DESING AND IMPLEMENTATION OF MODIFIED BOOST CONVERTER FOR ELECTRIC VEHICLE APPLICATIONS

Dr DINESH KUMAR, *Assistant Professor,*

Dr.CHANDRA MOHAN, Mrs. Marishetty Gayathri[3], Mr. Mallaram Bharath[4],

[2],[3],[4], *Undergraduate.Department Of EEE,*

*Jyothishmathi Institute Of Technology And Science,Nustulapur,Telangana,India*shivakumarjits@gmail.com[1], akankshaponchetty@gmail.com[2],marishettygayathri@gmail.com[3],mallaramrahul456 @gmail.com[4],

Abstract: A rethought boost converter architecture for solar-powered EV charging is the main focus of this research. The incremental conductance (INC) model for maximum power point tracking (MPPT) controller is presented in this paper. This proposed tracker takes into consideration variations in cell temperature and irradiance in order to predict the currents and voltages that represent the maximum power supply of a solar photovoltaic (PV) array. Some of the topics covered include research into solar panel evaluation criteria and the characteristics of lithium battery loads. Using MATLAB/Simulink, we simulate trials under a resistive load to examine the performance of enhanced boost converters with INC MPPT and P and O.

keywords: Photovoltaic source, electric vehicle, better boost converter, incremental conductance maximum power point tracking ($).

I INTRODUCTION

The popularity of oil-powered automobiles has skyrocketed due to the general improvement in living standards. In 2016, the number of two-wheelers surpassed 169 million, expanding at a rate of 20% annually. They played a significant role in the surge of private transportation vehicles. This growth has two major consequences: first, it forces the purchase of oil, which depletes precious foreign currency; and second, it causes health issues owing to emissions of CO, CO2, and NOx. Another option is the use of electric vehicles. Installing 6-7 million electric automobiles and hybrid electric vehicles by 2020 is an aim set by the Indian government as part of its national mission on electric mobility. In order for electric cars to become more common, a nationwide system of charging stations is necessary. Concerns about electric cars' range, higher starting pricing, and issues with charging infrastructure are limiting their broad adoption. We need to consider other solutions since this enormous demand is beyond the capacity of the already congested transmission network. One alternative is to use solar cells. A photovoltaic (PV) system generates power in bursts. Even though the sun shines for over 300 days a year in various regions of the nation, the strength and warmth of the light that reaches Earth fluctuates during the day and year. The depiction of the PV panel was investigated in depth in [1] using its single diode model. A panel's V-I characteristics are defined by its latitude, angle of inclination, number of cells in series and parallel combination (Ns, Np), and series and parallel resistances (Rs, Rp). Solar radiation levels have a substantial impact on PV and IV curves since these curves are inversely related to temperature. Maximum continuous power production changes during the day as a result of changes in temperature and irradiance. The literature [2, 3, 4] details the development, evaluation, and implementation of several MPP topologies. Many approaches have been reported in the literature for implicit measurement, including open circuit voltage and short circuit current, parasitic capacitance, fuzzy [6], constant current (CC), constant voltage (CV), and perturb and observe (P&O). The INC technique is simple to deploy and works well in situations when the irradiance fluctuates quickly. It just takes a few sensors. However, standard P&O also results in oscillations with the mean locations as their center.To counteract drift, some researchers have suggested INC methods, such as those dependent on anticipated step size [7]. Alterations to a battery's load profile are possible. An electrochemical model, an electrical model based on Thevenin, or an impedance model are some of the ways the battery might be represented. Various internal resistances of the battery are represented by resistors, surface capacitance in parallel by tiny capacitors, and charge storage and release capacity by large capacitors, as stated in the literature [8]. For the power converter to function reliably, it must be able to handle the large changes brought about by changing irradiance. To get the most power out of DC-DC converters, you may employ topologies like buck, boost, buck-boost, or flyback. An inductor is used for energy storage and filtering in conventional buck-based topologies. Traditional boost converters use load-side filters to compensate for inductors on the input side. While confining itself to a 50% duty cycle, it has the potential to double the input efficiency. There have been several discussions in the literature on various topologies for ripple reduction. To name a few, there are interleaved [9,10], cascaded [11], linked [12], and synchronous rectification [13] topologies. No matter how high the gain, topologies that rely on switching capacitors or Z-sources produce a great deal of input current ripple. For use in low voltage electric vehicle battery applications, the aforementioned very high gain topologies—which use gains of quadratic and higher—require a very limited duty cycle [12-16]. Losses are proportional to the square of the conductor's diameter. This topology is more suited for electric car applications based on photovoltaics (PV) because to its decreased ripples, moderate gain (which doesn't vary exponentially), and usage of inductors on both the source and load sides.

II LITERATURE SURVEY

[1] The article "Comprehensive Approach to Modelling and Simulation of Photovoltaic Arrays" was published in the May 2009 issue of the IEEE Transactions on Power Electronics by Marcelo GradellaVillalva, Jonas Rafael Gazoli, and Ernesto RuppertFilho.

An approach to the modelling and simulation of solar arrays is presented in this paper. The main objective of adjusting the curve is to find the open circuit, maximum power, and short circuit parameters of the nonlinear I-V equation. This method finds the optimal I-V equation for the single-diode photovoltaic (PV) model by using these three points, which are provided by all commercial array data sheets. It takes into consideration the effect of series and parallel resistances and makes sure that the maximum power of the model matches the maximum power of the actual array. Using the parameters of the improved I-V equation and some basic math blocks, you may design a PV circuit model using any circuit simulator. Power electronics design engineers may find the suggested circuit model and modelling approach helpful for simulating PV systems because of its ease of use, speed, accuracy, and simplicity. The elements that make up the single-diode PV model are explained in the initial chapters, and the reader will also obtain an education on PV devices. An in-depth description of the modelling approach follows.

[2] The article "Evaluating MPPT Converter Topologies Using A Matlab PV Model" was published in January 2001 in the Journal of Electrical and Electronics Engineering in Australia by Geoff Walker.

We provide a precise electrical representation of a photovoltaic module based on the Shockley diode equation. A basic model that takes temperature dependences into consideration consists of a photo-current current generator, a series resistance, and a single diode junction. In this example, we will use a standard 60W solar panel to demonstrate how to extract parameters and evaluate models in Matlab. The relationship among maximum power point, temperature, and insolation levels may be investigated using this model. Maximum power point trackers (MPPTs) with buck and boost topologies, which connect directly to a constant voltage (battery) load, are the main focus of our investigation. A slight advantage of the boost converter over the buck is its capacity to continually monitor the peak power point.

[3] "Optimization of perturb and observe maximum power point tracking method," published in July 2005 by IEEE Transactions on Power Electronics, was written by N. Femia, G. Petrone, G. Spagnuolo, and M. Vitelli.

Photovoltaic (PV) systems optimize the power output of PV arrays by dynamically monitoring the maximum power point (MPPT), which is affected by panel temperature and irradiation conditions. The maximum power point tracking (MPPT) problem has several solutions in the literature, but the P&O method has become the de facto standard for cheap solutions due to its ease of use. During certain time intervals specified by quickly changing atmospheric conditions, the P&O algorithm may get confused, and the steady-state operating point wobbles around the MPP, wasting some amount of available energy. According to the results, modifying the P&O MPPT settings to match the unique dynamic behavior of the chosen converter is the most effective strategy for mitigating the aforementioned disadvantages.

[4] Published in the June 2007 issue of the IEEE Transactions on Energy Conversions, the article "Comparison of photovoltaic array maximum power point tracking techniques" was written by T. Esram and P. L. Chapman..

Photovoltaic (PV) systems may monitor their maximum power point in a number of methods, as discussed in the article. The procedures were first laid down in writing. There are a variety of approaches to this problem, with at least nineteen different ways proposed in the literature. Researchers with an interest in PV power production in the future may find this website useful as a reference.

[5] "Simulation and hardware implementation of incremental conductance MPPT with directcontrol method using Cuk converter," published in the April 2011 issue of the IEEE Transactions on Industrial Electronics, was written by A. Safari and S. Mekhilef.

This article explains how direct control solar array power systems employ incremental conductance (IncCond) maximum power point tracking (MPPT). Methods for modeling and executing this technology on physical devices are also detailed. Because it simplifies the control circuit and investigates the effects of removing the proportional-integral control loop, the proposed system differs from current MPPT systems. The whole system relies on the converter design, system modeling,controller programming, and experimental setting. The final product is a device that can quickly and accurately measure MPPs without oscillation in the steady state and has outstanding dynamic performance. Due to its ability to provide accurate control in the face of rapidly changing weather conditions, the IncCond algorithm is used for MPP tracking.

III PROPOSED SYSTEM

A PV module's power production is very sensitive to environmental factors like temperature and irradiation. The load could get the whole power output of a solar photovoltaic module when the maximum power point tracking (MPPT) approach is used [15]. For photovoltaic modules to transfer their whole power output to the load, a DC-DC converter acts as a go-between, as shown in Figure. In this case, a step-up/step-down DC-DC converter is used. By modifying the duty cycle of the PWM control signal, the source-side load impedance may be adjusted, allowing for the greatest power transmission from the source.

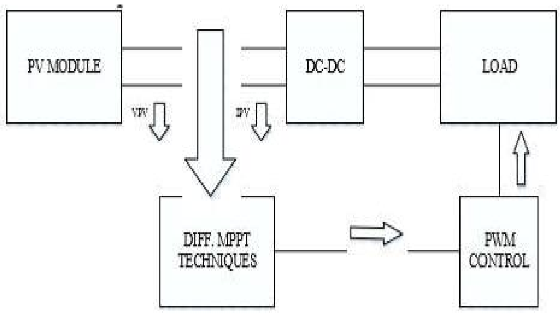

Fig.1 Block diagram of the DC-DC converter for MPP operation

A) MODIFIED BOOST CONVERTER CONFIGURATION

There has been a plethora of research on high gain topologies, both bidirectional and unidirectional. For the majority of topologies, a gain of five or more is required to transform low PV voltage into high dc link voltage via MPP extraction and inversion processing. To increase the voltage gain, Figure 2 shows a design that uses an inductor as a gain cell, along with two more diodes and an additional capacitor. The proposed topology is shown in the figure below.

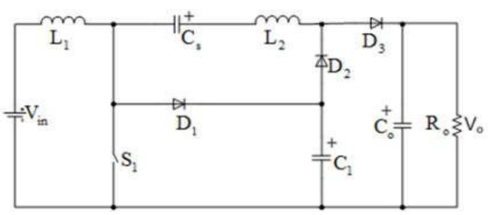

Fig. 2 Modified Boost Converter

Detailed instructions on how to use the converter are given down below. An increase in current charges the inductor L1 in the first mode when switch S1 is closed. The duty of accepting discharge and providing electricity to the load is carried out by C0. S1, which is grounded, charges the series capacitor via D2 and L2. The anode is unable to conduct in D1 due to the presence of the reverse bias. Make sure that the rating of diode D1 is equivalent to the load voltage so that C1's voltage cannot flow. Step 2: Disable switch S1. Once the current is flowing through the inductor via D1, the traditional boost converter, which has a gain of 1 1 −d, charges cap 1. By combining Vin and VCs, we can get the load voltage. The capacitor reverse biasses the diodes, resulting in a reduced gain, despite the fact that the normal gain of the cell is 2 1 −d. One gain cell that helps achieve higher voltage gain is the series capacitor and inductor L2 with diode block /switch [18].

B) PROPOSED INC MPPT

By incrementally monitoring the PV array's current and voltage, the controller in an incremental conductance (INC) algorithm may foresee how a change in voltage would affect the system. This method is superior to the P&O algorithm in monitoring changing conditions, but it utilizes more processor power in the controller [11]. It may mimic power oscillations produced by the P&O algorithm. Through the utilization of the PV array's incremental conductance (ΔI/ΔV), this technique ascertains the sign of the power-voltage alteration (ŔP/ŦV). If the array conductance (I/V) and incremental conductance (ΔI/ΔV) are compared, the INC technique can find the maximum power point. When the input and output currents are equal (ΔI/ΔV=I/V), a voltage called the MPP voltage is generated. This voltage will be maintained by the controller as long as the irradiation stays constant. When P = VI, the INC technique assumes that ΔP/ΔV equals zero at the highest power point. With the incremental conductance method, all it takes to measure the voltage and current output of a photovoltaic device are two sensors: one for voltage and one for current. The implementation flow diagram of the INC algorithm is shown in Figure 3.

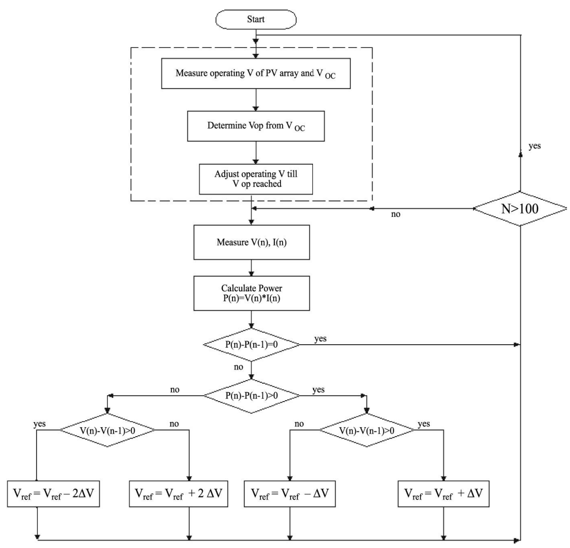

Fig 3: Incremental Conductance Method Algorithm

IV.SIMULATION RESULTS

A) EXISTING RESULTS

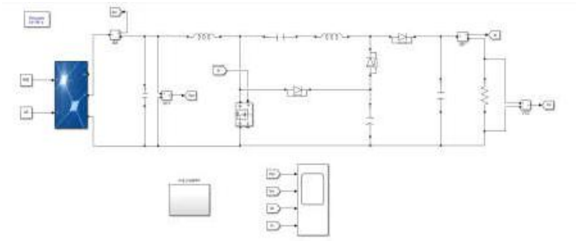

Fig.4A topology for a modified boost converter that can charge electric vehicles using solar energy Using P and O MPPT

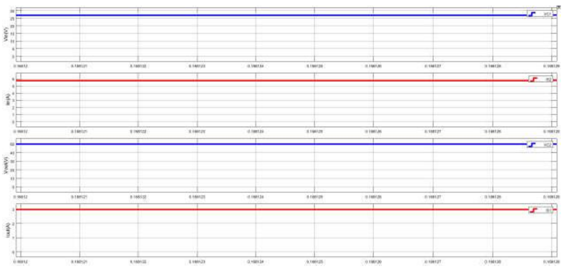

Fig.5 Zoomed View of (a) PV Voltage (b)PV Current (C) Load Voltage and (d)Load Current

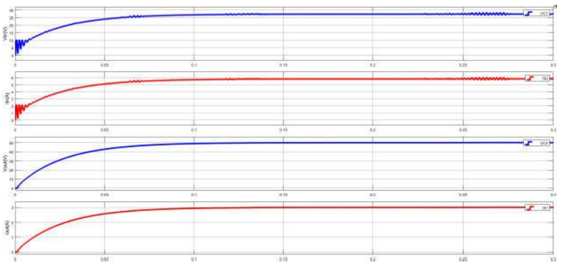

Fig.6 (a) PV Voltage (b)PV Current (C) Load Voltage and (d)Load Current

B) EXTENSION RESULTS

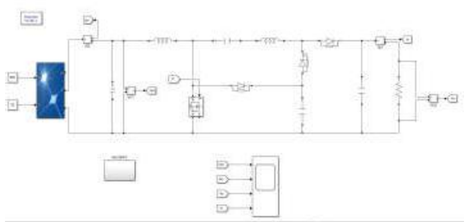

Fig.7Modified Boost converter topology for electric vehicle charging from a photovoltaic source Using INC MPPT

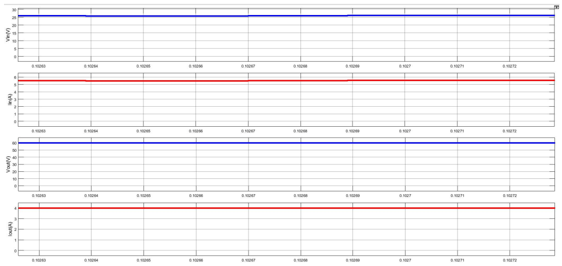

Fig. 8 Zoomed View of (a) PV Voltage (b)PV Current (C) Load Voltage and (d)Load Current

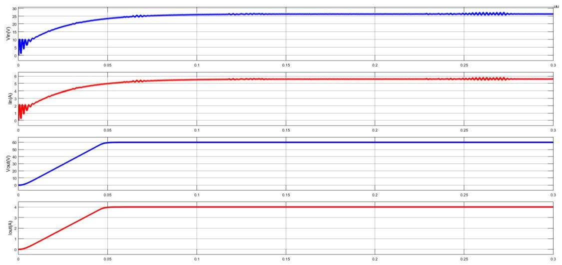

Fig.9 (a) PV Voltage (b)PV Current (C) Load Voltage and (d)Load Current

COMPARSION TABLE

	Existing system	**Extension system**
Load Voltage	50V	60V
Load Current	3A	4A
Settling Time	0.1Sec	0.05Sec
Voltage Gain	1.923	2.307

CONCLUSION

This research suggests using a unidirectional modified boost converter with INC MPPT. Here you may see the outcomes of simulations conducted in MATLAB/Simulink. Using a photovoltaic (PV) source and a resistive load, we modelled and described the proposed converter's open-loop functioning. The simulation results showed that the voltage is increased from 50V to 60V and current is 1A greater than the typical controller. We created the updated converter after comparing INC MPPT to P and O MPPT in MATLAB. As predicted by the simulations, the findings show that the voltage gain is 0.384 larger with the reconfigured modified boost architecture using INC MPPT. Due to the extreme sensitivity of the PV output to changes in temperature and light intensity, closed-loop control is essential. When the right method is used to run simulations, encouraging outcomes are achieved.

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