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Proteus Simulation Using Various Power Converters for a Photovoltaic System

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Abstract:-The need for renewable energy sources is on the increasethanks to the acute energy crisis within the world these days. Solar powercould be aimportant untapped resource in an exceedingly tropical country like India. The main hindrance for the penetration and reach of solar photovoltaic [PV] systems is their low efficiency. The main objective is to use the buck, boost and buck-boost converter along with a maximum power point tracking [MPPT] control mechanism to increase the efficiency of a PV system. The MPPT is responsible for extracting the maximum possible power from the photovoltaic cell. The converters are used to supply a constant and required voltage magnitude to the load

Keywords: *Photovoltaic cell, Maximum Power Point Tracking.*

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1. INTRODUCTION

In the field of power sector in recently one among the main issues is day-by-day increasing additional power demand however the amount and availableness of typical energy sources aren't enough resources to fulfil up the present day's power demand. Whereas puzzling over future availableness of typical sources of power generation, it's become important that the renewable energy supply should be utilized together with source of typical energy generation systems to full fill the need of the energy demand. . In order to rigging the current day's energy crisis one renewable method is the method in which power extracts from the incoming son radiation calling Solar Energy, which is globally free for everyone

Solar energy is lavishly available on the earth surface as well as on space so that we can harvest its energy and convert that energy into our suitability form of energy and properly utilize it with efficiently. Power generation from solar energy may be grid connected or it may be standalone power generating system that depends on the utility, location of load space, accessibility of facility close it. So wherever provide the provision of grids association is extremely troublesome or expensive the solar may be accustomed supply the ability to those areas. The foremost necessary 2 benefits of alternative energy area unit that its fuel price is totally zero and alternative energy generations throughout its operation don't emanate any greenhouse gases. Another advantage of exploitation alternative energy for tiny power generation is its portability; we will carry that whenever where small power generation is needed.

In the previous couple of years the ability conversion mechanisms for solar power has been considerably comes in compact size. The advance research in the field of power electronics and material science have greatly helpful for engineers to develop such a system that very small but effective and powerful systems that have capability to withstand for supplying the high electric power demand.

For every country day by day power density demand is increasing. Alternative energy generation have additionally the potential to handle the voltage fluctuation terribly effectively by setting the system price and also the low potency of the solar cells, this power generating systems will hardly participate within the competitive power markets as a main renewable supply of power generation

Scientists are constantly trying to improve in the field of development of the solar cells manufacturing technology for increasing efficiency. That will definitely help to make the solar generation as in habit for use in daily life as prime renewable source of electrical power on a wider range basis than present day conditions. In solar power generation system the latest power control mechanisms is using now these days calling the Maximum Power Point Tracking frequently referred as MPPT, it has guide to the increase in the efficiency of operation of power generation from the solar cells. Thus MPPT is most important in the field of consumption of renewable sources of energy.

2. METHOGOLOGY

In order to generate the power equivalent circuit of solar cell is designed. Output of the solar panel is given to the converter circuit. The MOSFET which is used as switch is controlled by a microcontroller, in which the coding is done and also it use aurdino as a platform for coding. The input for the microcontroller is taken from the solar panel through the voltage senor that converts analog signal into digital signal. The coding includes MPPT algorithm. The MPPT algorithm calculates the duty cycle for the converter corresponding to the maximum power point. According to the duty cycle generated the MOSFET switch of the converter is operated and output is maintained

2.1. MPPT ALGORITHM

The efficiency of a solar cell is very low and also when solar cells are connected together to form a panel then its efficiency is still not increased. In order to increase the efficiency (η) of solar cell or solar panel we have to use maximum power transfer theorem. The maximum power

transfer theorem says that the maximum power is transferred when the output resistance of source matches with the load resistance i.e. solar cell or solar panel impedance. So all MPPT technique's principles are based on maximum power transfer theorem that always trying to matching the impedance of load to source.

2.2. Perturb and Observe Algorithm

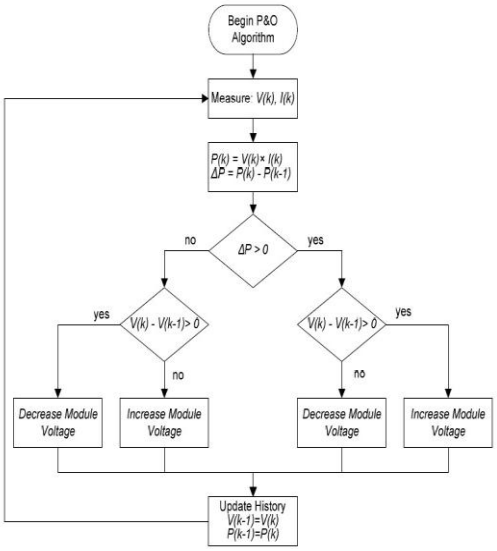
The weather and load changes cause the operation of a PV system to vary almost all the times. A dynamic tracking technique is important to ensure maximum power is obtained from the photovoltaic arrays.

The Perturb and Observe (P&O) technique is additionally called "Hill Climbing" technique. The foremost normally used MPPT formula is P&O technique. This formula uses easy feedback arrangement and small measured parameters. . In this approach, the module voltage is periodically given a perturbation and the corresponding output power is compared with that of the previous perturbing cycle power. If the power increases due to the perturbation then the perturbation is continued in the same direction. Otherwise the perturbation is reversed.When the stable condition is arrived the algorithm oscillates around the peak power point. In order to maintain the power variation small, the perturbation size is remain very small.

DC-DC Converter

The DC/DC converter is widely used in MPPT circuit for the main purpose of matching the load impedance with the panel impedance by changing its operating duty cycle. A DC-DC converter converting regulated DC output voltage from an unregulated DC input voltage. A DC-DC converter is a heart of MPPT hardware implementation. MPPT technology uses that DC-DC converter for regulating the solar input voltage and reach to the peak voltage i.e. MPP and provides impedance matching from source to load for the maximum power transfer to the load.

2.3. Flow chart



3. SIMULATION AND RESULT

3.1. SIMULATION OF SOLAR PANEL

3.1.1. SOLAR CELL

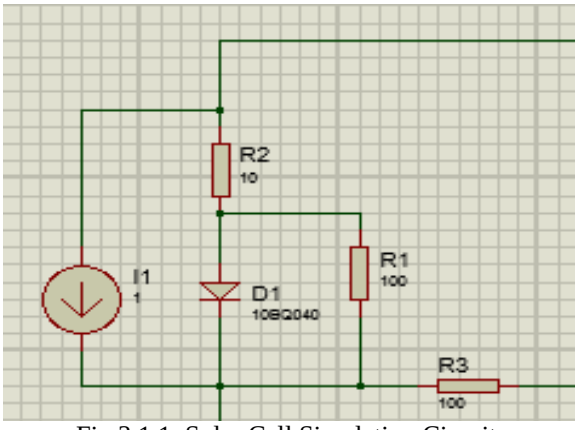


Fig.3.1.1. Solar Cell Simulation Circuit

3.1.2. SOLAR PANEL

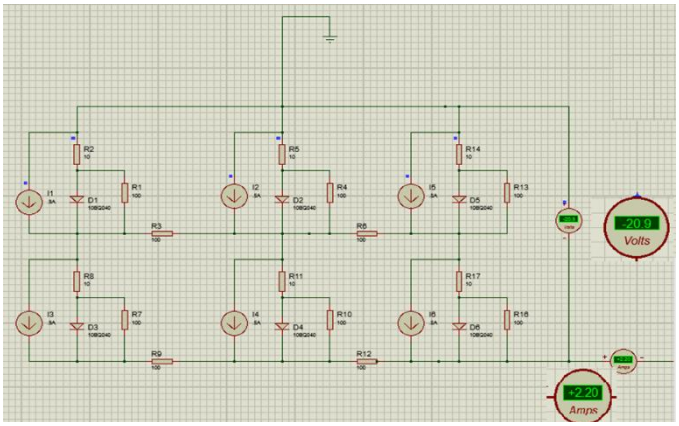


Fig.3.1.2. Solar Panel simulation circuit

3.2SIMULATION OF BOOST CONVERTER

3.2.1. CIRCUIT AND OUTPUT OF BOOST CONVERTER WITHOUT MPPT

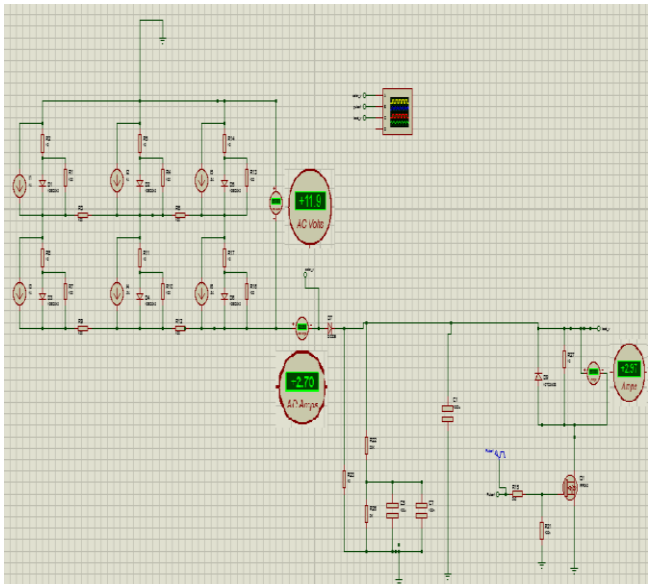


Fig.3.2.1. Simulation of Boost converter without MPPT

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3.2.2. CIRCUIT AND OUTPUT OF BOOST CONVERTER WITH MPPT

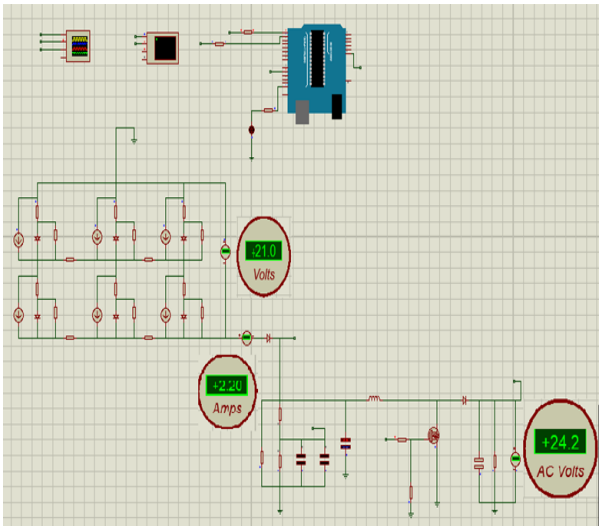


Fig.3.2.2. Simulation of Boost converter with MPPT

3.2.3 WAVEFORMS OF BOOST CONVERTER WITH MPPT

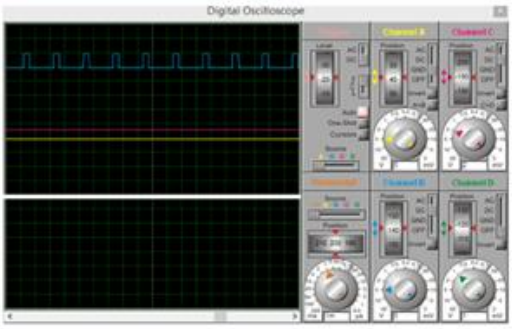
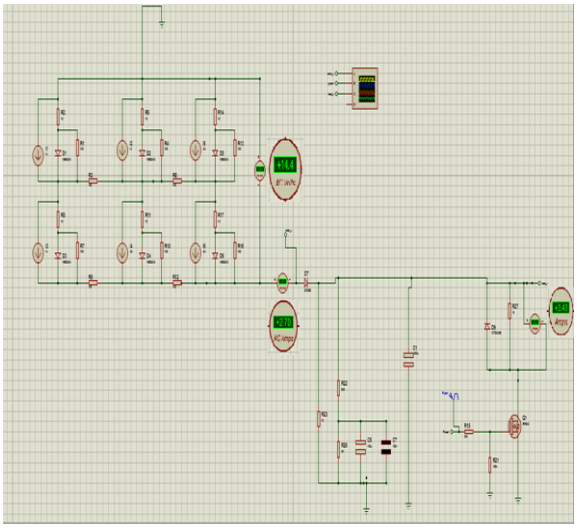


Fig.3.2.3. Waveforms of Boost converter

Channel A- INPUT
Channel B-PWM
Channel C-OUTPUT

3.3. SIMULATION OF BUCK CONVERTER

3.3.1. CIRCUIT AND OUTPUT OF BUCK CONVERTER WITHOUT MPPT



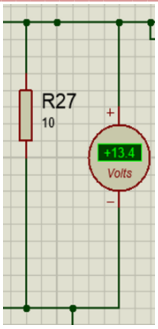


Fig.3.3.1. Simulation of Buck converter without MPPT

3.3.2. CIRCUIT AND OUTPUT OF BUCK CONVERTER WITH MPPT

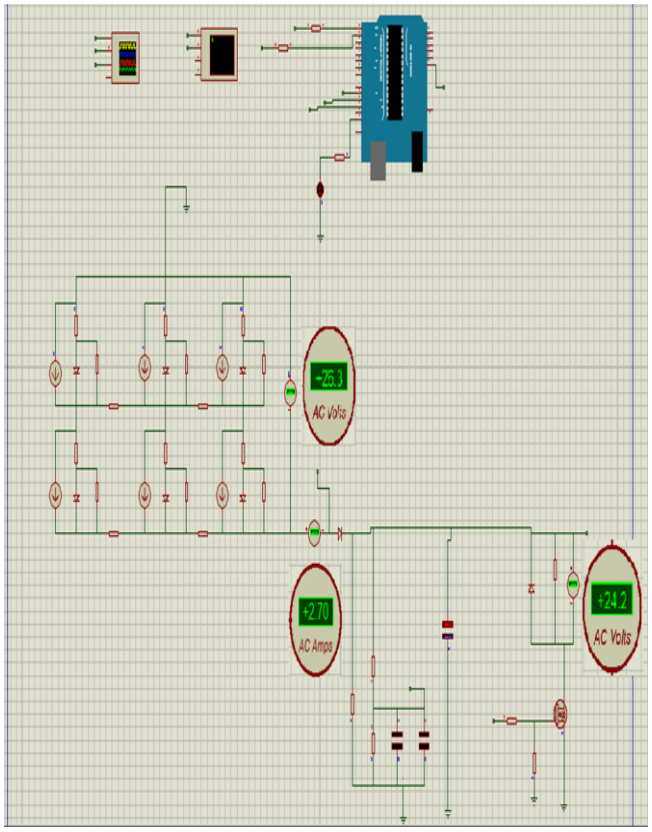


Fig.3.3.2. Simulation of Buck converter with MPPT

3.3.3. WAVEFORMS OF BUCK CONVERTER WITH MPPT

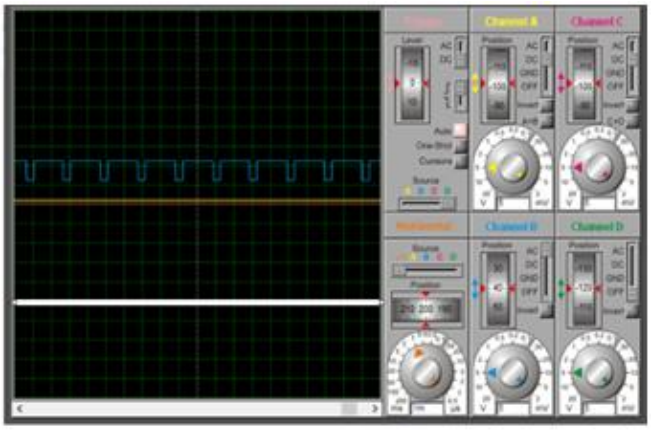


Fig.3.3.3. Waveforms of Buck converter

3.4. SIMULATION OF BUCK-BOOST CONVERTER

3.4.1. CIRCUIT AND OUTPUT OF BUCK-BOOST CONVERTER WITH MPPT [BOOST OPERATION]

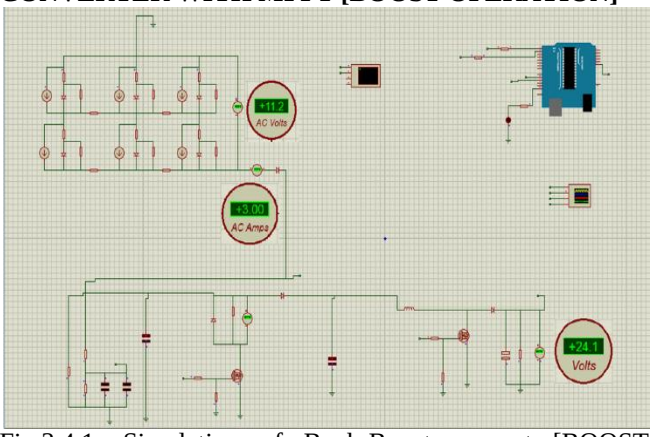


Fig.3.4.1. Simulation of Buck-Boost converter[BOOST operation]

3.4.2. WAVEFORMS OF BUCK-BOOSTCONVERTER [BOOST OPERATION]

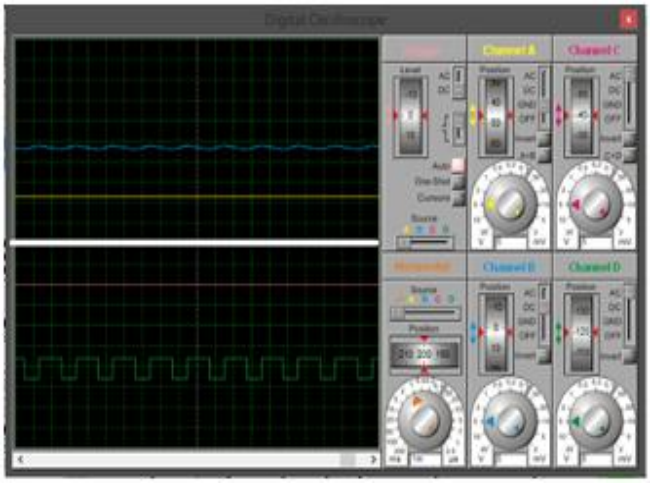


Fig.3.4.2. waveforms of Buck-Boost converter[BOOST operation]

3.4.3. CIRCUIT AND OUTPUT OF BUCK-BOOST CONVERTER WITH MPPT [BUCK OPERATION]

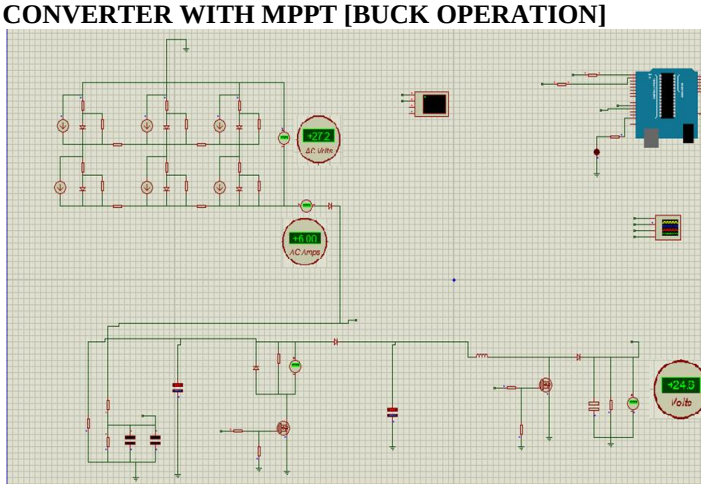


Fig.3.4.3.Simulation of Buck-Boost converter[buck operation]

3.4.4. WAVEFORMS OF BUCK-BOOST CONVERTER [BUCK OPERATION]

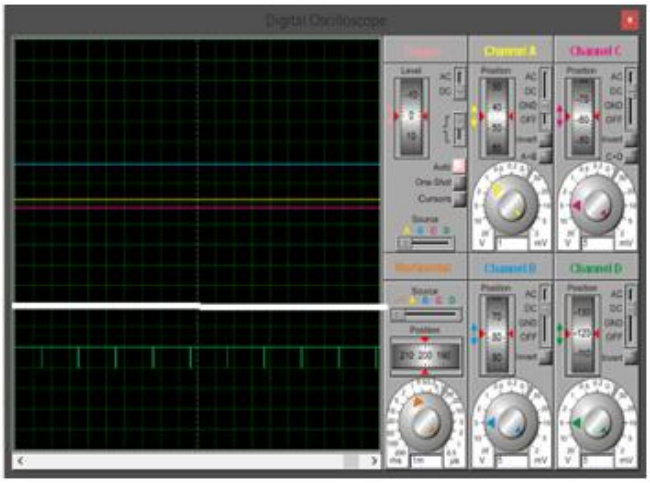


Fig.3.4.4. Waveforms of Buck-Boost converter[BUCK operation]

4.COMPARISON OF VOLTAGE OF VARIOUS CONVERTERS

The tables below gives us a better insight regarding the importance of Maximum Power Point Tracking algorithm.Table 6.1 shows that boostconverter is a step up converter and buck converter is a step down one and buck-boost converter which can step up or step down based on input voltage. Table 6.2 shows the comparision results of converters with mppt algorithm and without mppt algorithm and their respective power.

Converter	V_{in}	V_{out}
Boost converter	20	24
Buck converter	26	24
Buck-Boost converter	5-50	24

Table 6.1 Results Comparison

5.COMPARISION OF RESULTS OF VARIOUS CONVERTERS WITH AND WITHOUT MPPT ALGORITHM

Converter	V_{in}	V_{out} without mppt(V)	Power(W)	V_{out} with mppt(V)	Power(W)
Buck converter	20	13.4	38.8	24	62.4
Boost converter	26	20.6	54	24	63
Buck-Boost converter	5-50	21	73.6	24	96

Table 6.2 With and Without MPPT

6. CONCLUSION AND FUTURE WORK

6.1. CONCLUSION

In this project performance of Boost, Buck and Buck-Boost converters with and without MPPT algorithm for a solar

panel is compared. The first phase of the project includes designing and simulation of a solar panel from a basic circuit of a solar cell. Then the three converter circuits are designed and are employed to increase the efficiency of the solar panel without MPPT algorithm. Each converter circuit is then implemented with MPPT algorithm to vary the duty cycle of the switching device in accordance with the power output received by the solar panel. The most commonly used MPPT algorithm Perturb and Observe method is implemented for this purpose.

From the simulation results it is clear that the performance of each converter becomes more efficient with the implementation of MPPT algorithm.

6.2. FUTURE WORK

Further work in this project is that different MPPT algorithms can be employed to increase the efficiency of the solar panel and observe which MPPT works better with each converter. The output from the solar panel can be made continuously variable than manually changing it as it is done in this work. Further the hardware implementation of this project remains for the future work. The module can be used to design a grid connected photovoltaic system by implementing an inverter circuit between the grid and module.

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