Design and Performance Analysis of Multi-use solar PV charge controller training system

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***Abstract* - Solar Photovoltaic System is a clean and green source of energy. Which is very much popular source of energy nowadays. Solar PV system is out there in varied forms. Off-Grid star PV system is appropriate for rural areas in an also the places, wherever frequent electricity outage is occurring. Solar Modules, Inverter and Batteries are major components of Off-Grid Solar PV System. Battery cost is around 40% of total system cost. That is why, maintenance of Battery is very much important task in operation and maintenance of solar PV system. Solar Modules are not an ideal source of charging a Battery. In order to maintain the battery lifecycle, charging algorithms should be followed with regulated voltage and current. To charge the battery with regulated voltage and current, Charge Controllers are used in Solar PV system. Mainly two types of charge controllers are available for battery Charging. 1) PWM Charge Controller and 2) MPPT Charge Controller. In this project we will be learning how PWM and MPPT charge controllers are used to maintain the battery life cycle and how both the charge controllers are different from each other. In addition to battery monitoring and management using PWM and MPPT, we will be implementing Manual and Automatic IV plotting of Solar Modules with Sun Tracking Mechanism using Actuator and Microcontroller.**

***keywords* - Charge controller, Battery, solar modules, Automatic IV Tracing, etc.**

I. INTRODUCTION

Basically charge controller are having two types in industry which are MPPT and PWM. Charge controllers are control the voltage and current in the battery, solar panel etc. These in energy system we need to use of solar energy to save the other fuels that are diminishing day by day. Solar energy is available in nature and totally free source of energy .

In the charge controller PWM charge controller is connected with the solar array PV cells then at the time of sun power will regulate the charge controller in the battery. MPPT charge controller connected to the solar array PV cells. It gives maximum power at the point of time and regulate in the battery. In these time we have different types of trends like solar tracking, tracing voltage and current but combination of this trend gives high efficiency and reliability. The comparative study of two charge controller are record.

II. SYSTEM CONFIGURATION:

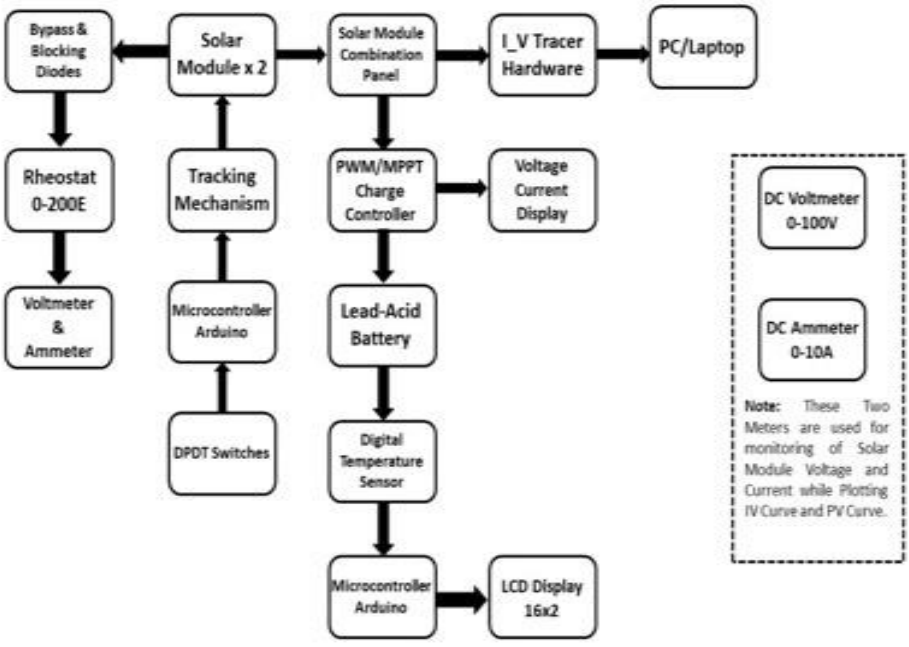


Fig.1 block diagram of solar PV charge controller training system

Solar Module:

Fig.2 Solar Module

Solar Module is a source of energy, which generates DC power using Photovoltaic effect. Solar Module is formed after connecting multiple solar cells in Series. Solar Cells are connected in series to form desired voltage. In this project 20W x 2 Poly/Mono Solar Modules will be used in order to charge Lithium Ion Battery. These two Solar Modules will be placed on MS structure with Tracking Mechanism in order to change the Tilt angle and Azimuth angle.

Single Axis Tracking Mechanism:

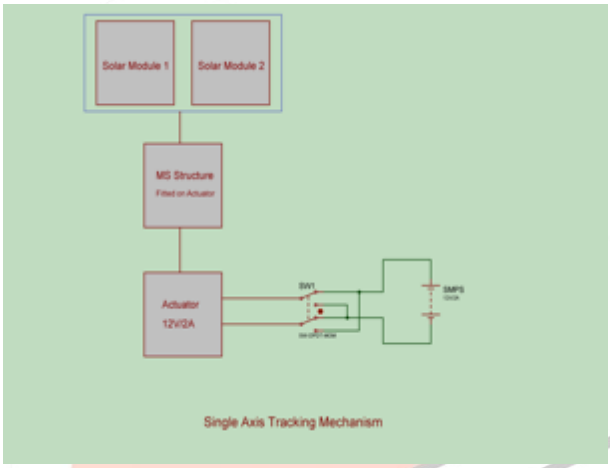


Fig.3 Single Axis Tracking Mechanism

Single Axis tracking mechanism has been implemented here to observe the change in voltage and current with change in tilt and azimuth angle. We will be using one 12VDC/2A actuator which is used to change the tilt angle. One DPDT switch is used in order to operate the actuator. DPDT switch are want to modification the lean angle of the Solar Modules.

Solar Module Combination Panel:

In this Project, we are going to observe the change in voltage and current of solar module, when it is connected in Series and parallel. In this combination panel multiple connectors are given to make the series and parallel connection of solar modules. In this combination panel DC voltmeter and Ammeter is given for voltage and current display while plotting IV curve.

Automatic IV Tracer:

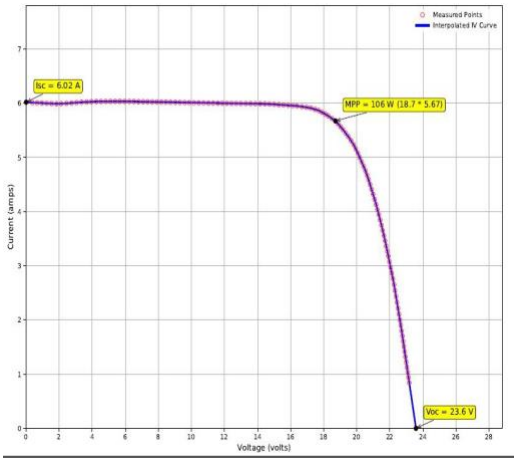


Fig.4 Graphical Representation of Automatic IV Tracer

In this project, Automatic and Manual IV tracer is given. Manual IV tracing will be done using Solar Module, DC Voltmeter/ Ammeter and Rheostat(200E/2A). For Automatic Tracing we will be implementing Electronic Rheostat which will be controlled using Microcontroller. Automatic IV Tracer hardware comes with USB cable which will be connected to Computer/Laptop and in Computer/Laptop one software is given where we can see the IV and PV curve. User can save the IV curve.

***Charge Controller*:**

As the name implies that charge controller manage the flow of current going to battery bank from solar array. The charge controller preserve life and performance of battery. It protect the battery by disconnecting it from the circuit when over charging and over discharging is happen.

The main function of charge controllers are:

1) To regulate voltage and current returning from the battery.
2) To prevent the battery from overcharging.
3) To stop the battery from warming.
4) To stop the battery from discharging.
5) To stop the battery from reverse drainage.

***PWM charge controller**:*

Fig.5 PWM charge controller

PWM stands for pulse width modulation. It is also known standard charge controller. They are less complicated than MPPT controllers, and so typically less costly. It slowly reduce the power going to battery when it goes to maximum capacity. PWM charge controllers have same nominal voltage across battery bank and PV array. It give constant voltage battery charging by switching solar system power devices. PWM controller is an switch which is connected between solar panel and battery.

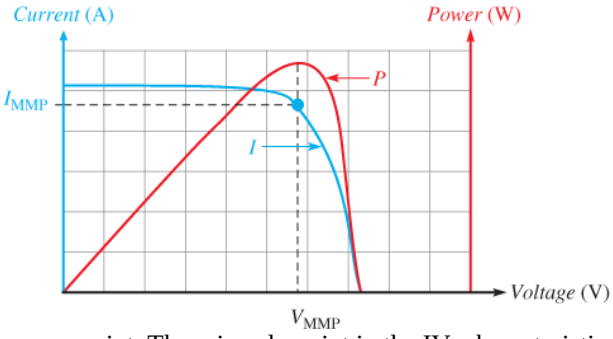
PWM system has following advantages:-

1) Charging efficiency is high.
2) Battery life is longer.
3) It reduces overheating, overcharging and discharging problems.

***MPPT Charge Controller**:*

Fig.6 MPPT Charge Controller

MPPT means maximum power point tracking. MPPT charge controller is most advance charge controller in solar system. The function is to bring operating point of load closed to the maximum powerpoint under different operating condition. It extract maximum available power from PV module under various condition (less radiation,more radiation,high temperature etc). It used algorithm electronic circuitry.



The above figure shows maximum powerpoint. There is only point in the IV_characteristics of PV module at which power delivered by PV module is maximum. The MPPT and charge controller are two different functions, The developer combined this two function in one electrical circuitry called MPPT charge controller.

Advantages:

1. MPPT gives maximum power from PV cells efficiently.
2. We can configure algorithms for maximum power point tracking.
3. Advanced digital power supply technologies promote the circuits energy conversion efficiency.
4. Data can be stored.
5. Throughout the implementation of MPPT with the Arduino we can gives protection from overcurrent, overvoltage, overload etc.

Lead Acid Battery:

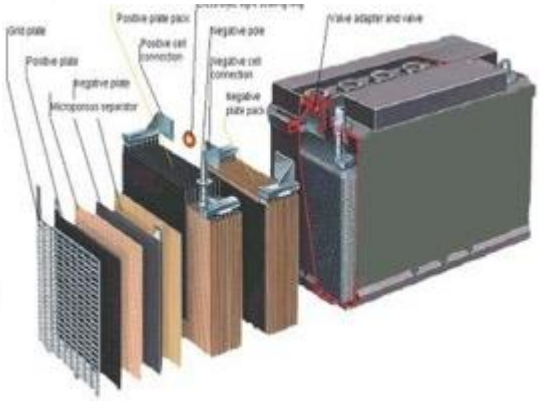


Fig.7 Lead Acid Battery

The battery that uses sponge lead and peroxide for the conversion of the energy into electrical power, such type of battery is called as lead acid battery is most commonly utilized with in the ability stations and substations as a results of it's higher cell voltage and cheaper price.

Temperature Sensor:

The DS18B20 could be a 1-wire programmable Temperature sensing element from maxim integrated. It's is wide want to live temperature in laborious environments like in chemical solutions, mines or soil etc. The constriction of the sensing element is rugged and can also be purchased with a water-proof possibility creating mounting method simple. It can measure a wide range of temperature from -55°C to +125° with a decent accuracy of ±5°C. Each device includes a particular address and desires only one pin of the MCU to transfer data so it a very big choice for activity temperature at multiple points while not compromising much of your digital pins on the microcontroller. This Temperature sensor is used to monitor the temperature of the Lithium Ion Battery.

Relay circuit :

In this project, three channel relay circuit will be implemented. Which will be used to control the load based on battery state of charge . Load will be made On and Off based on the priority.

LCD display:

In order to monitor the battery voltage and current and Temperature, 16 x 2 LCD display is used. Arduino Microcontroller will be used for measurement and display.

III.APPLICATION:

1. Study of basic electrical parameters of solar module (i.e. Voc, Isc, Vmp, Imp and Mpp).
2. It is used for a rural areas where electricity is not reached.
3. For increasing efficiency of residential load.
4. Off-Grid solar power plant used for industrial load by using this system.

IV. FUTURE SCOPE

- Reliability of the system increses.
- As you know the solar plant efficiency is low hence in the future it is really useful to incredes.
- Overall efficiency of the plant increases.

V. CONCLUSION:

After the studying paper [1] and [2] we have conclusion single axis solar system better than fixed-axis and dual-axis system it gives more efficient energy from solar panel. In this project we gives calculated data of basic parameters and also comparably study of charge controller with it's different work. Charge controller also help to battery management and also provide protection from overcurrent and overload etc. By providing Automatic IV Tracer we can check voltage and current at the given time and it also manually voltage and current data with IV plot. By using this system in we can observe the working of bypass diode blocking diode. Relay are used for the to turned-ON and OFF based on the priority. LCD display gives the voltage, current, temperature measurement.

VI. REFERANCE

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