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Benefits and Simulation of MPPT Controller for PV Systems

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***Abstract*-— In the paper we discuss the benefits from the use of the maximum power point tracking algorithm in the control of photovoltaic systems.We compare the advantages of the considered approach in comparison to the previous solutions like the use of pulse width modulation .It is proven in the paper that the microcontroller implementation of the proposed algorithm allows one to reduce both the energy losses and the costs related to system design, Maximum power point tracking controller is preferable than the PWM controller. To perform the MPPT operation in the system the PIC microcontroller is employed. The MPPT controller not only reduces the energy loss and also reducing the cost of laying the system.**

***Keywords*: MPPT, incremental conductance algorithm, PIC and Buck-Boost.**

I. INTRODUCTION

The solar energy is a renewable form of energy which can be harvested by using the solar panel and solar collector. The solar energy is quite promising one compared to the other form of renewable energy. Now a day the problem for the energy crisis is mainly due to the energy loss. The energy loss not only affects the customer side it also affects the utility to invest more money on the constructing the new utility. The energy loss cannot be avoided fully but it can be minimized by implementing various protocols in the utility side. In the solar panel, the energy loss can be avoided by implementing the various control strategies such as MPPT and PWM. Both the controlling method has both advantage and disadvantages. The PWM technique can be employed for the small utility. But the problem with the PWM technique is it compares the cell voltage with the load voltage and after comparing it pulls down the solar cell voltage to the load voltage. So there will be the energy loss in the system and also increases the no of cell required for the load demand. But at the other side, the MPPT technique will compare the solar cell voltage to the load voltage. Based on the compared

result the MPPT will pull up the solar cell current to meet the required demand. It has an advantage that less efficient panel can be used to satisfy the load demand and also for the storing purpose the less rated battery can be used. But for the small system use, the PWM controller is preferred. MPPT is very unique in the field of solar panel and it brings the application of the power electronics in the field of photovoltaic.

The panel rating is 12 volt, 100 watts the Vmp is 18 volts and Imp is around 5.56 amperes and imagine that is connected to the battery for the rating of 11volt and 14 volt

PWM controller: The PWM controller pulls down the voltage11*5.56=61watts .Here 39 watts energy is loosed.

MPPT controller: Here the controller will compare the source voltage to the load voltage 18/11=1.636. Based on the calculation the value k is multiplied with the imp current1.636*5.56=9.09. Then the current is boosted up by using the buck boost converter 9.09*11=99 watts. Based the irradiance and the temperature in the surrounding environment the conversion efficiency will vary.

Section II describes about the description of the system and the operation of the MPPT controller and working of the different parts in the system is briefly discussed in that section.

Section III describes about the detailed explanations about the project and how the simulation is done by using the proteus software and the block

II DESCRIPTION OF THE SYSTEM

II-1Block diagram

The figure 1 describes the system connected to the resistive load directly and the MPPT will act as the feedback loop to the system. The increment conductance algorithm is programmed on the PIC
16f877. The PIC controller is going to act as a

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feedback to the system, and it is also a heart of an MPPT. Based on the values of the compared Voltage and current, the PIC controller will generate a PWM signal. Based on the PWM signal the converter output will vary. The DC-DC converter is made up of the MOFET semiconductor switching devices. Based on the PWM Signal the conductance time of the switch will change based on that the output of the converters change.

The advantage with the PIC controller is we can multiple panel by connecting in the mechanism called master and slave technique. In which one PIC controller will support up to 256 slaves and the error free operation can be achieved by using the PIC controller. The photovoltaic cell is connected to the BUCK-BOOST converter and it is connected to the load. The MPPT will compare the photovoltaic voltage to the load voltage based on that the MPPT controller will use the DC-DC converter to boost the current. So the losses in the system will considerable reduced

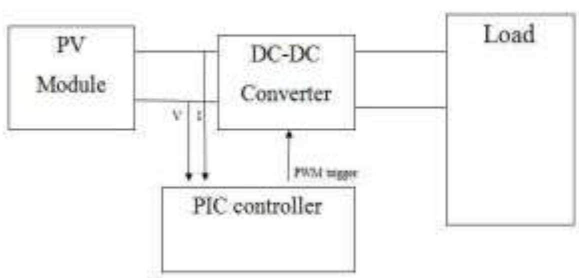

Figure 1: General description of a system connected to the load.

This model can also be employed for the wind energy in which the inverter is used in the area instead of the rectifier. Now how the MPPT controller will increase the current which can be expressed by the equation below.

K= Vmaximum / Vrated
I= K*Irated
P= Vrated*I

For the different maximum power point tracking technique the value of the K will vary. The conductance increase algorithm is so complex to implement and it's results is good compared to the
other algorithm technique.

II- 2 Detailed description

The detailed description of this work can be easily understood by seeing this below flow chart. In the MPPT curve the operating point will be high when the power-voltage curve point become zero at the point the tracking of the controller will become very good. The incremental conductance algorithm based on the differentiation of the power curve with its voltage. Based on the differentiated value only the operating point of the MPPT controller will change. The above diagram shows the I-V curve and power curve.

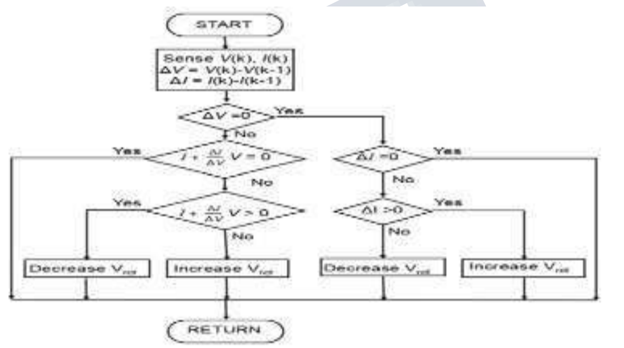

Fig 2: flowchart for the conductance algorithm.

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The slope point shows the operating point of the MPPT Based on the differentiated value only the operating point of the MPPT controller will change. The above diagram shows the I-V curve and power curve. The slope point shows the operating point of the MPPT.

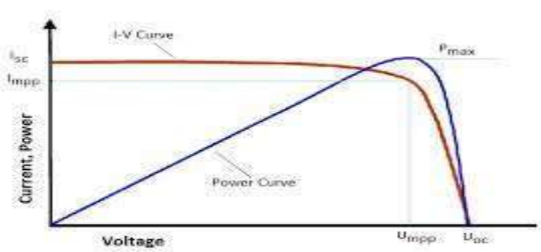

Fig 3 shows the operating point of MPPT

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To have the operating point is on the right hand side of the power curve the following conditions should be satisfied dp/dv<0 and di/dv<I/V. similarly for the left hand side of the operating point dp/dv<0 and di/dv>I/V. By seeing the slope we can find the operating point of MPPT.

III .DESIGN OF MPPT AND PHOTOVOLTAIC CELL

The MPPT controller and the buck- boost controller are modeled in the proteus simulation software. The MPPT controller is modeled by using the PIC microcontroller in the proteus. The Buck-boost converter is controlled by using the duty cycle based on that the operation of the system varies. . The equivalent circuit for the solar cell is also drawn by using the required components. The conditions for the PIC controller are programmed by using the suitable software. The condition is nothing but the increment conductance algorithm, based on that the program is returned. After that code is dumped on the PIC controller in the proteus hardware simulation software. Based on the Feedback obtained from the PIC controller will generate the duty cycle to the buck-boost converter. The on load performance of the MPPT controller is studied in this work.

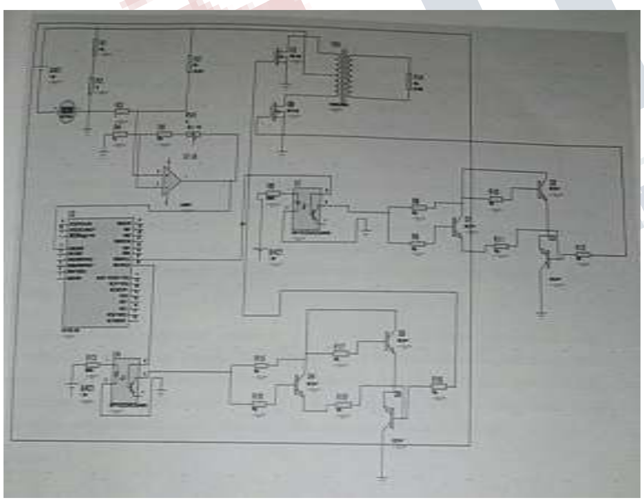

Fig 4 shows the hardware design of MPPT

Based on the result obtained from the hardware simulation toll the live work is done by connecting the restive load connected to the MPPT and the photo voltaic cell and its performance is studied by comparing with source to load connection. The performance is good.

IV. RESULT AND CONCLUSION

As we discussed earlier this work mainly depends upon the performance to study the MPPT controller the various graph has been plotted by using the hardware simulation tools.

IV 1 source to load without MPPT

The source is connected to the load usually the resistive load is usually used. For the different resistive load the performance of the photovoltaic cell is monitored. Based on that data the curve is plotted which is shown in the below fig

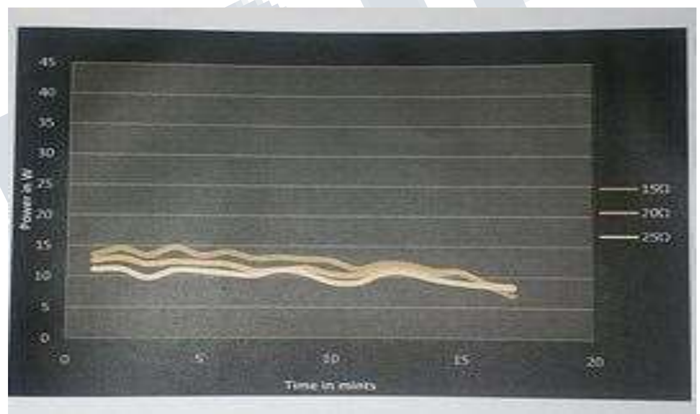

Fig 5 shows the load to source performance for different load condition

IV 2 source to load with MPPT

The graph is shown for the performance of the Buck- Boost converter when the MPPT will ignite the performance by changing the duty cycle of the converter. Based on that performance will vary which is shown in the below figure.

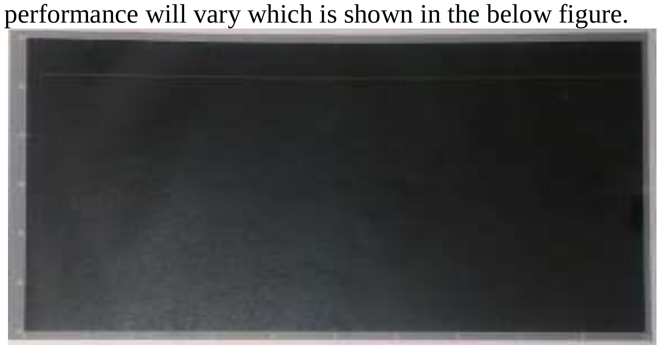

Fig 6 simulated converter output

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By seeing the above results we can conclude that MPPT controller gives the best performance when connecting to the load directly and also it prevent the flow of current from the source to the load. The MPPT is promising the operation of large solar panel utility to connect to the grid with the minimal loss with the upgraded solar forecasting.

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