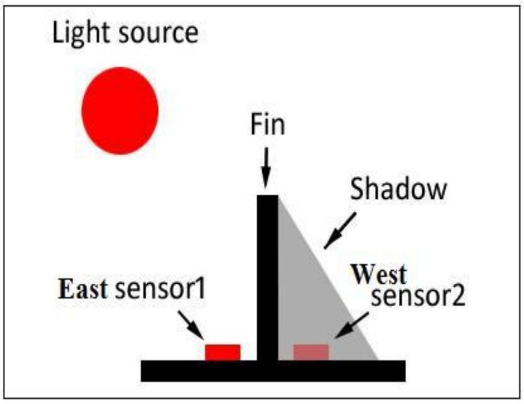


Fig. 1 Diagram of Horizontal Axis Solar Tracker

The Microcontroller program is helpful to monitor and displaying the intensity of light output from the photodiodes. The light detected by the Eastward-facing sensor is at a low intensity as compared to that sensed by the Westward-facing sensor. Hence, the sensor must be twisted westwards (by using motor controlling unit by using the solar tracker circuit system) up to the levels of light drawn by both the East and the West sensors are equal. At the point of the solar panel will be directly facing the light and produced electricity efficiently. The real world solar trackers are not simple in design. A solar tracker should retune on its own at the time of sunset such that it is ready at the time of sunrise, also it should reimburse with heavy cloud. In addition to this solar panel is made to cope with heavy winds and we should select a suitable motor for light tracker using two light sensors. Light tracker is typically used for maximum energy getting of solar panel as well as for making light subsequent robots. In this example, two LLS05-A light sensors is used. The output luminance gets from this sensor is of linear type. Figure 2 below shown the concept of how it works, it works by finding balance between the two sensors. Principle of process uses two photo transistors enclosed with a small plate to act as a safeguard to sunlight, as shown in below.

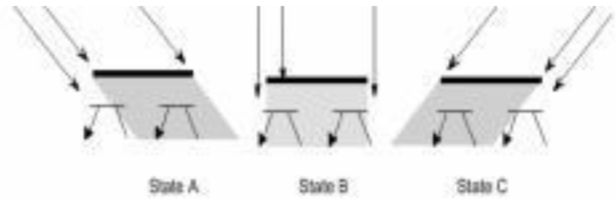


Fig.2 Operation of an LDR

III. POWER SUPPLY

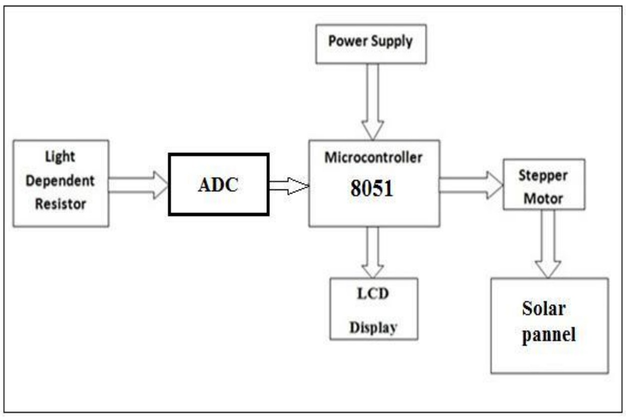


Fig. 3 Block Diagram of setup

IV. POWER SUPPLY INCLUDES FOLLOWING MAIN COMPONENT

1.Transformer
2.Rectifier
3.Filter
4.Regulator

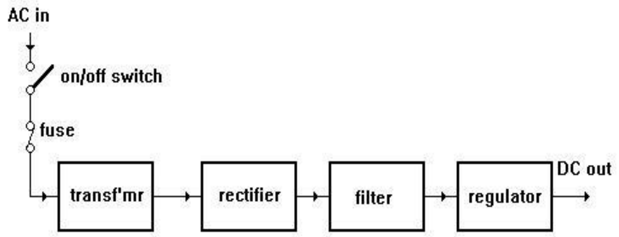


Fig. 4 Block diagram of Power supply

At first the maniac supply which passes through an isolating switch and safety fuse previously its transitory through the power supply component. In utmost cases the high voltage mains supply is 230 Volts. &it is too large for the electronic circuit.

For process of microcontroller compulsory 5 V DC supply required. It is consequently stepped down to a lower value by means of 5 V AC a Transformer.

When we require high DC voltages at that time we can step up the mains voltage. From the transformer the AC voltage is served to a rectifier circuit comprising of one or more diodes. The rectifier transmits AC voltage to DC voltage. This DC is not stable as compared to that of battery supplies. It is pulsating. The pulsations are round out by passing them through a smoothing circuit called a filter. In its simplest form the filter is a capacitor and resistor. Any outstanding small disparities can, if necessary, be removed from a regulator circuit which gives out a very steady voltage. This regulator also grabs any variations in the DC voltage output produced by the AC mains voltage altering in value. This 5 V DC voltage is provided to microcontroller for its operation..

V. EXPERIMENTAL RESULTS

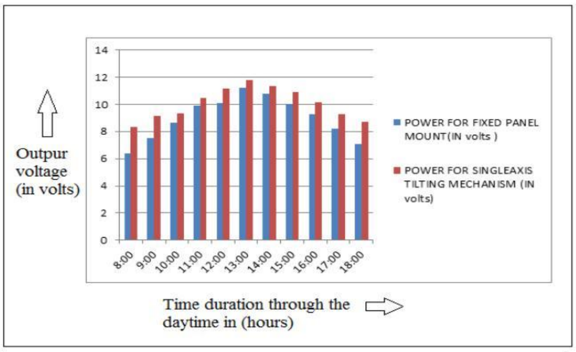
In order to validate the proposed model, it was necessary to compare the experimental results of the fixed panel with the smart solar tracker system. To acquire this figures, simple trials were performed. The testing setup for both fixed, and tracker system can be seen in Fig. The setups were installed on a metal frame that was 3 m above the ground. The open-circuit voltage and the current readings were documented using a multi-meter associated to the solar cells. The climatic condition considered for experimental was a sunny day during the entire test period. The average temperature documented was about 30˚C and the local wind speed was aired to be around 0.8m/s (or 1.6knots) during the tests.

The test was conducted with first the solar panel fixed to surface and secondarily with tilting mechanism as shown in above with DC motor.

The observations carried out are shown below.

Table 1 Result Table

Time In Hour (24 Hr Format)	Voltage For Fixed Panel Mount (In Volts)	Voltage For Single axis Tilting Mechanism (In Volts)	% Increase (In Voltage)
08:00 to 09:00	6.3	8.3	23.5
9:00 to 10:00	7.5	9.1	18.0
10:00 to 11:00	8.6	9.3	7.4
11:00 to 12:00	9.8	10.4	5.3
12:00 to 13:00	10.1	11.1	9.1
13:00 to 14:00	11.4	11.8	3.3
14:00 to 15:00	11.1	11.3	1.7
15:00 to 16:00	10.7	10.9	1.8
16:00 to 17:00	9.6	10.1	4.9
17:00 to 18:00	8.2	9.3	11.5
18:00 to 19.00	7.6	8.7	12.1
Average Increase In Voltage			9.01



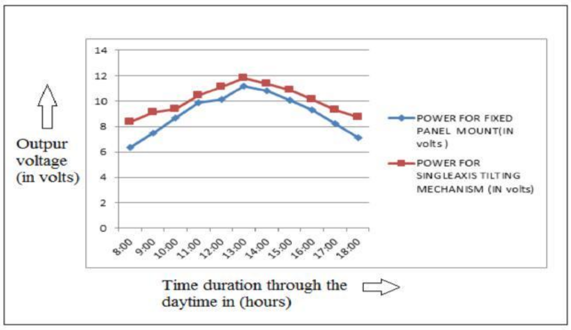


Fig. 5 Comparison between Power Consumed By Fixed Plate and Tracking Plate

VI. CONCLUSION

From the design of investigational setup with Micro Controller Based Solar radiation Tracking System By means of Stepper Motor. If we compare Tracking by the use of LDR with Fixed Solar Panel System we found that the performance of Micro Controller Centered Solar Tracking System is enhanced by 09-15% and it was seen that all the fragments of the experimental setup are giving good results. The essential Power is used to run the motor. Furthermore, this tracking system does track the sun in a unremitting manner. And this system is more efficient and cost-effective in the long run. From the results it is found that, by the automatic tracking system, there is 30 % gain in increase of efficiency when compared with non-tracking system. The solar tracker can be silent improved additional features like rain protection and wind protection which can be done as future work

VII. FUTURE SCOPE

The goals of this project were intentionally kept within what was supposed to be achievable within the selected timeline. As such, many enhancements can be completed upon this initial design. That being said, it is felt that this design characterizes a operative small scale model which could be simulated to a much larger scale. The following endorsements are provided as ideas for future expansion of this project:

- Intensification the sensitivity and accuracy of tracking by using a various light sensor. A phototransistor with an amplification circuit would provide enhance resolution and better tracking accuracy/precision.
- Use a dual-axis strategy versus a single-axis to increase tracking accuracy.

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