

Application of PSO for MPPT in Intelligent Solar system With Automatic Switching between ON grid and OFF Grid Connections

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Abstract— Renewable energy generation is that the most fascinating analysis space in gift days. Solar systems are becoming a lot of interest attributable to their increased and enormous potency. Solar power varies with the intensity of the sunshine. As a result the output power of the PV panel changes. This variable provides can neither be connected to grid nor used for load. Thence to urge a most power, Maximum Power Point technology (MPPT) is projected. Existing algorithms like progressive electrical phenomenon and Perturb and Observe technique verified to be less economical find the optimum resolution. Thence soft computing technique known as Particle Swarm optimization algorithmic rule (PSO) is projected to seek out the most power. Particle Swarm optimization (PSO) technique has been applied for multi-junction electric cell system. The most aim of PSO is to seek out duty cycle to the Boost convertor to keep up constant output voltage no matter power made by solar panels. The projected MPPT management algorithmic rule is developed in MATLAB that optimizes the panel voltage. Generated solar power sometimes needs conversion to Associate in nursing alternating amount that is achieved victimization inverters. A 3 level electrical converter is enforced to get a harmonic less AC output. Simulation results show that the projected algorithmic rule is a lot of economical than the present techniques.

Keywords— Maximum Power Point Tracking (MPPT), level inverter, Buck Boost DC-DC converter, Particle Swarm Optimization (PSO), Boost Converter.

I. INTRODUCTION

Now days, attributable to heating and therefore the rise in fossil oil value, countries worldwide have began to invest mostly in analysis and development associated with renewable energy sources. Among renewable energy generation systems, alternative energy generation has received the foremost attention; from small-scale applications to large-scale operations, the possibility of alternative energy applications is liberal. However, as a result of the energy conversion potency of photo voltaic (PV) power generation system (PGS) is low and therefore the price of alternative energy generation is beyond that of thermal power generation or nuclear generation, determinant the way to annex most power from a PGS has

become an important topic. Solar Photovoltaic (PV) energy is approved as a well-liked supply of non-conventional energy thanks to sizable amount of advantages, particularly low operational price and less pollution. Solar PV energy has increased interest in electrical applications, from the time once it's afthought as a considerably free and principally obtainable energy offer. Among many renewable energy schemes, PV power generation structures area unit projected to play a stress half as AN uncontaminated power electricity supply since PV panel's area unit recommended to put in roof-tops of house and buildings. The characteristic curves of a photovoltaic cell area unit nonlinear and depend upon the irradiance level and close temperature, leading to a singular current-voltage (I-V) curve. To enhance the potency and liableness of the PV system many following systems area unit cited within the literature. Consequently, the in operating point (OP) of a PGS should be adjusted to the extent during which the most potency of the solar cells are often achieved, and this system is termed maximum power point tracking (MPPT). This peak purpose includes a nonlinear variation with Irradiation and temperature. Thence to run the PV system at its MPP, the PV system needs to feature maximum power point tracking (MPPT) controller. MPPT management is mixed with DC/DC boost convertor can grant the PV array to supply the most out there power, regardless of the part conditions. MPPT area unit classified into 3 giant teams. Initial cluster is termed as Perturb and Observe and progressive electrical phenomenon methodology. The disadvantage of this cluster is its slow following ability, steady state fluctuation at maximum power point (MPP) and reduced attainment. To subjugate these drawbacks soft computing techniques area unit evolved. The techniques that area unit enclosed during this class area unit the Fuzzy logic controller (FLC), Artificial Neural Network (ANN) and Evolutionary Algorithms (EA). These teams even have some shortcomings attributable to many issues find it irresistible needs periodic coaching and it resort extra memory can become laborious to execute in bio impressed strategies. The third cluster comes below the kind of biological process computing, Particle swarm optimization (PSO), Genetic algorithmic program (GA), Bacterial hunting algorithmic program, Ant colony optimization (ACO) area unit the techniques enclosed below this class.

II. PARTICLE SWARM OPTIMIZATION ALGORITHM

Particle swarm optimization was first developed by Kenney and Eberhart in 1995 and it has been emerging rapidly in recent years. PSO is mainly used to solve power system optimization problems. It provides optimal solution to problems like Unit commitment, optimal reactive power dispatch, and Economic load dispatch etc., foundation of PSO is on swarm endowment to solve constrained optimization problems. The primary set of solution is called population and each member in the population is called as swarms. In this algorithm, a number of particles are employed in an n-dimensional space.

PSO uses an initial solution called swarms which are generated at random.

$$A_i = [A_{i1}, A_{i2}, A_{i3} \dots A_{in}]$$

Particles find their search direction by using gregarious and perceptive information. These particles move within the search house to search out an honest best answer. The best position that a particle has found is termed pbest and therefore the best position that any particle found is termed gbest. And here the new position of a particle is found by the following equation.

$$A_{i(t+1)} = A_{i(t)} + K_{i(t+1)} \dots (1)$$

The formula calculates the new velocity as follow.

$$K_{i(t+1)} = w \times K_{i(t)} + T_1 \times rand(1) \times [A_{pbesti} - A_i] + T_2 \times rand(1) [A_{gbesti} - A_i] \dots (2)$$

Where,

$K_{i(t+1)}$ = Particle velocity

$A_{i(t+1)}$ = Current position of particle

A_i = Previous position of particle

w = Weight of factor

T_1 & T_2 = learning coefficients, usually lies between 1 to 2

$rand()$ = $rand()$ is a function that generates a uniform-distributed random real number between 0 and 1.

III. PSO BASED MPPT ALGORITHM IMPLEMENTATION

The output current and voltage from the panel modification in keeping with insolation level. Main reason to style PSO primarily based MPPT rule is to trace the utmost power from the PV system. It finds the best voltage price to be created by the Buck-Boost convertor supported power price. once price of current is calculated, the consonant voltage price that provides most power is computed from PSO. As shown in below diagram of the planned model.

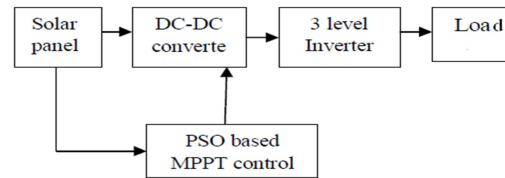


Figure 1: Block diagram for proposed model

As we tend to mentioned rule ascertain the best voltage price that maximizes the target operate. The controller adjusts the duty quantitative relation of Dc-Dc convertor to urge the specified output voltage. so whole PV star system's most power is find all the time and reborn to needed AC price for the load.

A.PSO ALGORITHM IMPLEMENTATION:-

PSO algorithm flowchart of the proposed PV system is illustrated in Fig 2.

1. Fix the speed and position limit once the parameters and particles square measure initialized.
2. For every particle the speed and also the position square measure initialized arbitrarily.
3. for every particle the worth of Pbest has been calculated.
4. Gbest price has been set once the most effective price of the particle has been reached.
5. The worth of the speed and also the position has been updated automatically supported the Gbest.
6. Repeat the steps three and four till the optimum answer is earned and also the optimized price has been determined at the last iteration supported Gbest.

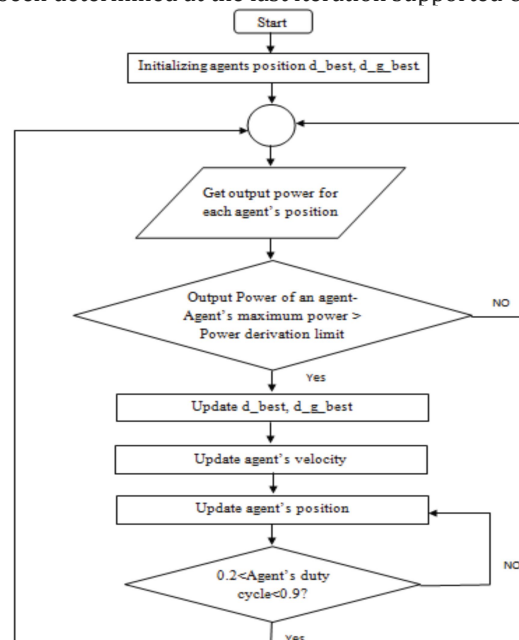


Fig. 2. PSO method flow chart

IV. POWER ELECTRONIC CIRCUITRY

The main advantage of planned electrical converter topology is that it generates AC amount with less switching losses and reduced harmonic current. The buck boost device will either accelerate or step down the DC voltage of panel. The output voltage of a device is adjusted with the assistance of the duty cycle. And therefore the device is controlled with the assistance of MPPT controller that is coded with PSO. The output of the PV panel is connected to the electrical converter is commodious to stay in track the worth of power that is most no matter time. The subsequent expression that proves that output current of panel is directly proportional to the temperature and incident radiation.

- I_r = reverse saturation current
- I_p = photon current
- K = Boltzmann's constant ($1.38 \times 10^{-23} J/K$)
- I_s = Short circuit current
- Q = electron charge ($1.6 \times 10^{-19} C$)
- S = short circuit current temperature co efficient
- V_o = Open circuit voltage
- C = ideality factor
- T_r = Reference temperature (K)
- T = solar cell temperature (K)
- R = solar cell radiation
- N_s = number of cells in series connection
- N_p = number of cells in parallel connection

$$I = N_p I_p - N_p I_r \left[\exp\left(\frac{QV}{KCTN_s}\right) - 1 \right] \dots (3)$$

$$I_r = \left[I_p / (\exp((V_o \times Q) / KCT) - 1) \right] \dots (4)$$

$$I_p = [I_s + (S/1000)(T - T_r)]R \dots (5)$$

The Conventional boost or buck converters contain onerous switching technique. Thanks to this will increase switching losses and thence it reduces the potency of system. The buck boost converter's duty cycle is adjusted as per the MPPT algorithms optimum voltage worth. 2 stage systems incorporate cascaded connections with accrued variety of switches. Power loss is high in such topologies. The obtained DC voltage ought to be reborn to a corresponding AC quantity. Relatively higher or lower output is obtained as per the load needs. The planned system is intended and enforced employing a 3 level electrical converter and its simulated mistreatment MATLAB software package.

V. SIMULATION RESULTS

According to the specifications of the device it will operate with voltage ranges from zero to 200V at every input of the

converters. The formula and simulation circuits' are developed in Mat-lab setting. The potency is tested mistreatment totally different variety of swarms and iterations. Convergence of the formula depends on speed and random factors. Within the planned system solar panels with totally different materials are used. Here totally different materials like GaInAsp, GaInp, GaInAs, GaAs and it's connected to separate Boost device. The simulation results of the PV system mistreatment PSO optimization technique has been shown in below Figure. Simulation results depicts that PSO primarily based MPPT formula will apace and exactly verify the utmost power of every modules and therefore the system accomplished a correct sense of the utmost power output. PSO traps the worldwide best price once radiation level is totally different because of environmental conditions. The assorted values of best voltage and power for every separate iteration are tabulated within the below tables. The simulation results of the PV system mistreatment PSO optimization technique has been shown in Fig.3. Simulation results depicts that PSO primarily based MPPT formula will apace and exactly verify the utmost power of every modules and therefore the system accomplished a correct sense of the utmost power output.

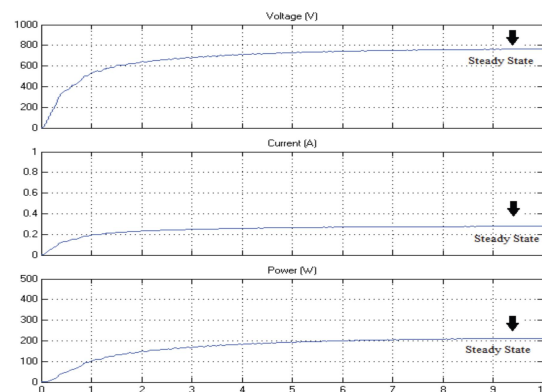


Fig. 3. Simulation results of Voltage, Current and power tracked using PSO algorithm

It is noted that the temperature has been same for all the four materials and the Insolation value changes from 300 to 1000 W/m2 and the results are displayed in table number 1.

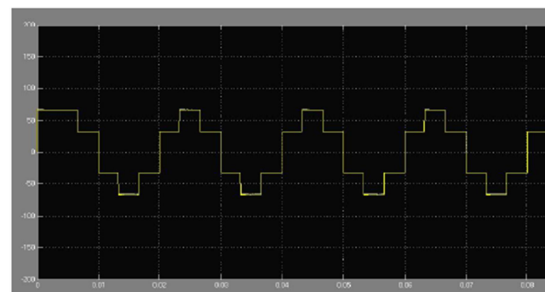


Fig.4 Voltage waveform of three level

Table: - COMPARISON OF CONVERTER OUTPUTS WITH DIFFERENT INSOLATION LEVELS

Radiation	Iteration	Population of particles	Optimal Voltage	Current	Power
300	100	100	15.63	1.23	19.22
300	60	100	15.63	1.23	19.22
300	30	100	15.63	1.23	19.22
500	100	100	17.15	1.85	31.72
500	60	100	17.15	1.85	31.72
500	30	100	17.15	1.85	31.72
750	100	100	18.12	2.53	45.84
750	60	100	18.12	2.53	45.84
750	30	100	18.12	2.53	45.84
800	30	20	730.7	0.259	189.3
850	30	20	730.7	0.260	189.98
900	30	20	733.5	0.260	190.71
925	30	20	730	0.265	193.45
1000	30	20	736.6	0.267	197.0

Voltage and Current waveforms of the planned electrical converter circuit are shown in Figure 4 and Figure 5. Circuit shows that less variety of change devices is employed that reduces the switching losses. So the potency of the system is enhanced.

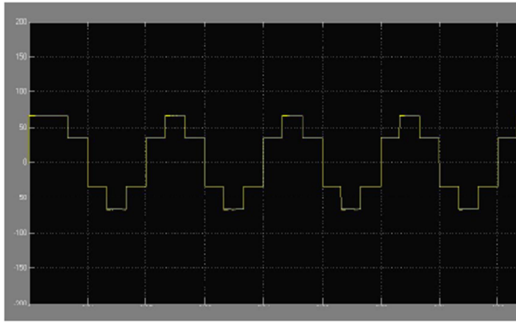


Fig.5. Current waveform of three level inverter.

And PSO technique has bound deserves when put next to alternative techniques they're listed as follows, straightforward structure, straightforward Execution and incorporates a in no time convergence speed to the well-liked resolution and it's terribly high pursuit speed. Regardless of the irradiation the planned PSO has been track the maximum point has been shown in Table I and it offers corresponding duty cycle to the converters that aren't attainable by alternative MPPT techniques.

VI. CONCLUSION

In this paper the planning and implementation of the projected methodology is mentioned intimately. An optimization algorithmic program known as Particle swarm optimization algorithmic program is projected to get most power from the panel. Particle Swarm optimisation technique with Associate in Nursing economical duty cycle formatting has been incontestable during this paper. The projected algorithmic program effectively tracks the world optima of power worth. The projected methodology was tested beneath unvarying and partly shaded environmental conditions. Potency of the system is any augmented by electrical converter configurations. The topology proves to be a lot of economical in each price and gain. Losses square measure extremely reduced with projected electrical converter model. Existing MPPT algorithms like Perturb & Observe, Incremental conductance phenomenon fails to trace the optimum worth beneath partial shaded conditions. The projected optimization technique overcomes this downside. So overall potency is improved with the projected techniques. Supported simulation results the subsequent conclusions were obtained. PSO methodology was found to possess smart pursuit power even beneath partly shaded and ranging part conditions.

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