Solar Panel Using Maximum Power Point Tracking

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Abstract— Today's world there is a lot of increase in energy demand. Now it's time for us to come up with innovative solutions. The utilization of solar energy is very less compared to other available resources at present. It is going to increase in future. We are going to describe a technique for extracting maximum power from a photovoltaic panel to charge the battery. The power from the solar panels is applied to charge controller which gives output to a battery where energy is stored. An inverter is present at the output of battery to access stored power. A DC-to-DC converter is present inside the charge controller to match the PV module voltage to battery voltage. Microcontroller is programmed to always output maximum power. It performs its operation by taking input & output voltage as well as current from solar panel and DC-to-DC converter, irradiance levels from light sensor and temperature from temperature sensor. An additional feature here is to transmit the data from the microcontroller to location via serial communication interface.

Key words: Photovoltaic Panel, MPPT, DC-To-DC Converter, Microcontroller and Serial Communication

I. INTRODUCTION

Solar energy is one of the most important renewable energy sources that have been increased in recent years. It has the greatest availability compared to other energy sources. Solar energy on earth is sufficient to power the total energy needs of the earth for one year. The conversion of solar energy into electrical energy has many application fields.

Solar to electrical energy conversion can be done in two ways: solar thermal and solar photovoltaic. Solar thermal is similar to conventional AC electricity generation by steam turbine excepting that instead of fossil fuel; heat extracted from concentrated solar ray is used to produce steam and apart is stored in thermal insulated tanks for using during intermittency of sunshine or night time. Solar photovoltaic use cells made of silicon or certain types of semiconductor materials which convert the light energy absorbed from incident sunshine into DC electricity.

Photo voltaic generation systems generally use a microcontroller based charge controller connected to a battery and the load. A charge controller is used to maintain the proper charging voltage on the batteries. The input voltage from the solar array, then charge controller regulates the charge to the batteries prevent any overcharging. So good, solid and reliable PV charge controller is a key component of any PV battery charging system to achieve systems maximum efficiency. Whereas microcontroller based designs are able to provide more intelligent control and thus increases the efficiency of the system.

II. LITERATURE SURVEY

New MPPT algorithm is based on the maximum power point tracked with the help of PV array. [1].

The PV-PC is implemented by a boost current converter (BCC). It is used to eliminate sulphating crystallization on the electrode plates of the LAB and to prolong the battery life. The boost current converter is associated with the PV module which is modeled to maximize charging energy in battery under MPP. [2].

The solar system is modeled in MATLAB/SIMULINK. Simulation. The result shows that P&O based MPPT has better performance and more power is produced from solar panel. [3].

Panom Petchjatupornetal introduced maximum power point tracking algorithm by using artificial neural network for a solar power system. [4].

Maximum power point of a solar array can be efficiently tracked by applying some simple activation functions and three layer neural network. Maximum Power Point Tracking (MPPT) technique is widely deployed. [5].

Lot of MPPT techniques have been developed in recent years but still most commercial systems utilizes perturb & observe (P&O) MPPT technique because of its low cost, simple algorithm and ease of implementations.

In standalone dc system, dc to dc converter was used to interconnect the solar Photovoltaic (PV) panel and battery. [6]. To utilize solar PV to best, maximum power point Tracking (MPPT) was in-corporate with controller.

III. PROPOSED SYSTEM

In this paper we have presented the photovoltaic solar panel operation. Finest way to increase the efficiency of a solar panel is to use a Maximum Power point Tracker. MPPT maximizes the array efficiency for reducing the overall system cost. In addition to that, we design the MPPT by using the algorithm called "Perturb and Observe". It is implemented by using a DC-DC Converter. We have various types of DC-DC converter. Out of them we have selected the most suitable converter which is "BUCK & BOOST" converter.

The block diagram of Solar using maximum power point tracking is shown below.

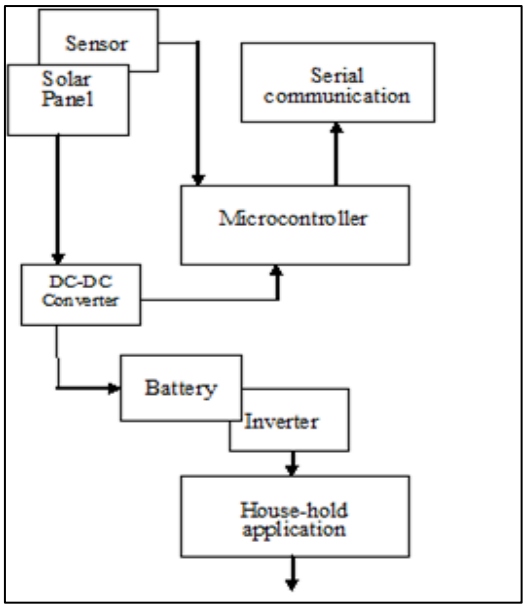

Fig. 1: Block Diagram of Solar Panel Using MPPT.

The block diagram consists of following parts:-

A. Microcontroller:

Microcontroller is responsible for input and output processing of entire system. Microcontroller 89C51 is used which is low power, high performance CMOS 8 bit microcomputer with 4kb of flash programmable and Erasable Read only memory. Reading sensors device value, controlling battery charging circuit and monitoring system performance are basic tasks of microcontroller.

B. Photovoltaic Module:

PV device made up of various type of semiconductor material arranged in various structure. Silicon, polycrystalline thin films, single crystalline thin films are three main type of material. DC-DC Converter (Boost and buck) DC-DC converter is also used to convert unregulated DC input into controlled DC output at desired voltage level.

1) Boost converter is power converter which DC input voltage is less than DC output voltage. Means PV input voltage is less than battery voltage.
2) Buck converter is power converter which DC input voltage is greater than DC output voltage. Means PV input voltage is greater than the battery voltage.

C. Battery:

Electrical energy produced by PV module array cannot always be used because demand for energy does not always coincide with its production. Batteries are commonly used in PV system.

D. Inverter:

Inverter has function to take DC voltage stored in batteries and transform it into AC voltage which is used by small applications.

E. ADC 0809:

Monolithic CMOS device with 8 bit A-D converter, 8 channel MUX and microprocessor compatible logic gates. The 8 bit A/D converter uses tech for conversion logic successive approximation.

F. Working:

Here in this system main part is photovoltaic module. Sunlight incidents on Photovoltaic panel. PV panel converts solar energy into electrical energy.

Sensors are used to sense voltage, current, temperature level. Infrared sensors are used to detect the position of PV panel. The output from PV panel is given to DC-DC converter. DC-DC converter is used to produce pure DC voltage as well as for optimizing the output voltage of panel to match the required voltage level of battery.

Microcontroller is programmed to give maximum output power. Method which is used for tracking the maximum power is "perturb & observe".

G. Maximum Power Point Tracking:

By continuously tracking the MPP we get max PV module output power. Here by using charge controller it is not possible to obtain MPP control hence we use MMPT algorithm. Typical VI characteristic of a solar panel is shown in Fig.

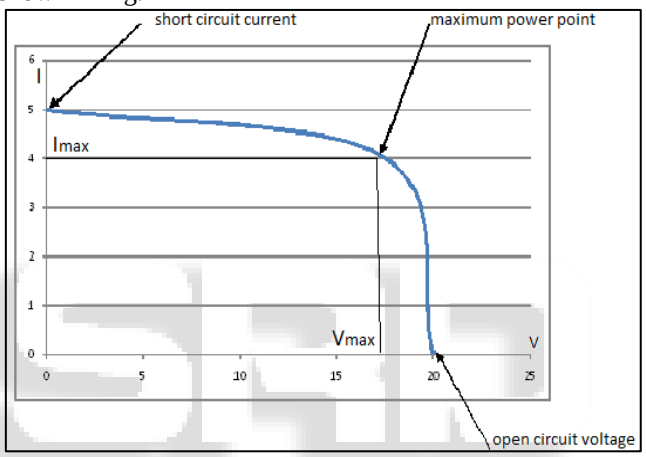

Fig. 2: PV Array V-I Characteristics

As we known MPPT algorithms are Important in PV applications. Because, maximum power depends on load connected temperature and irradiance level.

IV. PERTURB AND OBSERVE METHOD

Perturb and observe method is based on "hill climbing" principle and this method is widely used. If the operating voltage of the PV array is perturbed given direction and if the power drawn from the PV array increases, means that the operating point has moved to the MPP and, the operating voltage must be further perturbed in the same direction.

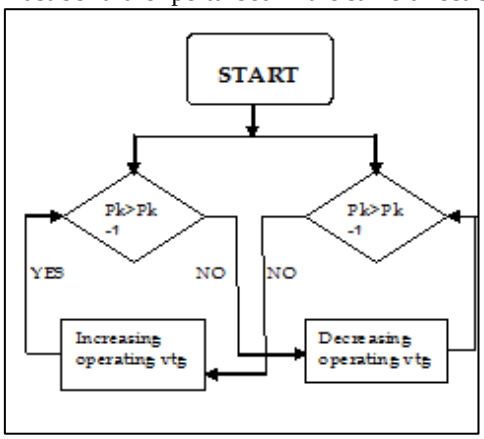

Fig. 3: Flowchart of Perturb and Observe Method

The important factor to choosing a technique to perform MPPT is the ability of an algorithm to detect multiple maxima, costs, and convergence speed.

The various algorithms are available here out of all the available perturb and observe method is the most recognized.

V. FUTURE SCOPE

In future this approach can be applied for tracking the maximum power point without using any type of controller. Hence, reducing the cost &increasing the efficiency of the system. The basic advantage of only using perturb and observe method is that when it is properly optimized it can offer very high max power point tracking efficiency, Which is highly competitive against other max power point tracking algorithms.

VI. CONCLUSION

Here we present simple but efficient photovoltaic system with maximum power point tracking. Description of each component like solar panel, DC-DC converter and charge controller is presented. As, our aim was to design a system which can extract maximum output power, so we explained about maximum power point (MPP) and maximum power point tracking (MPPT). There are different methods for tracking maximum power point but out of those perturb and observe method is used for its simplicity and ease of implementation.

P&O algorithm requires only two sensors (voltage and current) for output. This control method gives another benefit of steady-state analysis of the DC-DC converter

VII. REFERENCE

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