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PHOTO VOLTAIC PEAK-POWER TRACKER USING A SQUARE-WAVE INVERTER

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ABSTRACT

Energy conversion from PV arrays received a lot of attention, especially in outer-space power system applications. Different methods of peak-power tracking have been proposed to capture the maximum power at different levels of insulation. Many peak-power trackers are implemented with a microprocessor or microcontroller, by using different control strategies. Water pumping from a PV array is a valid option to pollution-generating diesel and human-powered water pumps. However, with the battery module, the battery needs to be checked regularly. In the system with a battery, the peak power tracking can be handled by varying the duty ratio of a dc-dc converter, which is generally installed between the battery and the PV array. But in this paper we are not using battery. We are generating the power from PV module and by using MPPT feeding power to the induction by an inverter.

INTRODUCTION

The fuel consumption is increase day by day is the major problem in the world. So by utilizing some natural renewable energy we can resolve the problem and along with we can protect the environment related to warming and damage ecological. Due to this we need to increment the utilization of renewable energy in the environment, there are so many renewable energy in the environment. Solar energy is obtainable by using photovoltaic module. But the insolation and temperature of the panel change in the same day itself so we have to use some technique by that maximum power can be obtained and utilize it with minimum losses. So if the load is an induction motor by using integrated inverter DC voltage can be converted into AC with minimum losses . For conversion of DC to AC in inverter circuit we need firing pulse to trigger the switches so by using MPPT we are generating pulse so that obtained output should be maximum.

A PV system is very popular because of their matching load characteristics application. In this system there are total four stage to the complete process. In first stage generation of DC takes place in the second stage generation of gate signal in third conversion of DC into AC and finally induction motor to the load.

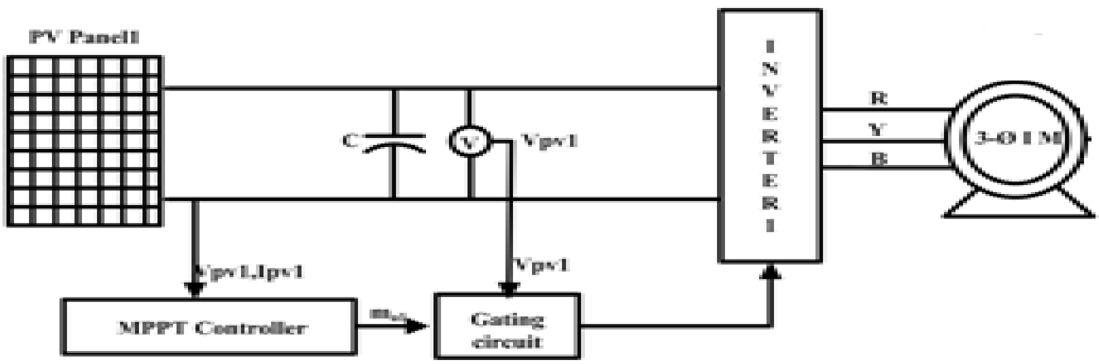

Fig.1 PV system with MPPT, inverter and load.

Main focus here on the conversion of DC into AC with maximum power point tracking. The control of the system is more complicated than that for the system with a dc battery on the dc bus. The block diagram of the system is shown in fig.1. The PV array receives energy from the sunlight. The PV array generates electric power, which is fed to the induction motor via an inverter. The induction motor is mechanically coupled to the water pump. As the insolation level varies during the day, the output of the PV array follows the change. The water pump is a centrifugal pump, with the output torque varying as the square of its rotor speed. To increase the output of the water pump, the speed of the water pump is increased by adjusting the frequency of the inverter.

The solar PV power is mostly suitable for stand-alone system which drives a parabolic torque load . The centrifugal pump has parabolic torque load characteristics which are mostly used for water pumping application in domestic, agricultural and industrial sectors. So, it will be a better option to use the solar PV power for water pumping application. This encourages one to use an electric motor-pump integrated with PV system, with better performance and efficiency. Solar power fed D.C motors are already in use for water pumping application.

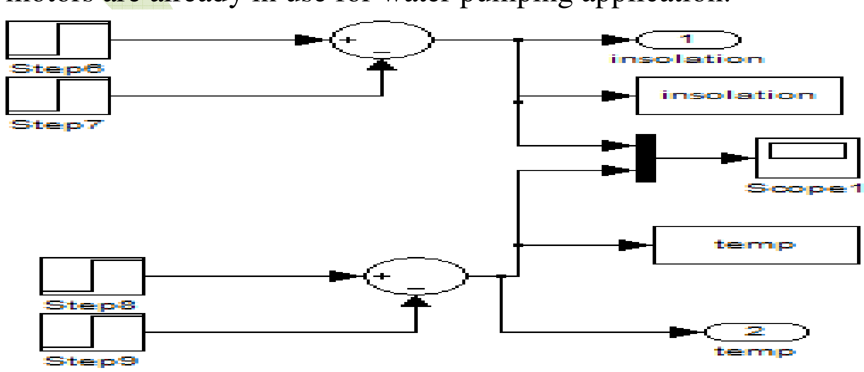

Fig.2 insolation and temperature effect

Even though its dynamic performance is good, due to high initial and maintenance cost, they are not recommendable.

In fig.2 we are creating the insolation and temperature changing effect in a day So we are getting different temp and insolation by using step size in step6 we are taking step time, initial value and final value 8, 0.8 and 1 in step7 values are 16, 0 and 0.3 in step 8 values are 8, 33 and 42 and in step9 values are 16, 0 and 4 respectively.

PHOTO VOLTAIC MODULE

In this photo voltaic module by using insolation and temperature effect we generate the current and the voltage. In this diagram by using modeling of PV module we have to generating the voltage and current so after the main block we are doubling the current by making gain two and capacitor is connected to make the DC smooth the we need to integrate and finally getting the voltage and to make a complete cell we are taking 14 cells in series for the final voltage.

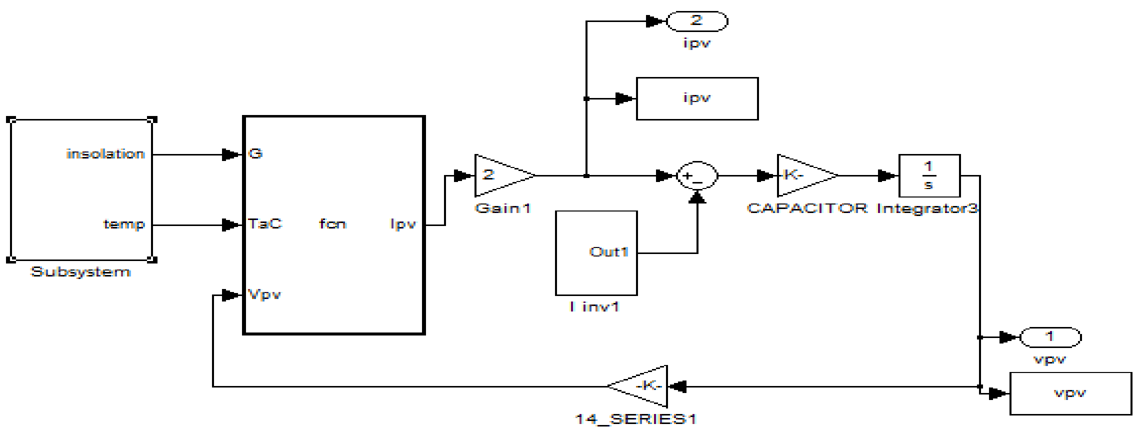

Fig.3 Voltage and current generation

The inverter block Fig.4 is here to get the phase A, phase B and phase C average current along

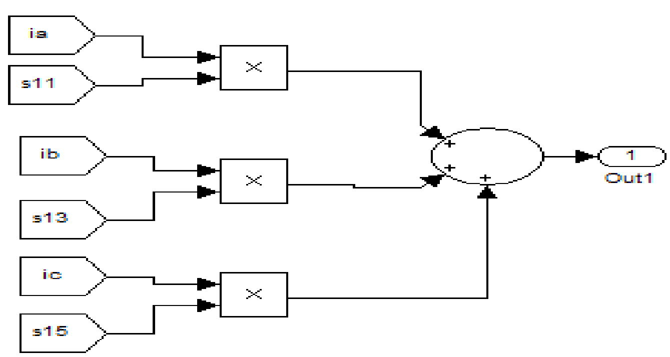

Fig.4 Three phase current with switching time

With the switching time means time is multiplying with the current and finally getting the resultant current.

MPPT MODELING

In this the current and the voltage from the PV module need to filter out and the product of current and voltage will be power. So by using sample and hold circuit we generate a sampling pulse and combine with the current and voltage we will get a modulation index which is very useful here for the generation of gate pulse to the inverter circuit. But we are also providing current limit and gain one to the modulation index to ensure the disturbance.

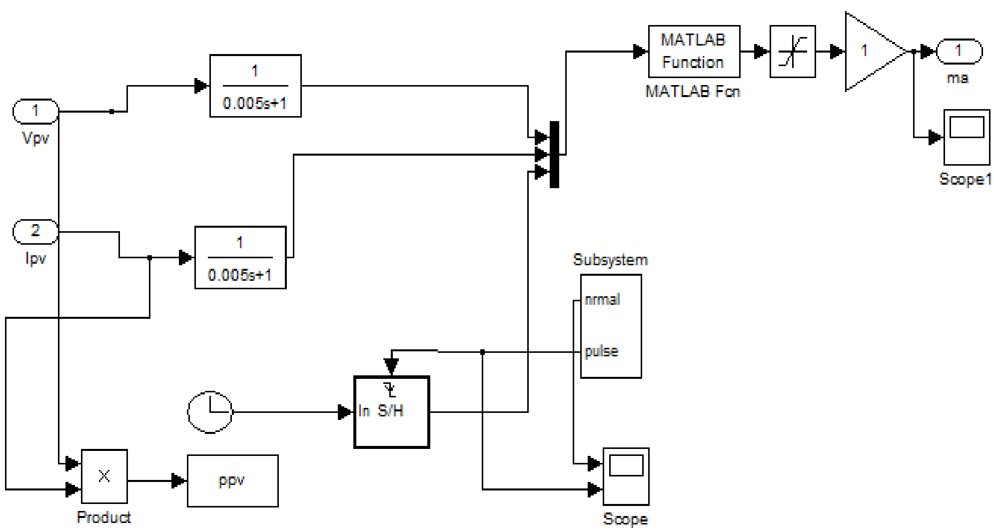

Fig.5 Generation of modulation index

The sample and hold circuit is falling edge type with zero initial condition. And subsystem to provide gain 1/3 to the frequency and frequency is

$$f= (ma*50)/(sqrt(3/2)$$

Where ma<.866
Otherwise frequency will be 50 Hz.
After integrating this multiply with the gain and getting the pulses.

THREE- PHASE VOLTAGE GENERATION AND LOAD

In three phase inverter the important thing is gate pulse and in this we are generating the gate signal by using modulation index. In Fig.6 the modulation index and the frequency related to the modulation index is given to the main block along with a constant gain to generate the gate pulse and time index. The main thing in this is the state space technique by using that we can transform the three phase voltage in two phase this can be understand by following equations

$$V\alpha = 3/2\ VRN = 1/2(VRY - VBR)$$

$$= 1/2(2\ VRO - VYO - VBO)$$

$$\text{And}\quad V\beta = \text{sqrt}3/2(VYN - VBN)$$

$$= \text{sqrt}3/2(VYO - VBO)$$

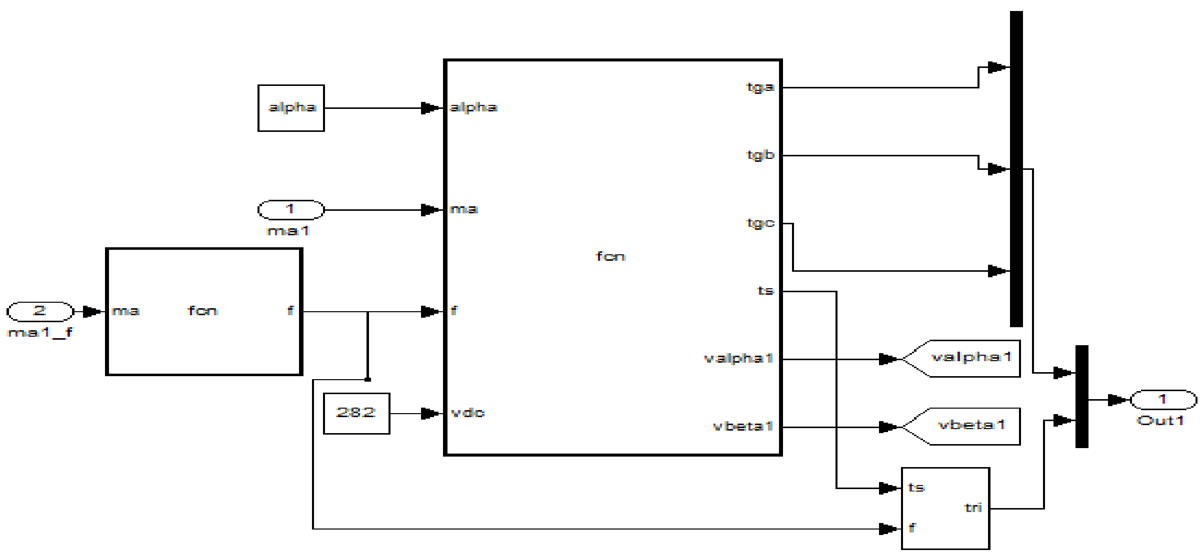

Fig.6 Gate signal generation

But this Vα and Vβ directly can be calculated by using

$$v\alpha 1 = ma*vdc*\cos\alpha$$
$$v\beta 1 = ma*vdc*\sin\alpha$$

One more thing in space vector when all the top device or bottom devices are ON Vα and Vβ will be zero.

The switching time ts is calculated by

$$ts = 1/(n*f)$$

where n=48Hz supportable frequency by hardware and software

And tri is the minimum pulse with time for the switching. So finally we are getting tga, tgb, tgc and tri from the circuit. Now we have to generate the line voltage by the inverter circuit.

This we can do by followings equations

$$vdp = Vdc/2$$
$$vdn = -Vdc/2$$

where Vdc is input voltage

and Vdp voltage is when top device is ON and Vdn voltage is when bottom device is ON.

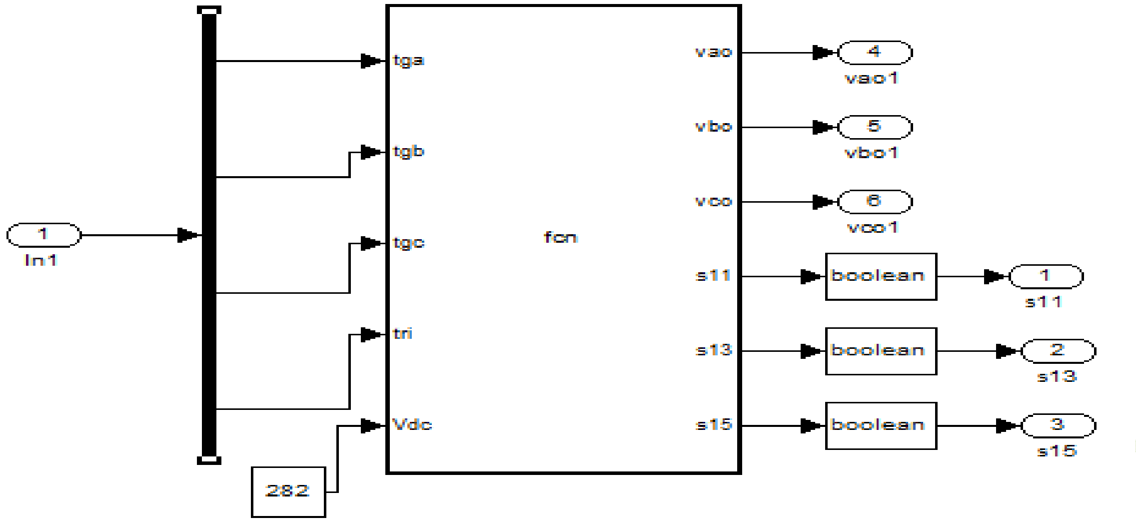

Fig.7 Voltage generation by inverter

In inverter the switches are defined by S11,S13,S15 which are positive groups thyristors and S12,S14,S16 which are negative groups thyristors.

So voltages can be calculated by

if tga>tri
vao=vdp
s11=1 , means that this is conducting
else
vao=vdn
if tgb>tri
vbo=vdp
s13=1, means that this is conducting
else
vbo = vdn
if tgc>tri
vco = vdp
s15=1, means that this is conducting
else
vco=vdn

where Vao, Vbo and Vco are the pole voltages.

And phase voltage can be find by using the followings equations..

Phase voltage = Pole Voltage-Vtriplen

Where Vtriplen=(Vao+Vbo+Vc0)/3

Vaa=Vao-Vtriplen

Vbb=Vbo-Vtriplen

Vcc=Vco-Vtriplen

Where Vaa, Vbb and Vcc are the Phase Voltage respectively.

Now these Phase voltages we can apply to the induction motor

SIMULATION RESULTS

Fig.8 Insolation and temperature results.

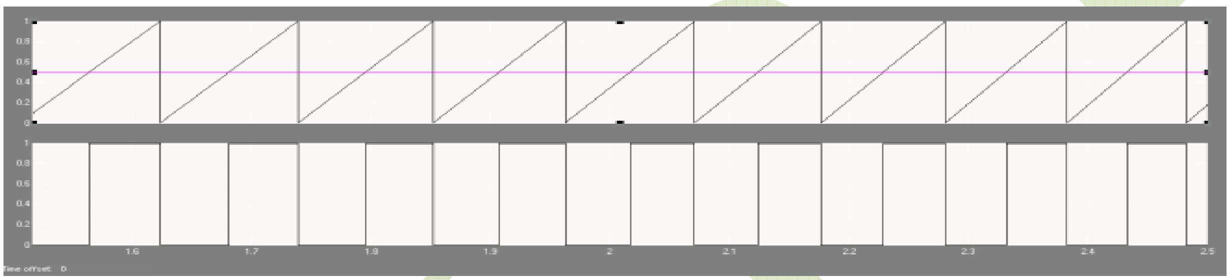

Fig.9 Sample and hold results.

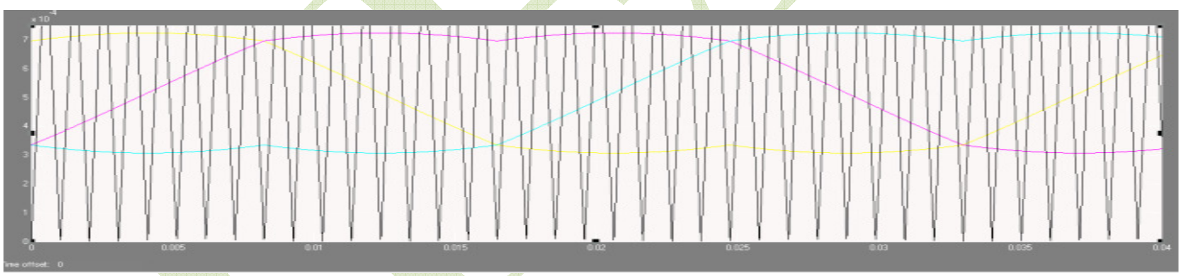

Fig.10 Modulation index results.

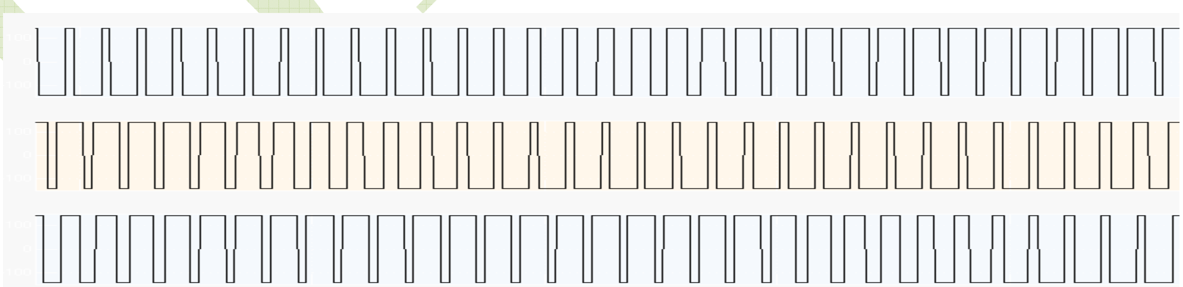

Fig.11 Three phase voltage results.

CONCLUSION

In this paper we have generated the voltage from PV module with temperature and heat effect on the module and by using MPPT generated pulse to the inverter switching . converted DC voltage into AC and that voltage we can use for the induction motor to the application.

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