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# Analysis Different MPPT Techniques for Photovoltaic System

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***Abstract- In this paper we analysis different three MPPT techniques in photovoltaic system. These MPPT techniques are used to increase the efficiency of the photovoltaic system.***

***Keywords:*** **- Photovoltaic Cell Modeling, MPPT Techniques.**

## I. INTRODUCTION

The solar energy is most important renewable energy as compare to non renewable energy like gasoline, coal..Etc because solar energy is clean, inexhaustible and pollution free. The main application of photovoltaic system are in standalone (domestic, street lighting, military and space application)[1-2] or grid connected configuration(hybrid system) [3]. Moreover the solar cell has nonlinear PV characteristics and change with change in radiation and temperature. And there is unique point in PV or IV characteristic which PV system operates at maximum efficiency, this point is called Maximum power point. The maximum power point trackers (MPPTs) are used to maintain the maximum power point. The MPPT minimize the overall system cost and maximize the array efficiency. Many algorithm have been proposed [4][5].in this paper we discuss the three different technique and analysis the comparison between these technique.

## II. MODELING OF PHOTOVOLTAIC SYSTEM

A photovoltaic cell is basically semiconductor diode whose p-n junction expose to light [6].photovoltaic cell are made from different types of semiconductors using different manufacturing processes. The monocrystaline and polycrystalline are generally used in commercial level. When light fall on the cell it generate the charge carriers that originate the electrical current if the cell is short circuited.

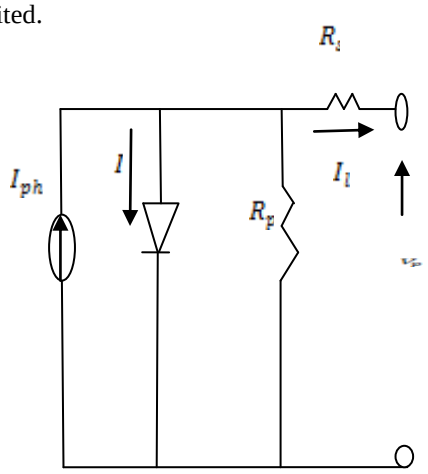


**Fig (1)**

$$I_{l=I_{ph}} - I_d$$

$$I_{l=I_{ph}-I_{sc}(\exp\frac{eVp}{kT}-I)}$$

- = current and voltage of the voltage of the cell.
- = saturation current.
- =short circuit and direct current.
- =Boltzmann constant.
- = absolute temperature.
- = charge of electron.

To draw the real model photovoltaic cell it is necessary to take into the account the losses due to leakage current in the diode and losses due to connection and contacts. That why two resisters are added in model on resistor is in series and second one Is in parallel. The value of series resistant is very low but the value of parallel resistant is infinity. The equivalent circuit diagram of real photovoltaic is shown in fig (1)

## III. OUTPUT POWER CHARACTERISTICS

The output power is depends upon the temperature and radiation (sunshine) value of the site where is the panel is placed. This may increase or decrease the output power as the result of variations of temperature and radiation level. Electrical characteristics of a PV panel with different radiation level are shown in fig (2 & 3).Using the values of table (1)

**Table (1)**

| Symbol | Quantity | Value |
|---|---|---|
| PMPP | Maximum power | 60 W |
| VMPP | Voltage at PMPP | 17.1 V |
| IMPP | Voltage at IMPP | 3.5 A |
| ISC | Short circuit current | 3.8 A |
| VOV | Open circuit voltage | 21.1V |
| TSC | Temp. Coefficient of short circuit current | 0.0032 |

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| | | |
|---|---|---|
| TOC | Temperature coefficient of open circuit voltage. | $-80e^{-3}$ |
| k | Boltzmann constant | $1.3806503e^{-23}$ |
| q | Electron Charge | $1.60217646e^{-19}$ |
| A | Ideality factor | 1 |

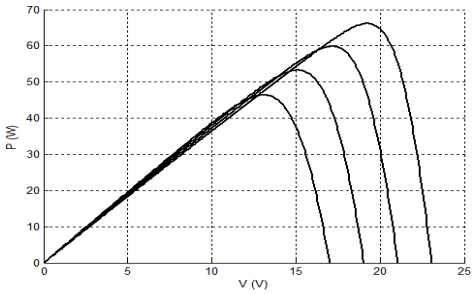


**Fig (2) PV Characteristic of Solar Panel**

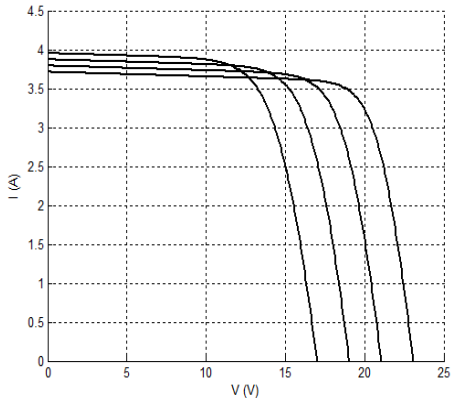


**Fig (3) VI Characteristics**

## IV. MAXIMIZING THE OUTPUT POWER

The output power of a PV panel is a function of temperature, radiation and the position of panel. It is also the function of product of voltage and current. By varying these parameters the power can be maximize. To maximizing the output power generally MPPT used. There are several MPPT method exists in order to maximizing the output power.

The existing methods are

- Perturb and observation method.
- Incremental conductance method.
- Parasitic capacitance method.
- Voltage based peak power tracking method.
- Current based peak power tracking method.

First three methods are studied and compare in this paper.

***Perturb and Observe Method***

***Principle Of Perturb and Observe Method***

The P & O algorithm operated by the periodically perturbing (increasing or decreasing) the terminal voltage or current and then compare with the output power by the previous perturbation cycle. If the power increases then one continues increasing the voltage or current in the same direction. If power decreases then continue vary the voltage or current in the reverse direction.

## V. INCREMENTAL CONDUCTANCE METHOD

As we know that P & O method have some limitations like it fails under rapidly changing environment condition. To overcome such limitations we use Incremental Conductance method.

## VI. PRINCIPLE OF INCREMENTAL CONDUCTANCE METHOD

This method consists of slop of derivative of the current with respect to the voltage to reach the MPP. To obtain this maximum point di/dv should be equal to the –i/v. By applying the variation in the voltage towards the biggest value or smallest value it affect the power value. If power increasing then should continues in the same direction, if power decrease then should reverse the direction. The flow chart of incremental conductance method is shown in fig (5)

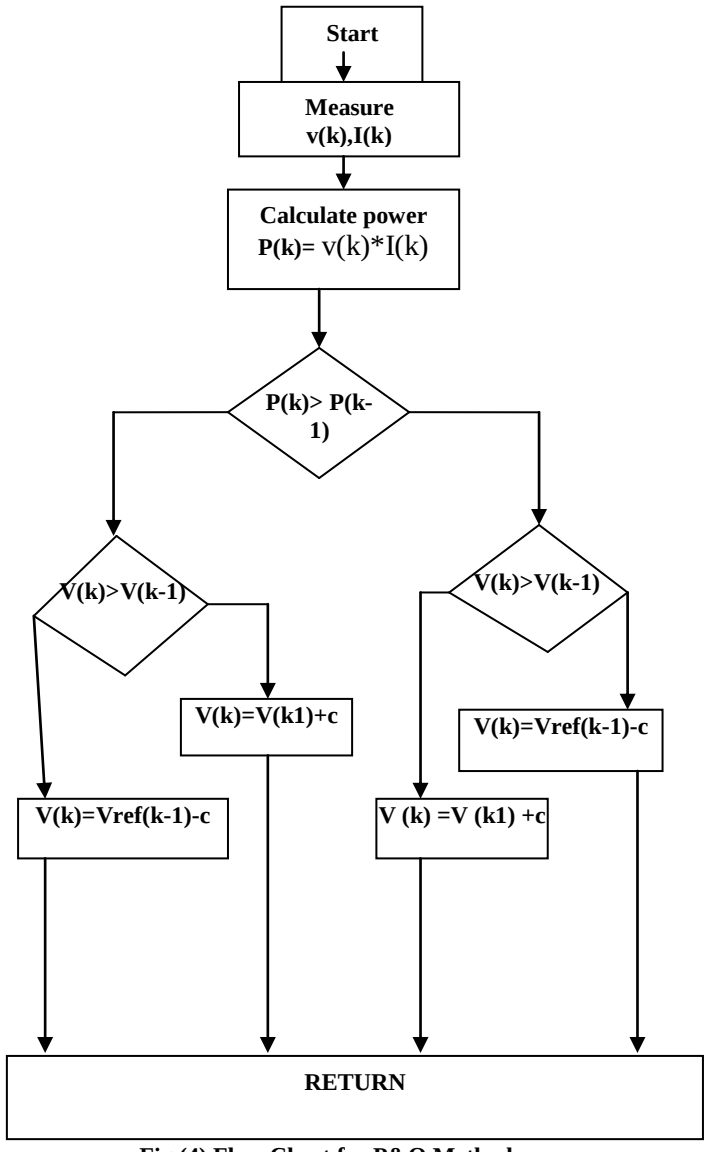


**Fig (4) Flow Chart for P&O Method**

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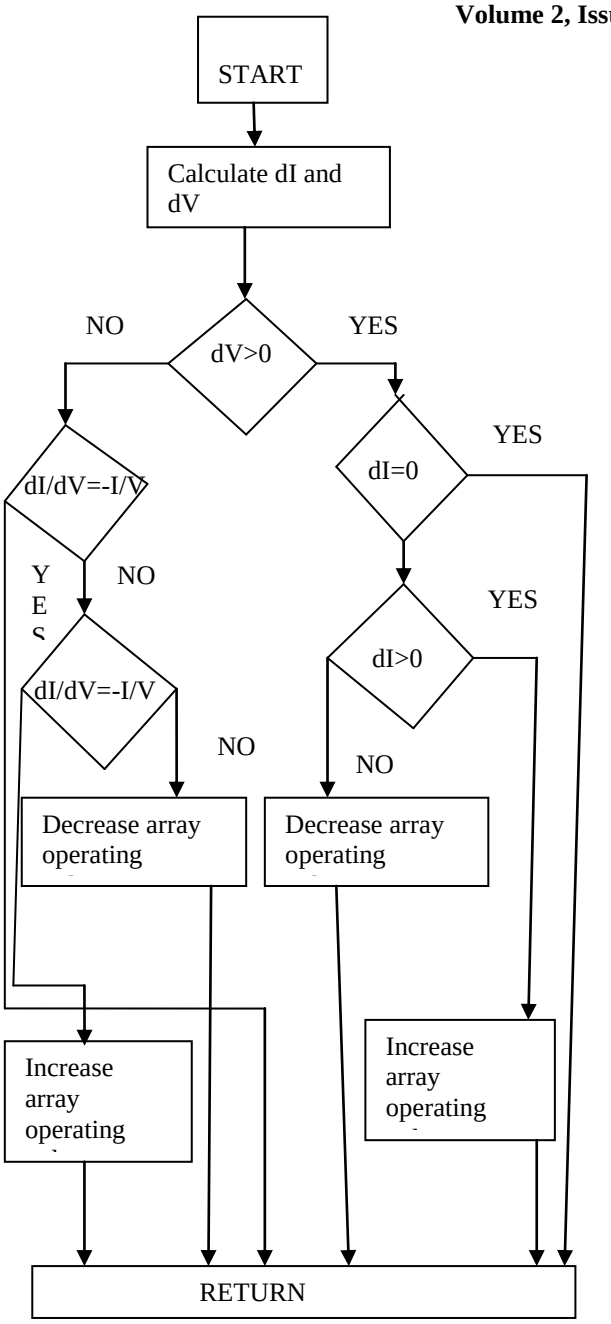


**Fig (5) Flow Chart of Incremental Cond. Method**

## VII. PARASITIC CAPACITANCE METHOD

The Parasitic Capacitance is most recently MPPT techniques. This technique is similar to Incremental conductance technique. except that the effect of solar cell parasitic junction capacitance $C_p$. The charge is stored in pn junction of the solar cells. if we add the capacitance to the lighted diode equation we obtained

I = $I_L$- $I_0$ [exp ($v_p$+$R_S$ I)/a -1] + $c_p$ (d$v_p$/dt) = F($v_p$)+$c_p$ d$v_p$/dt

This equation can be rewritten to show the two component of I and function of voltage $f_{vp}$ and current in the parasitic capacitance [7]. In the parasitic capacitance the maximum power is obtained at the point where (dP/d$v_p$) By multiplying the above equation by array voltage ($v_p$) to obtaining the power of array and differentiating the result.

## VIII. SIMULATION RESULTS

After running the simulation model of these three MPPT techniques, we observe the different values of average power output, ripple amplitude and time response. These values are shown in table (2). The temperature average value is 25°c with the variation of +/- 15°c by using the MATLAB simulation model. The average radiation value is 600 w/$m^2$ with the variation of +/- 200 w/$m^2$.

**Table (2)**

| | Time response | Average power | Ripple Amplitude |
|---|---|---|---|
| P & O Method | 1.758 | 279.7 | 88.23 |
| Incremental Conductance | 0.5579 | 280.7 | 88.73 |
| Parasitic Capacitance | 2.558 | 283.7 | 89.17 |

## IX. CONCLUSION

In this paper after discuss and analysis the three techniques (P & O, Incremental conductance and Parasitic Capacitance) to maximize the output power. The comparison table shows that by using the Parasitic Capacitance technique we get maximum output power as compare to P&O and Incremental conduction method. The ripple amplitude and time response are more as compare to that two technique but the output power is more.

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