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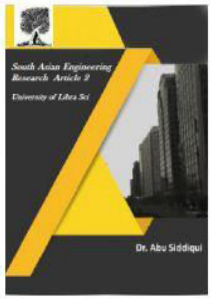

A NOVEL MAXIMUM POWER POINT TRACKING ALGORITHM USING CUCKOO SEARCH FOR PHOTOVOLTAIC GENERATION SYSTEM UNDER PARTIAL SHADING

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ABSTRACT

The rule purpose of this article is a novel Maximum power point following Algorithm using cuckoo filter for photovoltaic age system under mostly disguising. In Solar splendid imperativeness speaks to prevailing piece of usable sensible power essentialness on the earth. Photovoltaic frameworks convert imperativeness from the sun truly into power. Photovoltaic modules have a lone working point which results in the most extraordinary yield control. The MPPT structure is used to endeavor sun based essentialness. Conventional MPPT Algorithms (Incremental conductance, P&O) disregard to pursue the perfect control under quickly changing environmental conditions. Hereafter a splendid methodology reliant on formative figuring, Cuckoo Search Algorithm (CSA) is utilized to pursue the perfect power using SEPIC converter. This count, which is moved by the parasitic expansion system of cuckoo flying animals ensures the ability to find the overall MPP and besides gives a less perplexing control plan and lower all around structure cost.

Keywords: Cuckoo search Algorithm (CSA), Maximum power point tracking (MPPT), Partial shading, Photovoltaic module, SEPIC.

1. INTRODUCTION

With the appearance of mechanical upset, the interest of power has expanded immensely. At present, greater part of intensity created on the planet is from fossil filled power plants. Dominant part of the ozone depleting substances on the planet are discharged by petroleum derivatives, contributing 3/fourth of all carbon, methane and other ozone harming substance outflows. Additionally, universes non-renewable energy source save is being exhausted radically. Inside a limited ability to focus time, world should rely upon sustainable power sources to meet the greater part of its power request. Sustainable power sources are perfect wellsprings of energy having a much lower natural effect than customary energy advances. Sustainable power source innovations by and large require less upkeep than traditional energy generators. Their fuel is gotten from characteristic and accessible assets which lessens the expenses of activity. They create next to zero waste items, for example, carbon dioxide or different contaminations, so has a negligible ecological effect [1]. Sunlight based energy is one among the promising sustainable power hotspots for what's to come. Sun oriented vitality is light and warmth brilliant from the sun which is saddled utilizing a scope of advancing advances, for example, sun oriented

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warming, sun based photovoltaic, sun based warm energy, sun oriented design and photosynthesis. Sun oriented energy is a spotless type of energy. It produces little measure of carbon gases or sulfur oxides. Different focal points of sunlight based energy ate that it is reasonable, solid and adaptable [5]. Sunlight based PV frameworks convert energy of sun into power by making utilization of the photovoltaic impact. The sun powered energy is changed over into power by making utilization of a semiconductor gadget that is known as a sunlight based cell. For functional applications requiring a specific voltage or current for their activity, various sun oriented cells are to be associated together in arrangement and parallel to shape a sunlight based board, likewise called as PV module [12]. For substantial scale age of intensity, the sun oriented boards are associated together in arrangement and parallel to shape a sun based PV array.

The PV boards show nonlinear V - I qualities as their output supply depends for the most part on the idea of associated stack. Henceforth, it is important to discover ideal power purpose of the board with the goal that the general effectiveness of the photovoltaic framework is expanded [13]. In this way, a Maximum Power Point Tracking (MPPT) calculation is utilized for extricating greatest accessible power from a PV module under different ecological conditions. A power molding circuit exchanges most extreme power from the sun powered PV module to the heap. A dc-dc converter can fill this need whose obligation cycle is differed in order to keep the working force at its consistent most extreme esteem and accordingly we can work the PV framework at its greatest proficiency. More than thirty MPPT calculations have been proposed, among that the Perturb and Observe (P&O) strategy and Incremental Conductance (IC) technique are the usually utilized strategies for MPPT. These techniques anyway neglect to follow most extreme power under fractional shading conditions. This draws out the need of clever techniques like Fuzzy Logic Control (FLC), Artificial Neural Network (ANN), Particle Swarm Optimization (PSO), Ant Colony improvement (ACO), Cuckoo Search Algorithm (CSA) and so forth for MPPT. In this paper, a relatively novel calculation known as Cuckoo look calculation is being examined about. Because of its favorable circumstances, it is picking up its place in the streamlining of wide assortment of issues.

II. MODELLING OF SOLAR CELL

PV cells have p–n junction characteristic must be pointed out: the open circuit like a diode. It produces the electrical power by utilizing photons. PV board comprise of independent single cell which are associated together to frame module and fundamentally a module comprises of 32 or 36 silicon cell. The silicon cell is comprised of material like single crystalline, multi crystalline, formless, Gallium Arsenide, Cadmium Telluride, Organic PV cell [5]. The single module yield power won't fulfill the necessity of the heap so the modules are associated in arrangement or parallel to expand the voltage or current appraisals and this comprises an entire sun powered board. Substantial quantities of interconnected PV board shapes sun based PV cluster.

Characteristics of PV System: Solar cell non-straight attributes are commonly displayed by utilizing single diode show which is basic and exact. In some writing two diode and three

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diode show additionally proposed [3]. The for all intents and purposes utilized single diode demonstrate is appeared in Fig.1. It contain a present source in parallel with diode and furthermore arrangement and shunt obstruction which speaks to the voltage drop at contacts and misfortunes because of spillage individually. PV cell has nonlinear bend in view of two primary factor in particular temperature and irradiance.

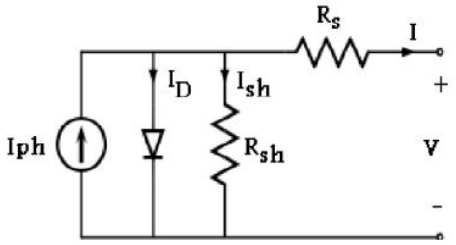

Fig.1: Equivalent Circuit of a Solar Cell

The I-V characteristics of the solar cell is given by which allows for the development of robust MPPT the equation

$$I_d = I\left[exp\left(q\frac{(V+IR_S)}{KT}\right)-1\right] \quad \ldots\ldots\ldots\ldots 1$$

$$I = I_{PV} - I_0\left[exp\left(\frac{(V+IR_S)}{nV_t}\right)-1\right]-\frac{V+IR_S}{R_0} \quad \ldots\ldots\ldots 2$$

Where I is sun oriented cell Current (An), Id is diode momentum (A), q is electron charge (1.6×10-19), K is Boltzmann calculation, Firefly calculation, Bacterial Foraging calculation consistent (1.38×10-23J/K), T is cell temperature in Kelvin, have drawn impressive specialist's consideration for V is Output voltage, Rse is arrangement obstruction, Rsh is shunt opposition.

For the most part V-I qualities of a PV exhibit are non-direct so it is hard to follow the MPPT.

Fig.2 indicates V-I qualities and Fig.3 demonstrate attributes of P-V under settled light and temperature conditions.

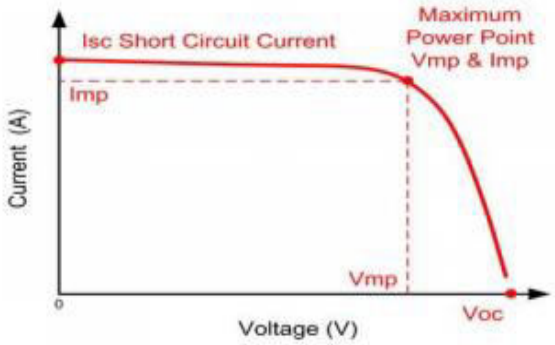

Fig. 2. V-I characteristics

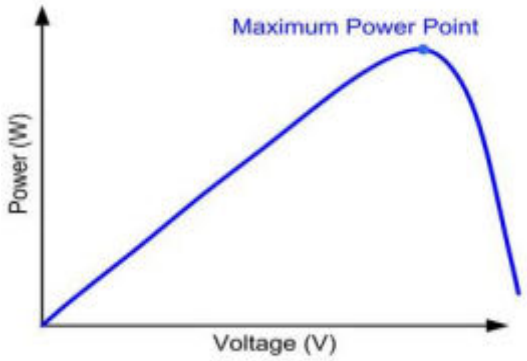

Fig. 3: V-P characteristics

III. PARTIAL SHADING

Partial shading has an emphatically non-direct impact on the power output and the electrical reaction of a PV framework [6]. Depending upon the degree and force of the shade, various local Maximum Power Points (MPP) may emerge, thwarting the viable following of the universally ideal working point, in this way prompting problematic execution, and also to problem area creation and quick disintegration of the shaded cells [7].

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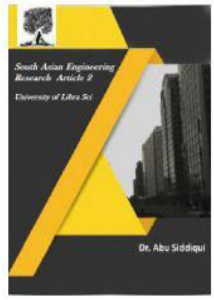

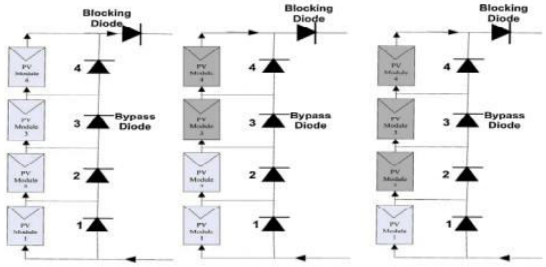

Fig. 4: Arrangement of PV array under uniform irradiation and different irradiation pattern.

By and large, the PV array ought to have something like one blocking diode associated in arrangement with the string and a detour diode in parallel to every module [8]. The motivation behind the blocking diode and sidestep diode is to keep the turn around stream of current when strings are associated in parallel and to avert hotspots in modules under halfway shading condition [9]. To follow the worldwide pinnacle viably without catching into the different neighborhood crests that exists amid fractional shading conditions [10]. Thusly it is fundamental to go for MPPT following procedures. The investigation of different shading and reproduction are displayed in [11].

$$I = I_L - I_O\left[exp\left(q\left(\left(\frac{(V+IR)}{KT}\right)-1\right)\right)\right] - \frac{(V+IR_S)}{R_{sh}} \quad \ldots.3$$

IV.CUCKOO SEARCH ALGORITHM

The cuckoo look (CS) strategy [6] is a bio-propelled parasitic multiplication plan of the cuckoo flying creatures. In CS, looking strides for a home is described by require flight system. A demand flight is essentially irregular stroll from which the progression sizes are being removed for collect disseminations. Because of exacts flight system, step sizes for CS are generally bigger than the ordinary PSO [7]. It quickens quicker union. As the particles draw closer to the MPP, the progression estimate continuously gets littler lastly diminished to zero. The stream diagram for CS is appeared in Fig. 5.

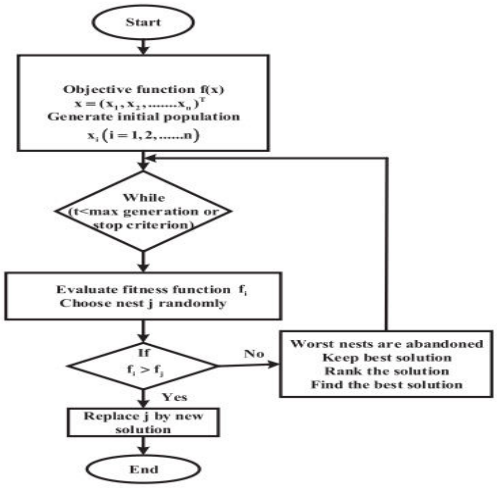

Fig. 5: Flowchart of cuckoo search method.

V. OVERALL SETUP FOR IMPLEMENTING MPPT

The SEPIC converter [15] and its controller are seen in Fig.6. Right off the bat, the SEPIC controller plays out the estimation of the momentary estimations of the voltage and current signs created by the photovoltaic cluster. From these qualities, the MPPT calculation changes the obligation cycle of the SEPIC converter. At long last, a PWM (Pulse Width Modulation) module is utilized to produce the terminating beats of the electronic switch Q1 by utilizing the obligation cycle[16].

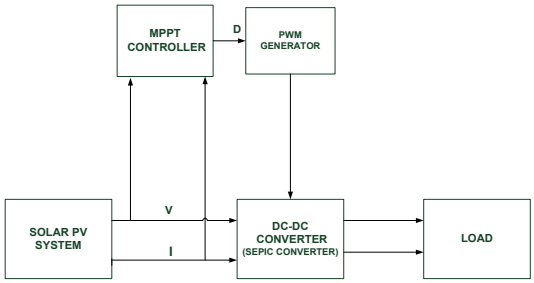

Fig. 6: Overall setup for implementing MPPT

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VII.SIMULATION RESULTS

Simulink model of the PV array is appeared in the Fig 7. It tends to be seen from the waveform that the power from the PV module is followed at its most extreme incentive with least motions. The MPPT calculation is executed in code frame and joined in the framework as an inserted capacity. The voltage and current from the board are detected and the MPPT calculation gives the best estimation of voltage, I. e, the voltage at which most extreme power is produced. This esteem is then bolstered to a controller which can produce the beats for the activity of the switch with the goal that the most extreme power is followed adequately. Different outcomes acquired after recreation under standard test conditions are as appeared in the accompanying figures.

CASE 1: EXISTING P&O MPPT METHOD

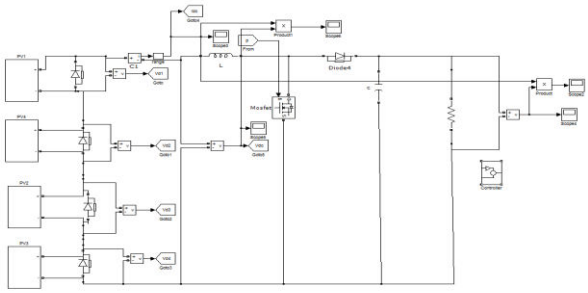

Fig 7 MATLAB/SIMULINK diagram of the existing system

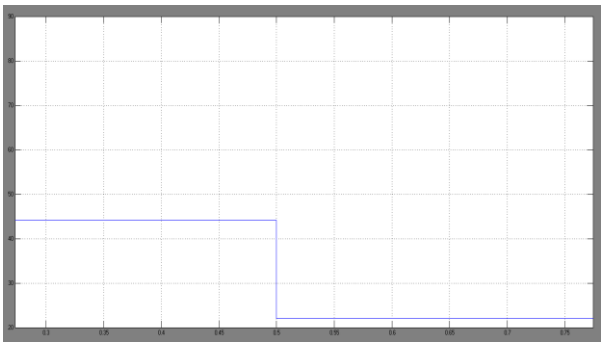

Fig 8 Input voltage

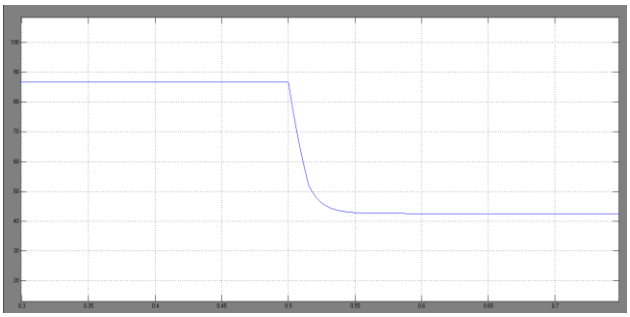

Fig 9 Output voltage

CASE 2: EXTENSION CUCKOO SEARCH MPPT ALGORITHM

The MPPT include is executed in code diagram and took an interest in the framework as an installed point of confinement. The voltage and current from the board are perceived and the MPPT check gives the best estimation of voltage, I. e, the voltage at which most preposterous power is made. This respect is then bolstered to a controller which can convey the beats for the activity of the switch with the target that the most over the top power is sought after adequately. Different outcomes obtained after stimulation under standard test conditions are as appeared in the going with figures

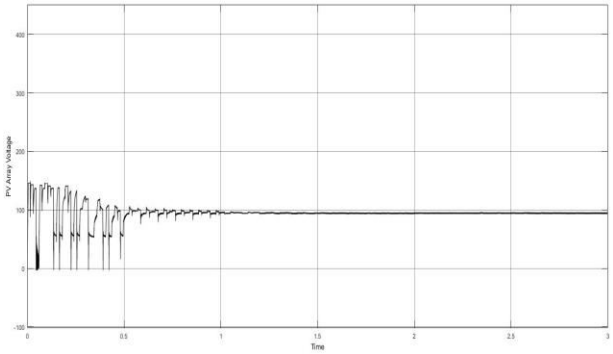

Fig 10. PV array voltage

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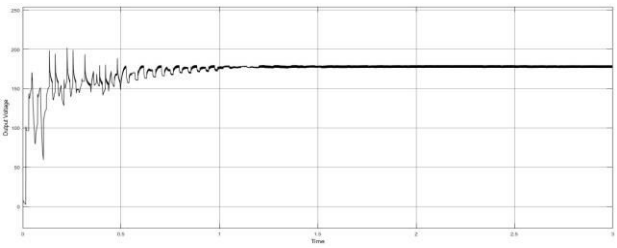

Fig 11. Output Voltage Specifications of PV module

The parameters of the single module under the standard test condition are as shown in Table 1. To study the algorithms four light conditions are set for this PV system, G_1=500 W/m^2, G_2=800 W/m^2, G_3=1000W/m^2, G_4=1000 W/m^2 respectively.

Table :1 Parameters of the PV module:

Parameter	Value
Maximum power (P_m)	249W
Open circuit voltage (V_{oc})	36.8V
Maximum power voltage(V_m)	30V
Short circuit current (I_{sc})	8.83A
Maximum power current(I_m)	8A

CONCLUSION

The traditional MPPT algorithms neglect to follow ideal power under incomplete shading conditions and under quickly evolving conditions. The Power molding circuit utilized is a SEPIC converter. The obligation proportion duty ration of this converter is naturally changed by the controller to follow the maximum power. To handle the issue of partial shading this novel strategy can be viably utilized. It is demonstrated that CSA works better under differing atmospheric conditions and its convergence speed is faster compared with different calculations. In this paper a novel MPPT algorithm is proposed dependent on cuckoo search algorithm. Following the cuckoos characteristic conduct and le'vy flight appropriation, MPP is followed effectively. It is affirmed from the recreation result that this calculation joins quicker than P&O. Moreover, it shows zero swaying at enduring state, in this way spares a lot of intensity. Moreover this calculation can follow MPP effectively when barometrical condition changes quickly.

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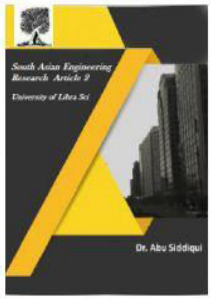

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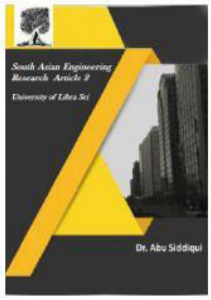

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