A Novel Approach to Obtain Maximum Power Output from Solar Panel using PSO

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Abstract— The configuration of a most extreme force point following (MPPT) controller for a sun based photovoltaic force framework is proposed using a help converter topology utilizing PSO calculation. Sunlight based board voltage and current are consistently checked by a shut circle focused around PSO microcontroller control framework, and the obligation cycle of the help converter persistently changed in accordance with concentrate greatest force. Framework testing affirms crest force following under changing lighting conditions. Under particular conditions, efficiencies in overabundance of 96% are demonstrated to be conceivable.

Key words: PSO, Maximum Power Point Tracking, Photovoltaic Generator, Transparent Conductive Oxide

I. INTRODUCTION

Sunlight based force is an option engineering that will assuredly lead us far from our petroleum subordinate vitality sources. The real issue with sunlight based board innovation is that the efficiencies for sun based force frameworks are still poor and the expenses for every kilo-watt-hour (kwh) are definitely not focused, much of the time, to contend with petroleum vitality sources. Our objective is to plan a Maximum Power Point Tracker (MPPT), a particular sort of charge controller that will use the sun oriented board to its most extreme potential. The MPPT screens the yield voltage and present from the sun based board and decides the working point that will convey that greatest measure of force accessible to the batteries. Utilizing PSO method MPPT can precisely track the continually changing working point where the force is busy's greatest, and afterward the productivity of the sun oriented cell can likewise be expanded. The expense profit for sunlight based force frameworks is so low there is no option be broadly utilized for fueling homes, organizations, or even individual items. Then again, the profit of using sun powered power in space far exceeds the expense to execute them. Sun powered force framework is less expensive than the expense to send transmission lines from the force matrix. On the other hand, PV frameworks further improve the rate at which the electron sent into the conduction band through the procedure of doping .Solar force is an astounding innovation as in it changes over daylight into power through the semiconductor material alone. Over the long haul, more up to date producing procedures and plans will demonstrate these sun powered boards more proficient and less excessive in future years. A sun based board's yield shifts relying upon certain surrounding climate conditions, for example, temperature, enlightenment, how clear the sky is, on et cetera. Our current workload is to plan a gadget that will extricate the most extreme sum.

II. VOLTAGE-CURRENT (V-I) CHARACTERISTIC

Extracting the maximum amount of power from the solar panel is difficult due to the nonlinearity of the Voltage-Current (V-I) characteristic. Figure 1.1 shows the V-I characteristic for Solar Corp's 379 Solar.

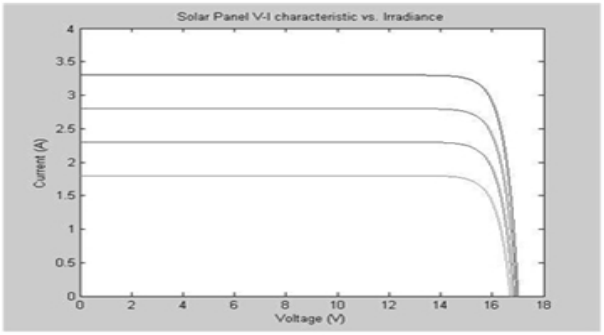

Fig. 1.1: Characteristic of Solar Corp 379 Panel

The blue line in Figure 1.1 is the actual V-I characteristic and the pink line corresponds to the power as a function of the voltage (P = I*V).To get the maximum power from the solar panel, the solar panel must always be operated at or very near the point where the power curve is at a maximum, its peak point. However, this operating point will constantly change due to the constantly changing ambient conditions. Irradiance is a characteristic that deals with the amount of sun energy reaching the ground. The irradiance reaching the earth significantly depend on where the panel is located geographically, the angle of the sun, and the amount of haze or cloud cover preventing all of the suns energy from reaching the ground. Silicon Semiconductor solar panel will decrease from 1700 cm2/volt-sec at 27^{o}C to 440 cm^{2}/volt-sec at 227^{o}C.where the hole mobility will decrease from 600 cm^{2}/volt-sec at 27^{o}C to 200 cm^{2}/volt-sec at 227^{o}C[4]. Temperature also causes the band gap energy of the semiconductor material to increase. Insolation levels measure the amount of energy in watt-hours for a square meter over a single day in Kwh/m^{2}/day. Insolation level units are not always stated, and can be seen as a ratio.

III. METHODOLOGY

The basic system is shown in block diagram of the Figure 1.2

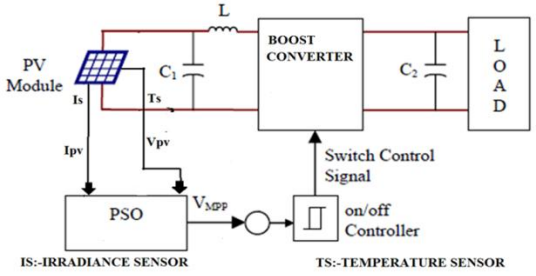

Fig. 1.2: System Block Diagram

Ten of our 50W solar cells would generate 500W[3]. This would yield a maximum of 20.8A, very comparable to other controller's ratings. The table below shows how big our batteries must be in amp hours, to provide a 100W light bulb with power.

All unit in amp	100w load	200w load	300w load
1 Day	34	67	100
2 Days	67	134	200
3 Days	100	200	300
4 Days	134	267	400
5 Days	167	334	500
6 Days	200	400	600
7 Days	234	466	700

Table 1.3 is calculated using the following formula

Calculating the derivative gives more insight into the effect of the quantization noise in power. The derivative is calculated as follows.

The difference in the two power samples is 32 rather than the quantization of 1 from the voltage and current samples. Calculating the derivative gives more insight into the effect of the quantization noise in power. The derivative is calculated as follows.

$$\frac{\Delta P}{\Delta DC} = \frac{P2-P1}{\Delta DC} = \frac{8224-8192}{\Delta DC} = \frac{32}{\Delta DC}$$

This means that one bit change in current and voltage will create a derivative of 32 / □DC. This derivative in register value equals 0.078 watts / duty cycle. This will get worse as the voltage or current moves up towards their maximum value.

To test this quantization on our system, a steady duty cycle is applied to the input of the system while measured the changing voltage and current samples.

This setup is shown in Fig. 1.4

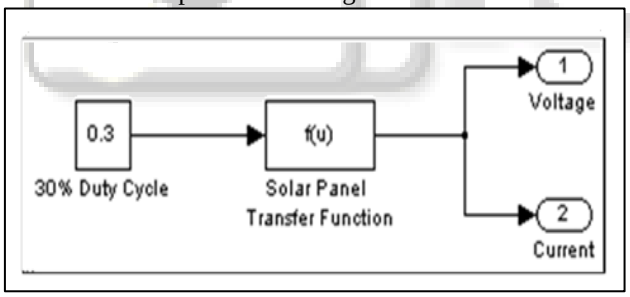

Fig. 1.4: Test Setup to Measure Quantization and Noise

The resulting voltage and current quantization noise is shown in Figures 1.5 and 1.6. Note the values are in 10 bit register values

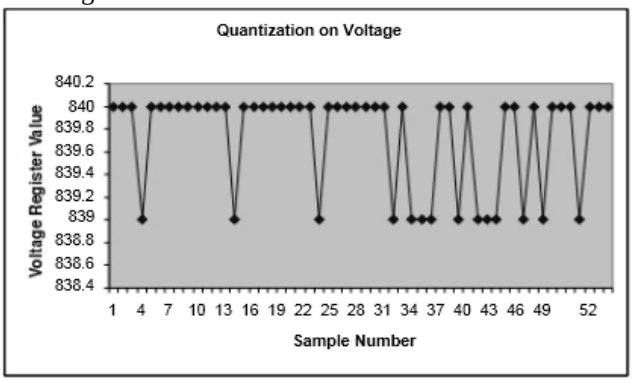

Fig. 1.5: Quantization of Voltage Register

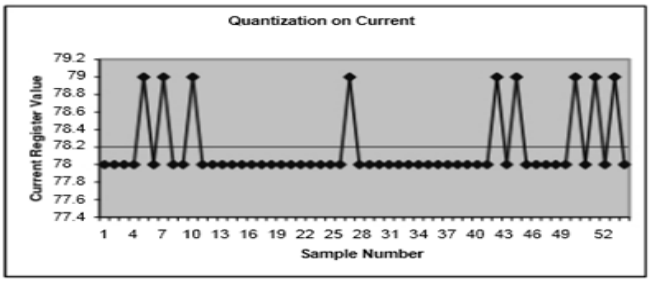

Fig. 1.6: Quantization on Current Register

IV. BASIC PSO ALGORITHM

New Velocity

$vi(k+1) = vi(k) + \gamma 1i(pi - xi(k)) + \gamma 2i(G - xi(k))$

New Position

$xi(k + 1) = xi(k) + vi(k + 1)$

i – particle index

k – discrete time index

vi – velocity of ith particle

xi – position of ith particle

pi – best position found by ith particle (personal best)

G – best position found by swarm (global best, best of personal bests)

g(1,2)i – random numbers on the interval [0,1] applied to ith particle.

A. The Common PSO Algorithm

$vi(k+1) = \varphi(k)vi(k) + \alpha 1[\gamma 1i(pi-xi(k))]+\alpha 2[\gamma 2i(G - xi(k))]$

φ - Inertia function

α1,2– Acceleration constants

As training progresses using a decreasing linear inertia

V. EXPERIMENTAL EVALUATION

So as to research the precision and execution of the proposed technique, a photovoltaic (PV) framework incorporates: one OFFC silicon sun powered board, a DC/DC converter, a battery and control framework (PSO MPP tracker and PID controller) are viewed as and recreated in MATLAB/SIMULINK programming. Which incorporates the PV module, the buck-help converter (Rashid, 2004) and the MPPT calculation The buck – support dc/dc converter is used because of a few reasons, in particular it displays better attributes with deference than the execution of PV cluster's MPP and it takes after the MPP at all times, paying little heed to the sunlight based insolation, the show temperature, and the associated burden. The PV module current and voltage are encouraged to the converter and the MPPT controller all the whi.

A. Simulation and Result

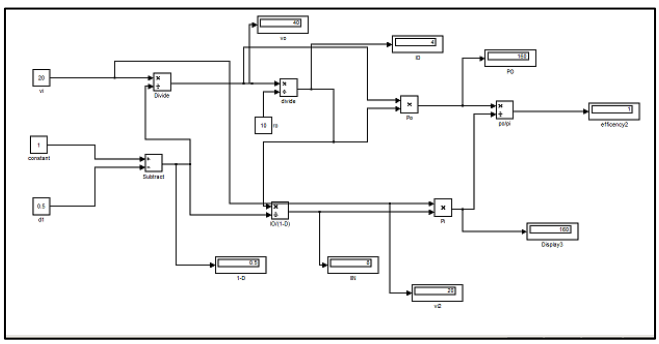

Fig. 1.7: Equation Model

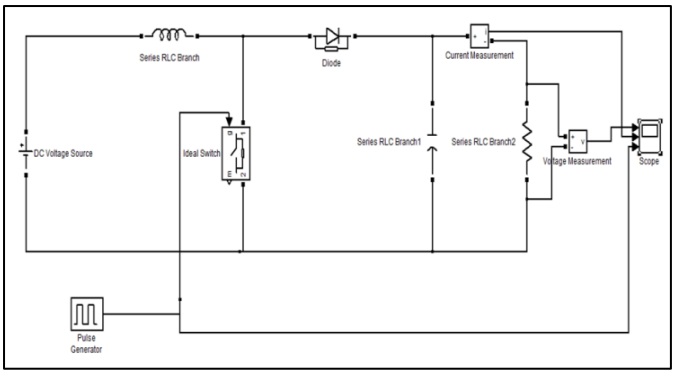

Fig. 1.8: Electrical Model of Boost Converter

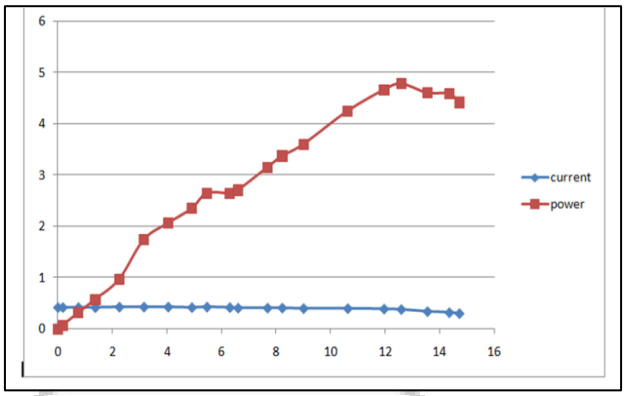

Fig. 1.9: Output Graph of Solar Panel

B. Outdoor Testing

The framework was broadly tried in lab with numerous distinctive variables. The framework ought to work in all conditions; however testing ought to be run for a full day's length, confirming the essential parts of it is fundamental.

A mixture of distinctive applications were explored and figured out if or not they are even plausible at the current state of sunlight based innovation. Framework moves in like manner with diverse daylight intensities and points, and additionally how the framework responds to passing mists.

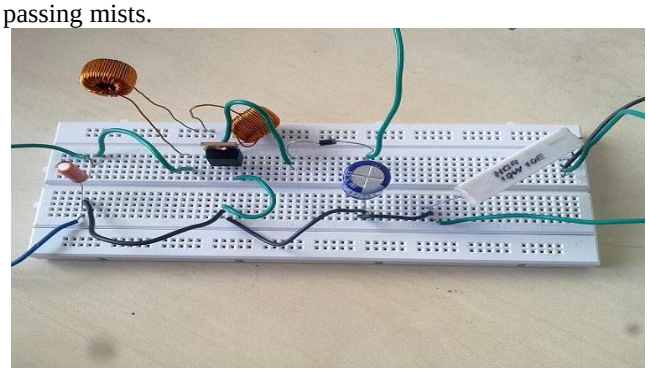

Fig. 1.10: Testing of Boost Converter

VI. CONCLUSION

To finish this undertaking in a compelling way an exhaustive understanding of sun powered innovation and The most doable application for sun oriented force is for remote areas obliging little amounts of force to run lighting, pumps, and other low power applications. Just uniting a sun powered board to a battery or a heap can further decline the accessible productivity. Sunlight based force frameworks profit from a MPPT gadget keeping in mind the end goal to concentrate the greatest accessible force from the sun powered boards in the framework. By observing the voltage and current yield of the sun oriented board, the MPPT tracks the continually changing working indicate in place draw the most extreme measure of force accessible amid all times of the day. To meet this principle outline necessity, numerous segments and working conditions were chosen focused around a proficiency examination that was performed keeping in mind the end goal to minimize the force misfortune through the hardware. A careful force misfortune examination turned out to be more prominent than 96% effective. A circuit that would screen the sun based board's energy yield and alter the working conditions focused around a control framework so as to expand the force yield was effectively outlined. An exceptional flow sensing thought was executed that minimized the force misfortune contrasted with different plans inquired about.

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