A Review on Solar MPPT system and its Application

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ABSTRACT

Solar energy is viewed as the most optimistic form of natural resources in the current century. The photovoltaic material is being developed to improve the efficiency of solar energy conversion. The paper focuses, mostly on the efficiency of the solar panel, in relation to the sunlight angle with respect to the panel surface. A solar tracking system for reusable energy is enhanced and made to absorb free energy from the sun, store it in the battery, and transform this energy to dc voltage. The use of stepper motor enables accurate tracking of the sun. LDR resistors can be used to determine the solar light intensity. A brief review is done over photovoltaic characteristics, design of tracking system and the software used for simulation model. A microcontroller based design methodology of an automatic solar tracker is presented in this paper.

Keywords: Microcontroller, Solar tracking system, solar photovoltaic module, Stepper motor, solar energy.

I. INTRODUCTION

Energy is the prime factor for the development of a nation. Nowadays, a large amount of energy is still produced from traditional fossil fuel sources such as oil and coal, which cause pollution and are damaging the environment in longer term. The modern trend in energy/electricity production is aligned to a move towards more sustainable renewable energy sources such as solar (photovoltaic) and wind energies.

The sun is the source of solar energy, directly or indirectly, which also works as a fuel for most renewable and solar based systems. Among all replaceable systems, photovoltaic system has great ability to replace the conventional energy resources.

The project tackled by the paper concentrates on the use of solar energy to generate electricity. This paper approaches the efficiency of the solar panel with respect to the incident angle of the sunshine on the panel. The most important challenges for the efficient operation of solar panels are linked to the weather conditions, the sunlight incident angle on the panel surface, and the high initial investment (development/setup costs).
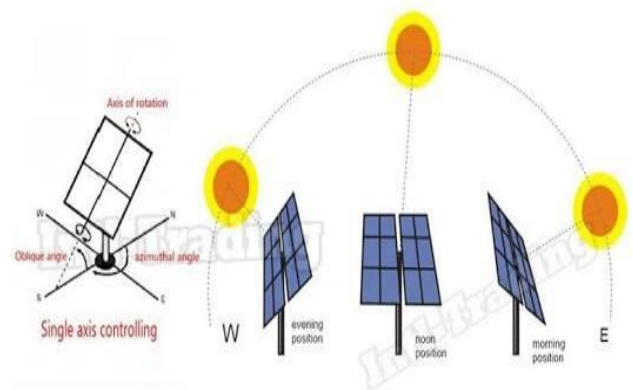

Figure 1: Traffic Light Detection

In the project, maximum power point tracker is an electronic DC to DC converter that computes the match between solar array (PV panels) & the utility grid. It simply converts a high voltage Direct Current output from solar panels to the low voltage needed to charge batteries. Maximum power point tracking is electronics tracking – usually digital. The charge controller verifies at the output of the panels and analyse it to the

battery voltage. Most upgraded MPPT's are about 93-97 percentage capable in the transformation. Typically, we get 22-45% power gain in winter and 10-15% in summer.

As discussed earlier that the output of PV module depends over the certain characteristics. Thus, to enhance the efficiency of Module or in order to harness the larger amount of electricity one has to deal with the characteristics on which the output depends. By providing solar tracking system to a PV module the respective output can be enhanced. The sunlight falls over the module can produce the maximum power at the times when the sun rays are perpendicular to the module surface. This will tend to maximize the amount of power radiated by the sun. It has been estimated that the use of a tracking system, over a fixed system, can increase the power output by 30% - 60% (Khan, et al., 2010).

A 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 other 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. The point where the maximum power from the system can be obtained is called Maximum power point, to track that point during the sunshine hours is called as Maximum Power Point Tracking (MPPT) to get the MPPT there are two ways of electronic design methodology which can be incorporated.

The power point tracker is a high –frequency DC to DC converter. They take input from the solar panels, transforms it to high frequency AC, and convert it to a different DC voltage and current to exactly compare the panels to the batteries. MPPT's operate at very high audio frequencies, usually in the 20-80 kHz range.

II. RELATED WORKS

In [1] Laura-Carmen-Marius was concerned with a portable automatic solar panel, mounted on a mobile trailer. The benefits of a mobile solar panel versus one mounted in a fixed position are highlighted. This research is focuses mostly on the efficiency of the solar panel, in relation to the sunlight angle with respect to the panel surface. They have use Arduino Uno Rev3 and Rotating the Servo motor HD6001DB. They will rotate the motor in symmetric angle.

In [2] Jeng-Nan Juang and R. Radharamanan was concerned a solar following system for reproducible energy is enhanced and built to absorb free energy from the sun, save it in the battery, and convert this energy to alternating current (AC). This paper is intended on solar energy, which is a renewable and reusable form of energy. On average the earth surface absorbs about 600 W/m2 of solar energy. They have use JUTA MPPT-10 Charge controller, The Allegro Micro system ACS758 current sensor, Arduino Uno and DEKA 8G34 Photovoltaic battery.

In [3] Ahmad Ashi, Amer, Abu Joudeh was concerned the solar energy an important renewable energy resource. To maximize the amount of harvested electrical energy through photovoltaic cells, solar tracking algorithms are usually used. In this work, we presented a design of a PV solar tracking system. Several tracking algorithms were implemented and evaluated. The proposed algorithm increased the harvested energy by about 4% on sunny days and 10% on rainy and cloudy days when compared to other studied tracking algorithms. They used FPGA boards to control the dual axis solar cell mount and also used a DC motor and a microcontroller unit with two LDRs to control a single-axis tracking system.

In [4] Khyati Vyas, Dr. Sunil Joshi and Dr. Sunil Joshi was concerned a smart solar tracker which consists of an automated tracking mechanism is reviewed in this literature. The various types and methods of operations are studied. The paper represented short review over solar tracking system depending on microcontroller. The paper describe about the simple and attractive features of tracking system. The use of stepper motor enhance accurately follows the sun. LDR resistors are employed to determine the solar light intensity. The paper concludes that embedding the tracking system with solar based system can reply accurately, the power demands at different operational condition. The system can also be incorporated with the two axis rotation of the panel in order to increase its output power.

In [5] S. Aziz and S. Hassan was concerned a model of the two axis solar tracking system that can communicate over the power line with other devices on the smart grid such as storage devices, consumer appliances, remote computers, etc. It is possible to store the generated electrical energy in several storage devices in the grid, based on the availability and demand. They have used Wheatstone bride with LDR. The motor refers to an actuator that operates on electrical energy to produce rotational motion. They have also used PLC system (Power Line Communication) refers to a system that depends only on power line networks.

III. METHODOLOGY

"The design of solar tracking system originates from the need to improve the performance of the solar collector. A solar panel receives the morning and evening sunlight and acute angle, thus reducing the total amount of electricity generated each day. The most attainable method of improving the performance of a solar power collector is to increase the mean intensity of radiation received from the source. This is achieved by tracking the sun.

The purpose of designing a solar tracker is to propose the conception and development of solar tracking system, such that the solar panel throughout the sunshine hour's remains perpendicular to sunlight beam and fit's to the user power requirement.
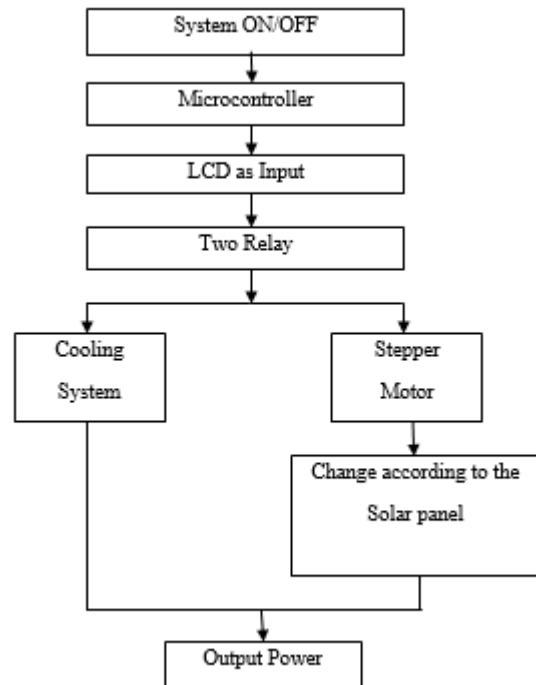

Figure 4: System Flow

The consumption of light tracking system is quite simple, where light detectors detect position of the sun, base on sensor reading, and generated sun tracking error, based on error, the control unit generates the voltage used to command drive circuit to drive a low – speed motor, that outputs the rotational speed or displacement of electric motor, until it perpendicularly faces the sun. Based on this and on pre-study process, a preliminary simplified block diagram representation of solar tracking system which is the shown in figure.

IV. SIMULATION MODEL

The ability to operate as a solar tracker, computer models of the PV panel and the electro-mechanical systems can be modelled using MATLAB/Simulink environment. In literature, MATLAB was used to model and analyse the PV

model characteristics. However, there are only a few attempts (aziz 2014) to model the entire PV standalone system, including the electro-mechanical subsystem such as DC motor, drive transmission, microcontroller output, and battery and charging module. The PV standalone system model comprises of a PV panel, a servo motor, LDR sensor, external disturbances and the microcontroller can be modified employing MATLAB/ Simulink.

It is preferred due to its easy to program language supported by ready toolboxes and graphic block diagrams can be designed for complicated system simulation. With the completed system model, it is used to analyze the power and its ability over the fixed solar panel before actual implementation (lelutiu 2017).

V. CONCLUSION

This paper presented a brief review over solar tracking system based on microcontroller. The various types and methods of operations are studied. The paper described about the simple and attractive features of tracking system. The solar tracker also provides lucrative solution for third world countries to integrate it into their solar system with a comparatively low coast through software based solution. The study reveals that the used the stepper motors enables accurate tracking of the sun. LDR Resistors are used to determine the solar light intensity. The paper concludes that embedding the tracking system with solar panel can response accurate and applicable to meet out the power demand at different operational situations.

In this system the further research can be done to make the system more precise and accurate. The system can also be incorporated with two axis rotation of the panel in order to increase its output power, but research could be done to achieve batter effectiveness.

VI. REFERENCES

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