SEPIC Converter based Solar Charger using PIC Microcontroller

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Abstract. The production of Electricity is one of the largest blessings that were given by the science to mankind. It has also become a component of the present life and one cannot imagine a world without it. The need for electricity to work with electronic gadgets and electrical appliances for our day to day life increases drastically. To reduce the utilization of energy from electricity board, solar power is used. The aim of this work is to design and optimize the solar charger which increases its capacity of solar energy using SEPIC converter. The SEPIC converter allows and maintains the constant dc output voltage. This technique is analyzed by using a PI controller and the optimization of power and its performance is carried out by PIC microcontroller. The importance of SEPIC converters and its application in the field solar charger used in industrial and home appliance were analyzed

Keywords: SEPIC converter, PI, controller Solar charger, PIC microcontroller

1 Introduction

The converter plays a major role for power transmission and saving power. Renewable energy like solar wind etc., can be used for power generation for a specific application. In general charging applications can utilize the solar energy for better performance. Input control of the converter is found to crucial for designing an energy based converter is depicted in [1]. SEPIC converter analysis is made in detail with [2]. Converters like SEPIC, BUCK, BUCK BOOST, KY boost, and LUO converter can be used for solar power generation [5]. Comparing to the operation of the entire converters SEPIC converter provides us the better performance for charging application [6]. Different controllers can be adopted with converters for stable operation of the application [3]. Soft computing techniques like fuzzy controller, neural controller place a major role in stability of the operation [4], [7]. Charging applications like mobile charging and laptop charging with solar energy is essential. Requirement for charging a mobile is 5 volts and for laptop it is <25volt.The section II explains the methodology of the proposed charging system and simulation circuit followed by output waveforms in section III; section IV depicts the conclusion of the simulated results.

ICASISET 2020, May 16-17, Chennai, India

DOI 10.4108/eai.16-5-2020.2304109

2 Methadology of the proposed charging system

The block diagram of the SEPIC converter fed charging system in Fig.1 briefs the outline of the operation of the solar fed sepic converter driven charging system. Simulation circuit of the solar fed sepic converter driven charging system as in Fig 2 is simulated using MATLAB Simulink. The dc source is given to circuit constructed using MOSFET then energy is fed to inductor L1 and capacitor C1 is charged. The capacitor charges output loads of R load and RL loads and results are seen. In open loop of Sepic converter the constant flow of current will be available, so through pulse generator the output loads of R and RL loads are varied and the results are seen in scope.

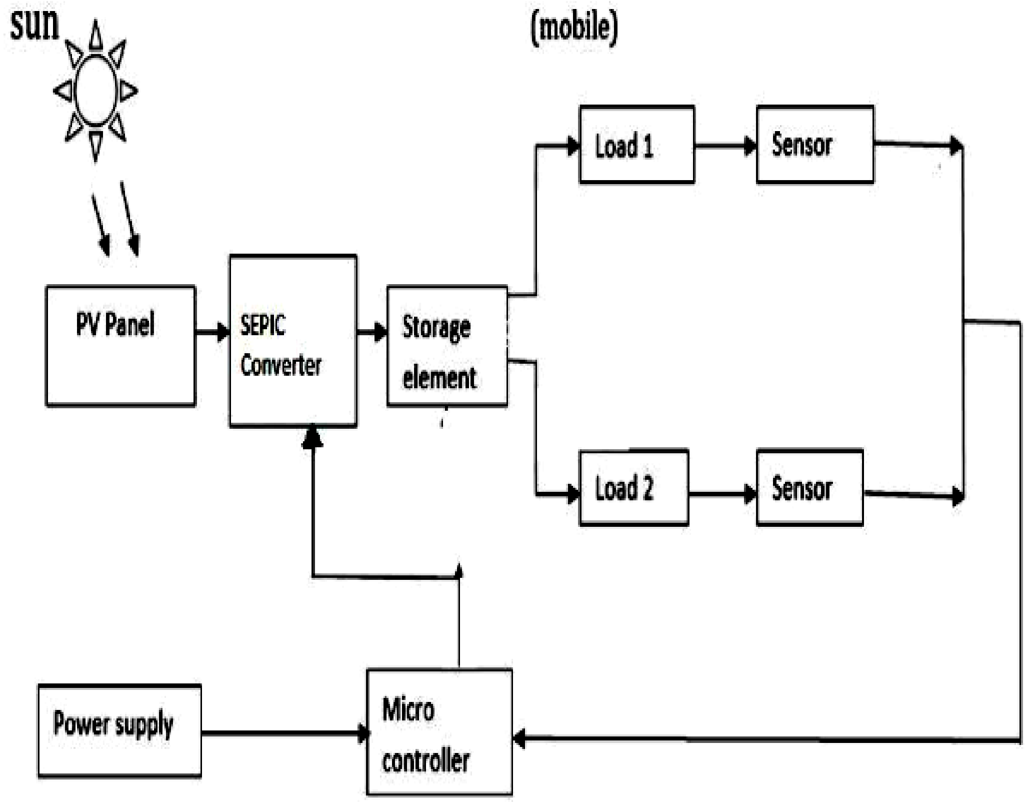

Fig. 1. Block diagram of SEPIC converter fed charging system

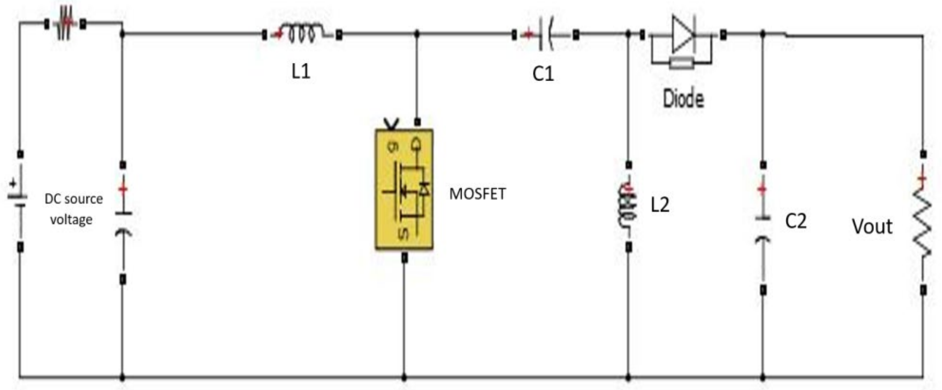

Fig. 2. Solar powered SEPIC Converter fed charging system

3 Simulated output waveforms of the proposed converter

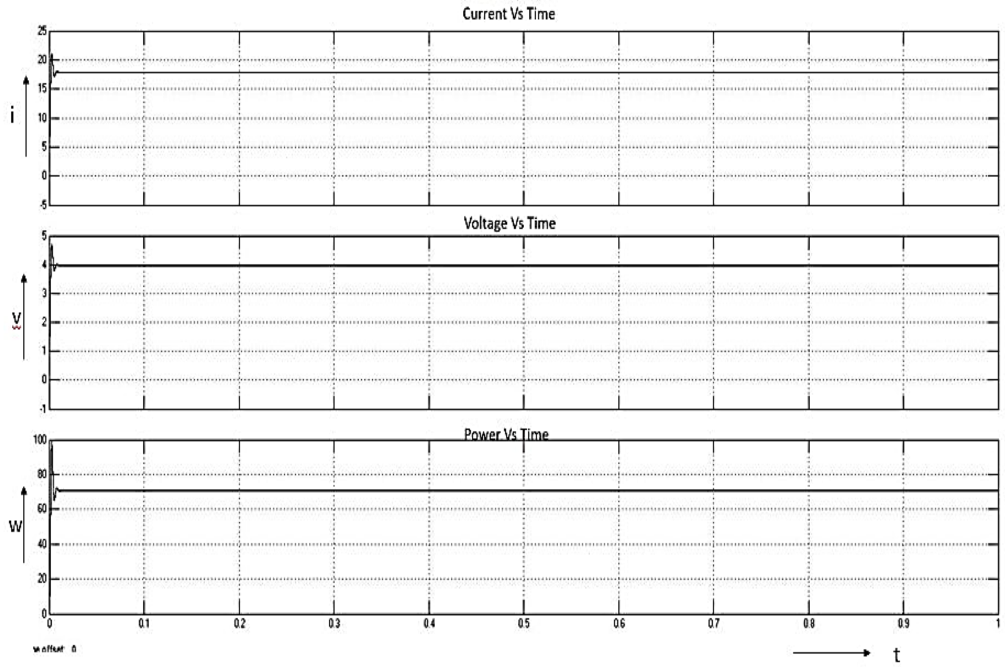

Fig. 3. Output waveform of SEPIC converter with R load (open loop)

The Fig 3 indicates the output waveform of SEPIC converter R load (open loop). The output current of R load goes to peak state up to 20A and goes down and stays in 18A. The output voltage of R load goes peak state at starting up to 5V and goes down and settles at 4V. The output power of R load goes peak state up to 90W in starting and goes down and settles down at 70W.

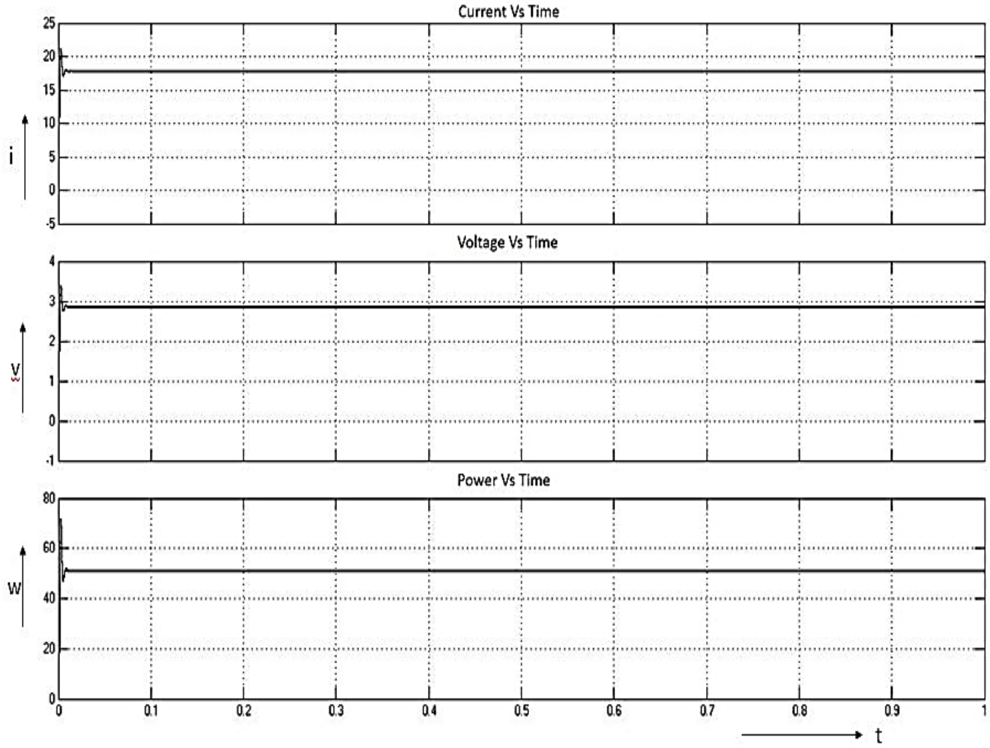

Fig. 4. Output waveform of SEPIC converter with RL load (open loop)

The Fig 4 represents the output waveform of SEPIC converter R load (open loop). The output current of RL load goes to peak state up to 20A and goes down and stays in 18A. The output voltage of RL load goes peak state at starting up to 3.5V and goes down and settles in 2.8V. The output powers of RL load goes peak state up to 70W in starting and goes down and settle down in 50W. Fig 5 displays the output waveform of Sepic converter R load (closed loop). The output current of R load increases gradually and stays in 3.2A. The output voltage of R load increases gradually and settles at constant 20V. The output power of R load increases gradually and settle down at 64W.

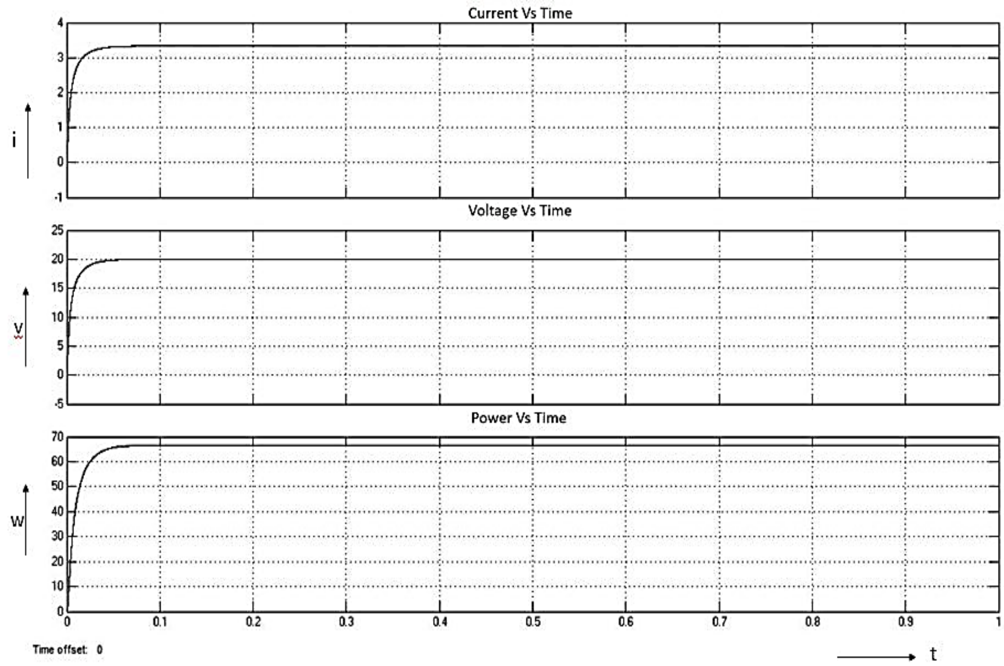

Fig 5: Output waveform of SEPIC converter with R load (closed loop)

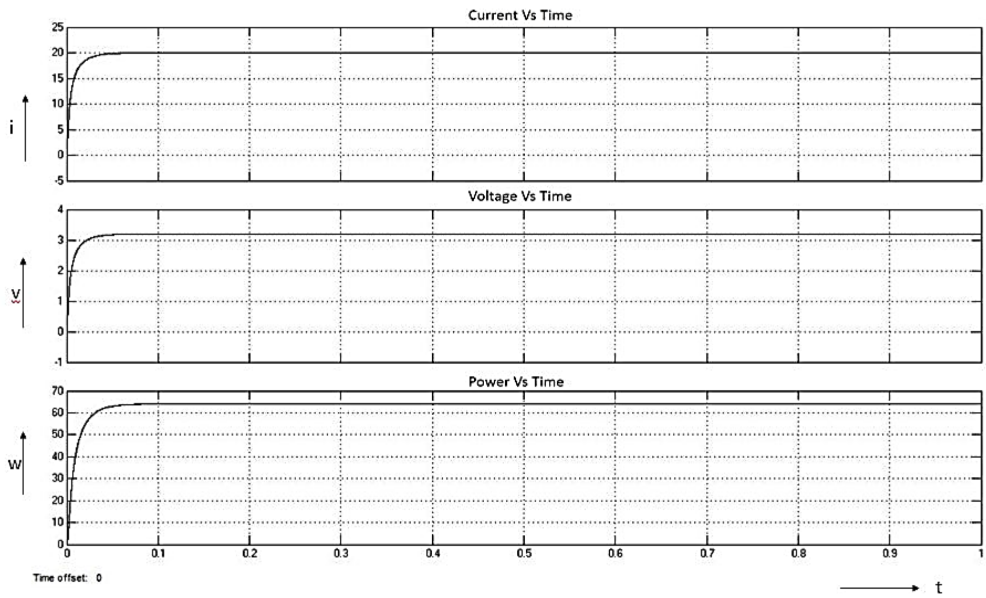

Fig 6: Output waveform of SEPIC converter with RL load (closed loop)

In Fig 6 output waveform of Sepic converter RL load (closed loop) is shown. The output current of RL load increases gradually and stays in 20A. The output voltage of RL load increases gradually and settles at constant 3.2V. The output power of RL load increases gradually and settle down at 64W.

Table 1 Result comparison of solar fed sepic converter driven charging system (open loop)

Parameters	Input	With R load	With RL load
Voltage(Volts)	12V	18.62V	6.9V
Current(Amps)	6A	3A	1.1A
Power(Watts)	72W	57.7W	7.5W
Efficiency		**90%**	

Table 1 describes the comparison table of the simulated open loop SEPIC converter fed by the Photovoltaic energy for two different load one for mobile and other for laptop represented with R load and RL load respectively and the results are tabulated as above. Table II describes the comparison table of the simulated closed loop SEPIC converter fed by the Photovoltaic energy for two different load one for mobile and other for laptop represented with R load and RL load respectively and the results are tabulated as below.

Table II Result comparison of solar fed sepic converter fed charging system (closed loop)

Parameters	Input	With R load	With RL load
Voltage(Volts)	12V	12V	6V
Current(Amps)	4.3A	3A	0.6A
Power(Watts)	51.6W	36W	3.6W
Efficiency		76%	

4 Conclusions

The dc-dc conversion is mostly used to maintain full operation in battery operated circuits. SEPIC converters are used for that purpose which assesta the price of the extra inductor and capacitor to maintain the stable operation. Simulation results for the physical potentiometer controlled SEPIC converter provide 90% efficiency which is helpful to maintain the voltage throughout the process. Additionally, an optimisation technique can be implemented to increase the peak efficiency with durable cost.

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