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A High Efficiency Maximum Power Point Tracking for a Distributed PV System under Rapidly Changing Environmental and Load Conditions

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ABSTRACT

In general Photo Voltaic (PV) systems need to operate under normal conditions as well as rapidly changing environmental conditions , in any case it should operate properly and it should draw maximum power and deliver maximum power to loads under any case . when the conventional maximum power point tracking (MPPT) schemes areplaced to operate under rapidly changing environmental conditions the more power loss will takes place because of slow tracking speed and output power fluctuations. In this paper we introduced the new MPPT technique to achieve maximum power, with reduced power loss under rapidly changing environmental and load conditions for PV cells. The proposedmethod for PV is implemented followed by dc to dc power converter.The theoretical analysis and the simulation results show that the proposed MPPT provides fast and accurate tracking under rapidly changing environmental conditions. And it shows the increased tracking speed and reduced time to get the maximum power .And it reduces the power loss by 85% approximately.

I. INTRODUCTION

As the expenses of non-renewable energy sources and their ecological concerns rise, the interest for advancement or developments in renewable power sources have been increased . In ordinary photovoltaic (PV) using central or, string inverters, each PV module panel is associated with an inverter that utilizations passive segments, for example, vast capacitors also, inductors. Miss match and fractional shading issues among the devices which are connected in series with the PV panels are the primary sources of the power loss. Keeping this point in mind and to overcome this power loss problem a maximum power point tracking (MPPT) controller has been introduced and embedded into an inverter. MPPT is an advanced control scheme to reduce the power loss and it uses the I-V characteristics of the PV panel. Different MPPT techniques have been researched, and they are divided into three types:single step, multivariable step, and binary-weighted step.single-step techniques include perturb and observe (P&O) in , P&O based on a PI controller in , *dP*-P&O in , incremental conductance (INC) , power-increment-aided INC (PI-INC) with a two-phased tracking. The major disadvantage of the conventional MPPT is its low tracking speed.similarlymulti variable step algorithms also have some disadvantages like having adhoc parameters to decrease the tracking time.Another MPPT strategy for fast tracking speedis based on the parallel weighted step (BWS) is the successive approximation register (SAR)

MPPT in. Be that as it may, the intermittent operation between its dynamic and shut down modes naturally makes the yield vacillate even without a change in ecological conditions. Besides, the MSB operation runs first in the SAR MPPT, which progressively disturbs the in general power loss. The proposed MPPT technique revealed that the MPP tracking is quickly without any fluctuation or an additional *ad hoc* parameter by using LSB first operation, which shows that the proposed method is having more superior performance compared to others in the tracking methods not only for normal conditions but also for rapidly changing environmental as well as load conditions.

II. PHOTO VOLTAIC SYSTEM

2.1Characteristics of a PV model :

The above figure represents the equivalent circuit of PV cell and a PV model it has one current source controller and a reverse blocking diode and some passive elements .and are connected in a manner as shown in the figure.

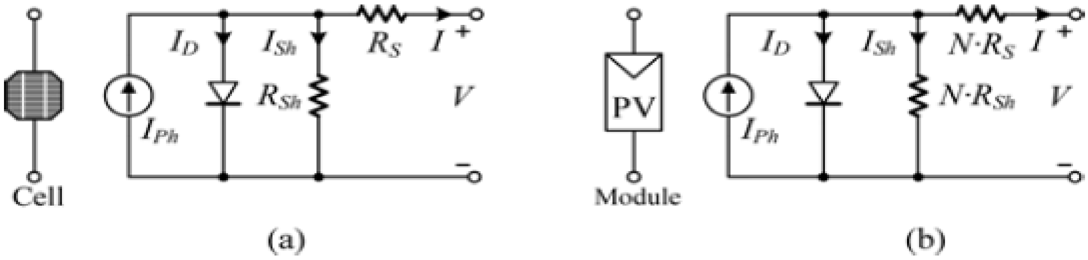

Fig .1. Equivalent circuit of (a) a PV cell and (b) a module.

It can be written as

$$I_s = I_{\mathrm{Ph}} - I_D - I_{\mathrm{Sh}}$$

$$= I_{\mathrm{Ph}} - I_S \cdot \left[e^{\frac{V + I \cdot R_S}{n \cdot V_T}} - 1 \right] - \frac{V + I \cdot R_S}{R_{\mathrm{Sh}}}$$

Here

I - is the current flowing through the cell ,

V-the voltage across the cell,

Is- is the saturation current ,

R_s- is the series resistance

R_{sh}- is the shunt resistance,

N – isthe ideality factor of the PV cell, and

$V_t$is the thermal voltage.

We know that the voltage generated from the pv cell is very low hence we connect the pv cells in series manner as shown in fig .1.(b). to design a PV module. The vi characteristics of PV cells in PV module are Identicle. The current equation related to PV modules are shown above.

The power generated by a PV module depends on the current and voltage relationship. Especially under rapid environmental changing conditions, I_{Ph} depends strongly on the irradiance changes and partial shading conditions, which results in a change in power as shown in Fig. 2.Fig. 2(a) Represents that the reduction in the voltage at the MPP (*V*MPP) and the open-circuit voltage (*V*OC) of a PV module as the irradiance is reduced.

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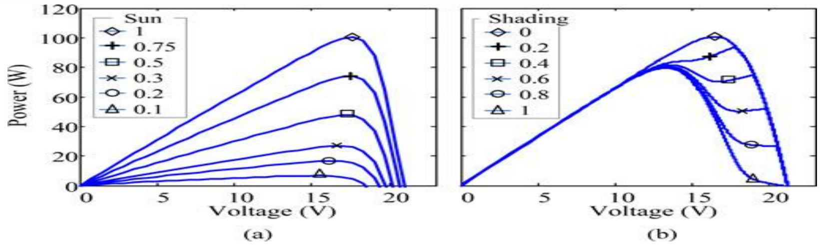

Fig. 2. Power versus voltage characteristics of a PV module (a) under various irradiance conditions and (b) with a partially shaded cell.

In Fig. 2(b), V_{MPP} is changed according to the amount of shading in a PV cell at the irradiance of 1 Sun. The greater the number of shaded cells, the larger the variation in V_{MPP} is.

III. CIRCUIT DESCRIPTION AND OPERATING PRINCIPLES

3.1Existed System :

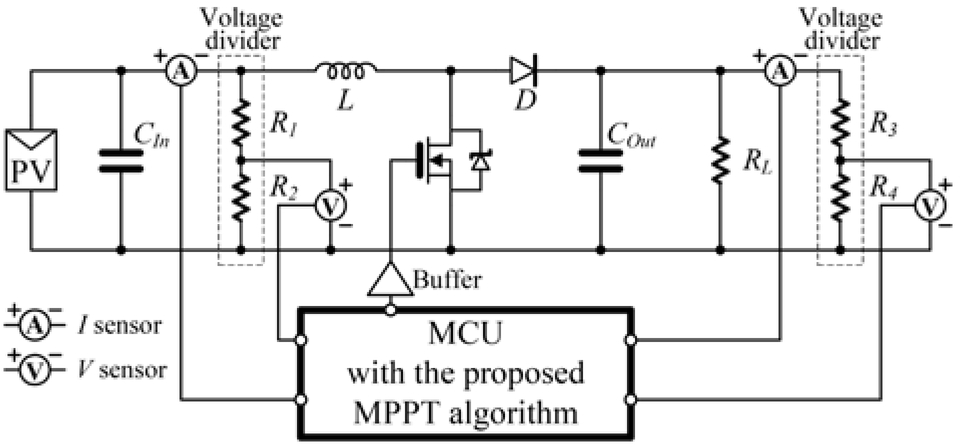

Fig 3. Existed block diagram ofPV with boost converter

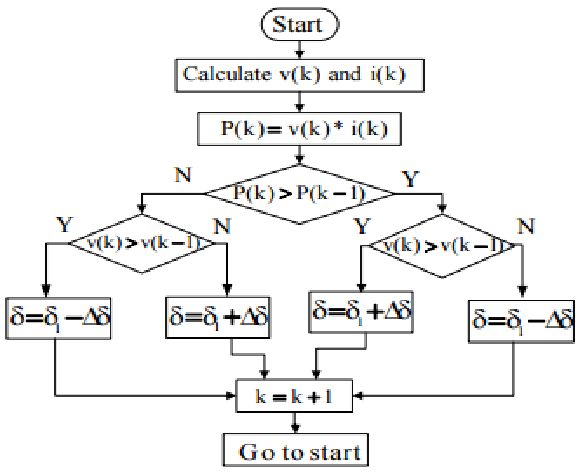

Fig 4.Existed mppt algorithm

In this method the output of PV module is directly fed to boost converter and from which it is supplied to a single load. And when the environmental conditions for example solar irradiance are suddenly changed then the out voltages varies as well as output power also varies.we know that PV output is inversely proportional to the

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load resistance. And The PV voltage varies with respect to the load .as the loads are increases the voltage drop also increases .

3.2 Proposed System

The Proposed Algorithm The MPP of a PV module fluctuates as per the environmentalconditions as talked about before. So as to decrease the control power loss under quickly changing condition conditions, the proposed calculation goes for tracking the MPP as fast as conceivable. The proposed MPPT calculations depend on the ABWS and the MDS, which tracks the MPP rapidly without the previously mentioned issues brought on by the P&O and the SAR MPPT. Like the BWS, the ABWS tracks the MPP by expanding the voltage tracking step in a twofold way yet begins from the LSB with the base voltage tracking step Δ in Fig. 4. After a specific number of emphases, the working voltage passes VMPP. At that point, the ABWS stops and the MDS sends to discover the correct MPP. The proposed algorithm is showed in the figure (6).The proposed MPPT algorithmenhances the tracking speed with less power loss for itsfast tracking without output power fluctuation under the stableenvironmental condition.

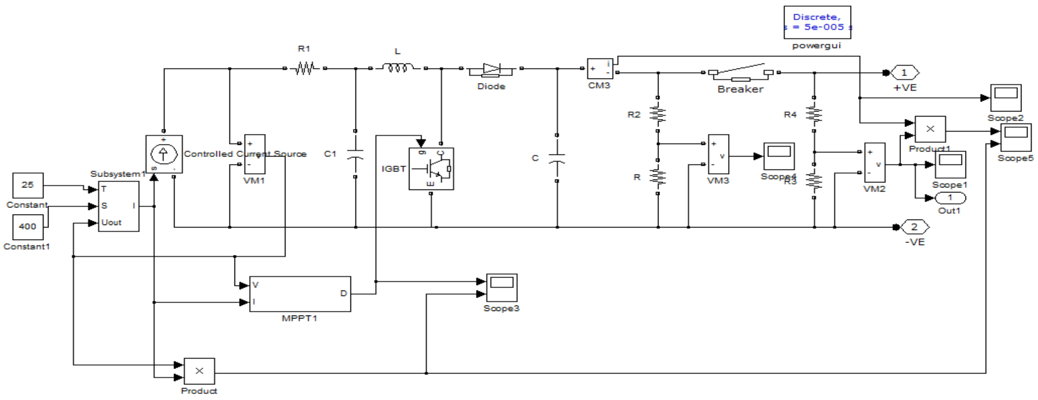

Fig 5.Proposed circuit model of PV with boost converter

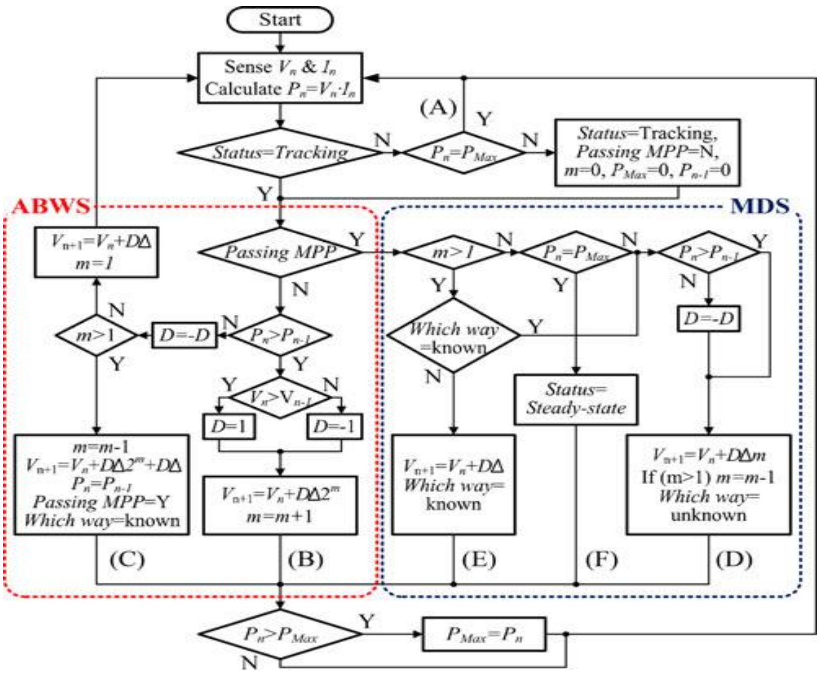

Fig 6. Proposed mppt algorithm

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Proposed MPPT Algorithm With a Boost Converter is shown in Fig. 5. It demonstrates a case of the usage for the proposed MPPT method committed to a dispersed PV modules. This system includes a voltage divider, an inductor, capacitors, a diode, a power MOSFET, a present sensor,, and a microcontroller unit (MCU). The lift converter controls the output voltage of a PV module by utilizing the PWM from the MCU as indicated by detected estimations of the voltage and current of the PVmodule. Since the voltage scope of the PV module is from 6 to 20 V, resistive dividers at the info and the yield of the lift converter are important to partition the voltages by ten all together for the permitted voltage of the MCU input level. This review utilizes a PWM frequency of 125 kHz.

IV. SIMULATION RESULTS

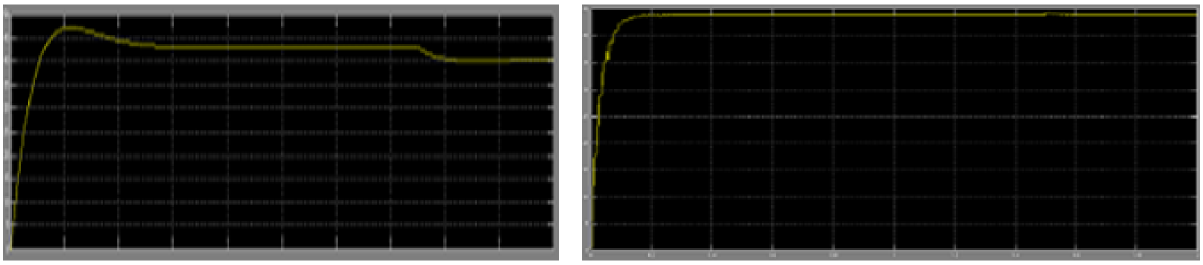


Fig.7.Simulation result of load voltage wave forms of existed and proposed system respectively

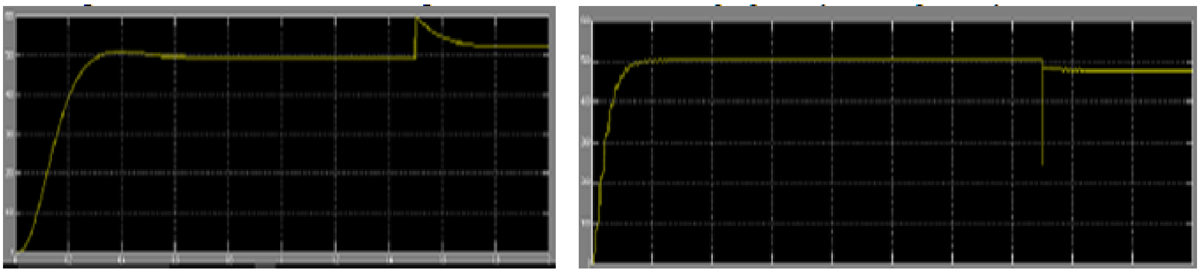
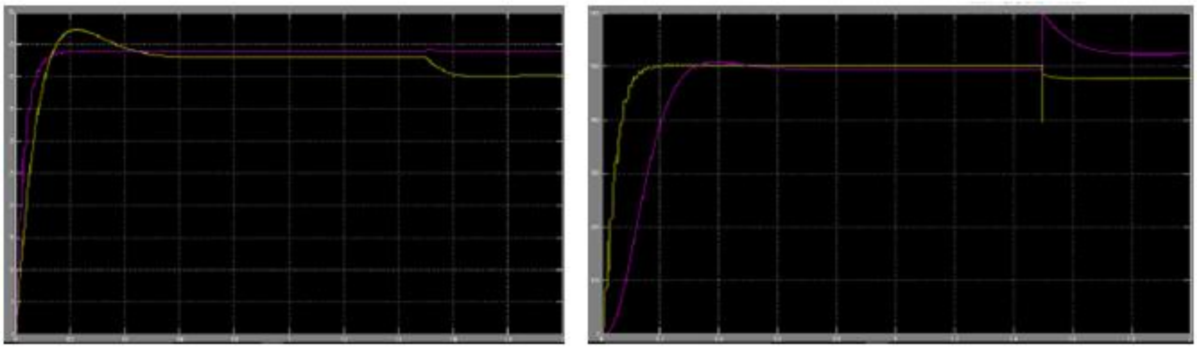


Fig.8.Simulation result of load power of proposed and existed methods.



(a) **(b)**

Fig.9.Simulation result of load voltage (a) and power (b) of proposed and existed methods when step change in the load

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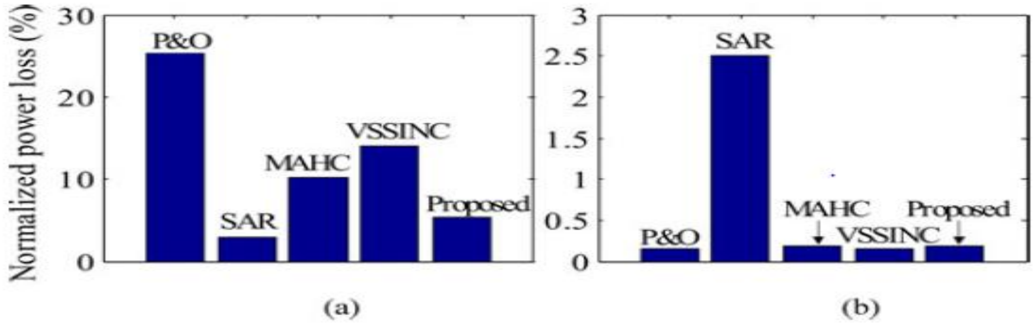

Fig. 10. Normalized power loss for dynamic tracking (a) initial setup during *t*1 and (b) step change in load during *t*2

V. CONCLUSION

This paper proposes anew MPPT method for a distributed PV systems under rapidly increasing load and environmental conditions, so as to track the MPP rapidly without change in the voltage levels with reduced power loss and fluctuations The proposed MPPT methods, the ABWS and the MDS, limit the power loss under quickly changing natural conditions without an extra impromptu parameter. In conventional method by connecting some extra load after some time some voltage drop will be takes place and it will take some more time to get the maximum voltage , but in our proposed method the maximum power tracking speed is high , and voltage drop is less after connecting extra load after some time. Despite the fact that the proposed MPPT framework is actualized by utilizing a boost converter, it can likewise be connected to a DC-DC converter. The test comes about measure the execution improvement of the proposed MPPT contrasted with the P&O concerning the following time and the general power loss under ordinary conditions as well as under quickly changing natural conditions as well as load .

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