SOLAR POWER EMPLOYING SEPIC CONVERTER DRIVEN BLDC MOTOR FOR ELEVATOR SYSTEM

N.IRFAN[1],R.MANIRATHINAM[2],S.SYEDAHMEDBASHA[3],P.VIGNESH[4],MR.M.SURESH[5]

[1234] UG SCHOLAR,ELECTIRICAL AND ELECTRONICS , DMI COLLEGE OF ENGINEERING,CHENNAI,TAMILNADU

[5]ASSISTANT PROFESSOR, ELECTIRICAL AND ELECTRONICS , DMI COLLEGE OF ENGINEERING,CHENNAI,TAMILNADU

***Abstract*-A SEPIC converter based maximum power point tracking in solar photovoltaic (SPV) array-for elevator system driven by a permanent magnet brushless DC (BLDC) motor. Incremental conductance maximum power point tracking (INC-MPPT) algorithm offers control of the BLDC motor. Optimize the power output of SPV array and it also provides the safe and soft starting of the BLDC motor with an appropriate control. Speed is controlled through a variable DC link voltage of VSI.**

***Keywords*: MPPTAlgorithm, SEPIC converter, 3phase Inverter, Electronic Commutator, Elevator system**

I. INTRODUCTION

To use Solar power for the elevator system To design a High Voltage Gain DC-DC converter. To design INC-MPPT.To Design VVVF Speed control in BLDC motor. The solar energy is converted in to electrical signal by Panel. In high buildings solar used as source The output of the solar is varying. The conventional boost converter is used in old days does not produce that much gain of output voltage. The proposed system has SEPIC converter has advantage over the fundamental converter and also has high voltage gain output. So is used in the BLDC drive applications. The speed of the motor is controlled by variation of the input to the inverter. The controller is designed to control the speed and also has MPPT program to get the maximum output from the solar. The inverter will operate according to the controlled pulse from the controller. The elevator is operated by using renewable power generated at the roof top solar panels.

II. CONVENTIONAL SYSTEM

To use solar power for the water pumping system for irrigation system and to design a high voltage gain DC-DC converter.in this system maximum power point tracking system is used and the variable voltage variable frequency speed controller in BLDC motor in this system solar energy is converted in to electrical signal by PV panel. Where the dc energy is given to zeta converter. The dc is then converted in to ac by using Inverter. Then the three phase AC given to the BLDC motor used for water pumping system. In real time survey in Johnson elevator the induction machine is used to the torine drive. The range of the speed is 1m/s-1.7 m/s.1800kg driving capacity is used in this system but the achieved speed of operation 0.3m/s to 0.7m/s.

The disadvantages of this system is Low torque/current ratio of induction motor. It has low power density. It has low efficiency, low voltage gain, complicated structure and control, the size and weight of induction motor is large. To provide a high voltage gain with extreme switch duty cycle.

The drastic reduction in the cost of power electronic devices and annihilation of fossil fuels in near future invite to use the solar photovoltaic (SPV) generated electrical energy for various applications as far as possible. The water pumping, a standalone application of the SPV array generated electricity is receiving wide attention now a days for irrigation in the fields, household applications and industrial use. Although several researches have been carried out in an area of SPV array fed water pumping, combining various DC-DC converters and motor drives, the zeta converter in association with a permanent magnet brushless DC (BLDC) motor is not explored precisely so far to develop such kind of system. However, the zeta converter has been used in some other SPV based applications [1-3]. Moreover, a topology of SPV array fed BLDC motor driven water pump with zeta converter has been reported and its significance has been presented more or less in [4]. Nonetheless, an experimental validation is missing and the absence of extensive literature review and comparison with the existing topologies, have concealed the technical contribution and originality of the reported work.

The merits of both BLDC motor and zeta converter can contribute to develop a SPV array fed water pumping system possessing a potential of operating satisfactorily under dynamically changing atmospheric conditions. The BLDC motor has high reliability, high efficiency, high torque/inertia ratio, improved cooling, low radio frequency interference and noise and requires practically no maintenance [5-6]. On the other hand, a zeta converter exhibits following advantages over the conventional buck, boost, buck-boost converters and Cuk converter when employed in SPV based applications.

Belonging to a family of buck-boost converters, the zeta converter may be operated either to increase or to decrease the output voltage. This property offers a boundless region for maximum power point tracking(MPPT) of a SPV array [7]. The MPPT can be performed with simple buck [8] and boost [9] converter if MPP occurs within prescribed limits.

- This property also facilitates the soft starting of BLDC motor unlike a boost converter which habitually steps up the voltage level at its output, not ensuring soft starting.

• Unlike a classical buck-boost converter [10], the zeta converter has a continuous output current. The output inductor makes the current continuous and ripple free.

• Although consisting of same number of components as a Cuk converter [11], the zeta converter operates as non-inverting buck-boost converter unlike an inverting buck-boost and Cuk converter. This property obviates a requirement of associated circuits for negative voltage sensing hence reduces the complexity and probability of slow down the system response [12].

These merits of the zeta converter are favorable for proposed SPV array fed water pumping system. An incremental conductance (INC) MPPT algorithm [8, 13-18] is used to operate the zeta converter such that SPV array always operates at its MPPT.

The existing literature exploring SPV array based BLDC motor driven water pump [19-22] is based on a configuration shown in Fig. 1. A DC-DC converter is used for MPPT of a SPV array as usual. Two phase currents are sensed along with Hall signals feedback for control of BLDC motor, resulting in an increased cost. The additional control scheme causes increased cost and complexity, which is required to control the speed of BLDC motor. Moreover, usually a voltage source inverter (VSI) is operated with high frequency PWM pulses, resulting in an increased switching loss and hence the reduced efficiency. However, a Z-source inverter (ZSI) replaces DC-DC converter in [22], other schematic of Fig. 1 remaining unchanged, promising high efficiency and low cost. Contrary to it, ZSI also necessitates phase current and DC link voltage sensing resulting in the complex control and increased cost.

To overcome these problems and drawbacks, a simple, cost-effective and efficient water pumping system based on SPV array fed BLDC motor is proposed, by modifying the existing topology (Fig. 1) to as shown in Fig. 2. A zeta converter is utilized in order to extract the maximum power available from a SPV array, soft starting and speed control of BLDC motor coupled to a water pump. Due to a single switch, this converter has very good efficiency and offers boundless region for MPPT. This converter is operated in continuous in conduction mode resulting in reduced stress on its power devices and components.

III.CONFIGURATION OF CONVENTIONAL SYSTEM

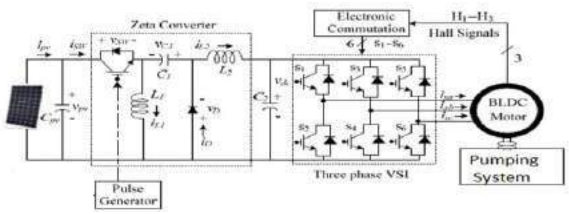


Fig. Circuit Diagram of Existing system

Structure of SPV array fed BLDC motor driven water pumping system employing a zeta converter is shown in Fig. . The system consists of (left to right) a SPV array, a zeta converter, a VSI, a BLDC motor and a water pump. The BLDC motor has an inbuilt encoder. The pulse generator is used to operate the zeta converter. A step by step operation of proposed system is elaborated in the following section in detail .The spv array generates the electrical power demanded by the motor-pump. This electrical power is fed to the motor-pump via a zeta converter and a VSI. The SPV array appears as a power source for the zeta converter as shown in Fig. 2. Ideally, the same amount of power is transferred at the output of zeta converter which appears as an input source for the VSI. In practice, due to the various losses associated with a DC-DC converter [23], slightly less amount of power is transferred to feed the VSI. The pulse generator generates, through INC-MPPT algorithm, switching pulses for IGBT (Insulated Gate Bipolar Transistor) switch of the zeta converter. The INC-MPPT algorithm uses voltage and current as feedback from SPV array and generates an optimum value of duty cycle. Further, it generates actual switching pulse by comparing the duty cycle with a high frequency carrier wave. In this way, the maximum power extraction and hence the efficiency optimization of spv array is accomplished.

The spv array generates the electrical power demanded by the motor-pump. This electrical power is fed to the motor-pump via a zeta converter and a VSI. The SPV array appears as a power source for the zeta converter as shown in Fig. 2. Ideally, the same amount of power is transferred at the output of zeta converter which appears as an input source for the VSI. In practice, due to the various losses associated with a DC-DC converter [23], slightly less amount of power is transferred to feed the VSI. The pulse generator generates, through INC-MPPT algorithm, switching pulses for IGBT (Insulated Gate Bipolar Transistor) switch of the zeta converter. The INC-MPPT algorithm uses voltage and current as feedback from SPV array and generates an optimum value of duty cycle. Further, it generates actual switching pulse by comparing the duty cycle with a high frequency carrier wave. In this way, the maximum power extraction and hence the efficiency

IV. PROPOSED SYSTEM

In high buildings solar used as source. The output of the solar is varying. The conventional boost converter is used in old days does not produce that much gain of output voltage. The proposed system has SEPIC converter has advantage over the fundamental converter and also has high voltage gain output. So is used in the BLDC drive applications. The speed of the motor is controlled by variation of the input to the inverter. The controller is designed to control the speed and also has MPPT program to get the maximum output from the solar. The inverter will operate according to the controlled pulse from the controller. The elevator is operated by using renewable power generated at the roof top solar panels.

The advantages of proposed system is High torque/current ratio. High power density,. Higher efficiency,. High voltage gain & efficiency Simpler structure and control, Reduced size and weight Provide a high voltage gain without extreme switch duty cycle

Solar panel is used to convert heat energy to DC power, DC power is given to the SEPIC converter. SEPIC = Single End Primary Induction Converter. It is a DC to DC converter. It boost the input and is given to the Inverter.MPPT = Maximum Power Point tracking. Incremental Conductance MPPT algorithm is used.3 phase Voltage Source Inverter converts DC to AC.VVVF speed control is done to set the speed of the elevator for a building.VVVF = Variable voltage Variable Frequency Speed Control.

The applications of proposed systemIt is used for ELEVATOR systems.It can also be used for renewable cranes.Speed control system can be also used in the electric cars.

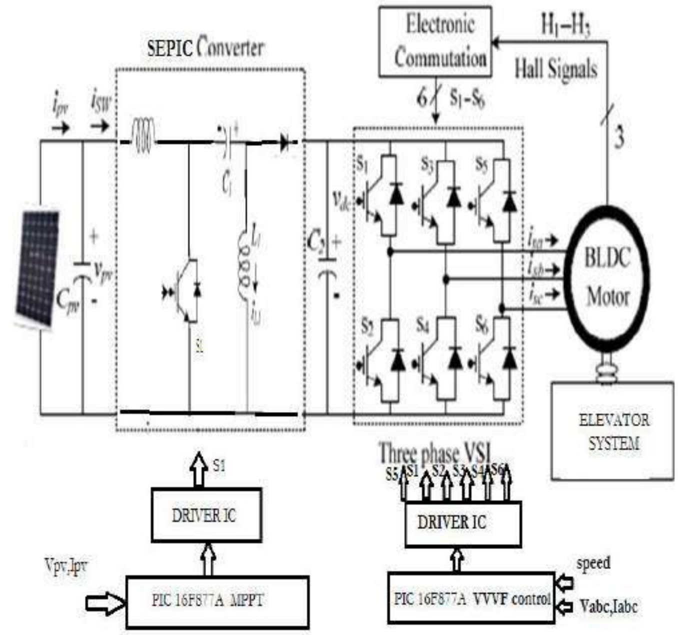


Fig. Proposed Circuit

i) MPPT TECHNIQUE

Maximum Power Point Tracking, frequently referred to as MPPT, is an electronic system that operates the Photovoltaic (PV) modules in a manner that allows the modules to produce all the power they are capable of. MPPT is not a mechanical tracking system that "physically moves" the modules to make them point more directly at the sun. MPPT is a fully electronic system that varies the electrical operating point of the modules so that the modules are able to deliver maximum available power. Additional power harvested from the modules is **then** made available as increased battery charge current. MPPT can be used in conjunction with a mechanical tracking system, but the two systems are completely different.ROLE OF MPPT IN SPV SYSTEM Photovoltaic systems are normally use a maximum power point tracking(MPPT)technique to continuously deliver the highest possible power to the load when variations in the isolation and temperature occur, Photovoltaic (PV) generation is becoming increasingly important as a renewable source since it offers many advantages such as incurring no fuel costs, not being polluting, requiring little maintenance, and emitting no noise, among others. PV modules still have relatively low conversion efficiency; therefore, controlling maximum power point tracking (MPPT) for the solar array is essential in a PV system. The Maximum Power Point Tracking (MPPT) is a technique used in power electronic circuits to extract maximum energy from the Photovoltaic (PV) Systems. In the recent days, PV power generation has gained more importance due its numerous advantages such as fuel free, requires very point Tracking (MPPT) techniques are available and proposed various methods for obtaining maximum power point. But, among the available techniques sufficient comparative study particularly with variable environmental conditions is not done. This paper is an attempt little maintenance and environmental benefits. To improve the energy efficiency, it is important to operate PV system always at its maximum power point. Many maximum power to study and evaluate s60e main types of MPPT techniques namely, Open-circuit voltage and Short-circuit current, P&O, IC etc. A solar cell basically is a p-n semiconductor junction. When exposed to light, a dc current is generated. The generated current varies linearly with the solar irradiance. The standard equivalent circuit of the PV cell is shown in Fig.1.

ii) INCREMENTAL CONDUCTANCE TECHNIQUE

The IC can determine that the MPPT has reached the MPP and stop perturbing the operating point. If this condition is not met, the direction in which the MPPT operating point must be perturbed can be calculated using the relationship between dl/dV and –I/V This relationship is derived from the fact that dP/dV is negative when the MPPT is to the right of the MPP and positive when it is to the left of the MPP. This algorithm has advantages over P&O in that it can determine when the MPPT has reached the MPP, where P&O oscillates around the MPP. Also, incremental conductance can track rapidly increasing and decreasing irradiance conditions with higher accuracy than P and O.

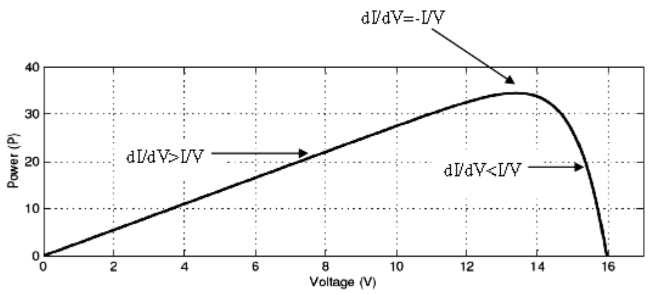


Fig.Graph Power versus Voltage for IC Algorithm

Fig-1 shows that the slope of the P-V array power curve is zero at The MPPT, increasing on the left of the MPP and decreasing on the Right hand side of the MPP. The basic equations of this method are as follows.

$$\frac{dI}{dV} = -\frac{I}{V} \text{ at } MPP$$

$$\frac{dI}{dV} > -\frac{I}{V} \text{ left of } MPP$$

$$\frac{dI}{dV} < -\frac{I}{V} \quad \text{ right of } MPP$$

INCREMENTAL CONDUCTANCE MPPT ALGORITHM

This method exploits the assumption of the ratio of change in output conductance is equal to the negative output Conductance Instantaneous conductance. We have,

P = V I

Applying the chain rule for the derivative of products yields to

∂P/∂V = [∂(VI)]/ ∂V

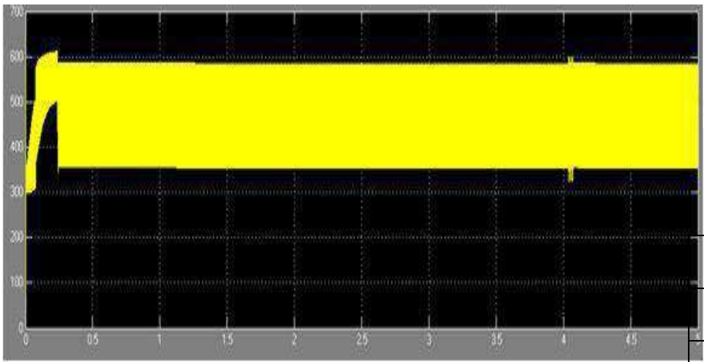
At MPP, as ∂P/∂V=0

The above equation could be written in terms of array voltage V and array current I as

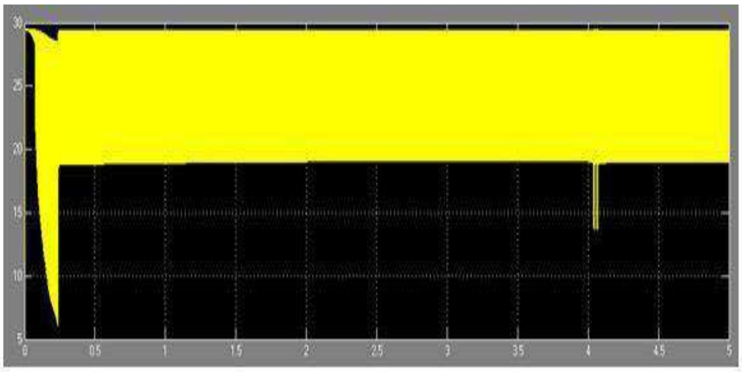
∂I/∂V = - I/V

The MPPT regulates the PWM control signal of the dc – to – dc boost converter until the condition: (∂I/∂V) + (I/V) = 0, is satisfied. In this method the peak power of the module lies at above 98% of its incremental conductance. The Flow chart of incremental conductance MPPT is shown below.

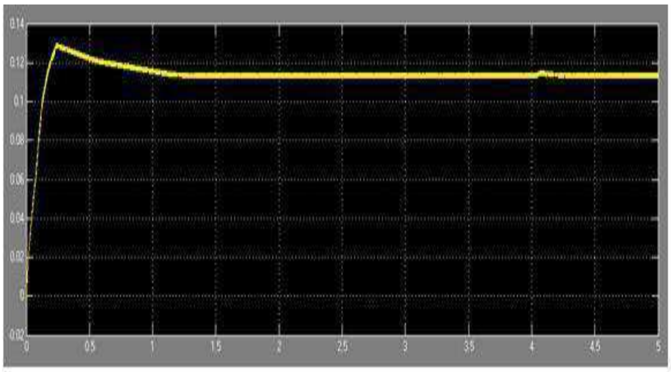
V. EXPERIMENTAL RESULTS



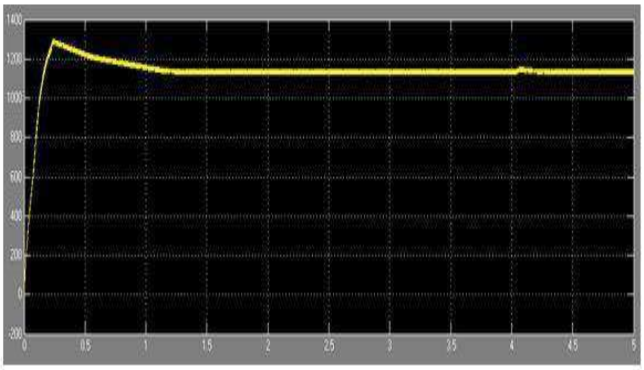
SOLAR INPUT VOLTAGE



SOLAR OUTPUT VOLTAGE



OUTPUT CURRENT



OUTPUT VOLTAGE

INPUT VOLTAGE	10 v
DC-DC OUTPUT	140 v
INVERTER	160v
BLDC	1000 rpm
SPEED(rpm)	1200-1300 rpm

VI.CONCLUSION

From the above experimental results a SEPIC converter is best compared to the Zeta converter for the application of Elevator System. In future this can be used for other applications with solar power input.

REFERENCES

[1] "A novel non-isolated high step-up DC –DC Converters for photovoltaic application'' by Mahajan sagar Bhaskar Ranjana; N. Sreeramulareddy; R . k. Pawan kumar

[2]''Non-isolated High step-up Boost converter integrated with sepic converter'' by ki-Bum park; Gun-Woo Moon;Myung-Joong Youn

[3]''A Cascaded High step-up DC-DC Converter With single switch for microsource Applications'' by shih-Ming Chen;Tsorng-juu Liang; Lung-sheng Yang;Jiann-fuh Chen

[4]''A Novel Non-isolated Switched inductor Floating Output DC-DC Multilevel Boost Converter For Fuelcell Applications'by Maharajan sagar Bhaskar Ranjana;Nandyala SreeramulaReddy; Rapalle Kusala Pavan Kumar

[5]'' Dual input isolated full-bridge boost dc-dc converter based on distributed transformer'bZhang.Z;Thomsen.o; Anderson M.A. E; Nielson.h.R

[6]The Discontinuous Conduction Mode Sepic and Cuk Power FactorPreregulators; Analysis and Design b Domingos Savio Lyrio Simonetti,Javier Sebastian and Javier Uceda

[7]Bridgeless Cuk Power factor correction rectifier with reduced condition losses by M.Mahadevi and h.faraneh-fard

[8]Single phase buck rectifier employing voltage reversal circuit for sinusoidal input current waveshaping by R.itoh,K.Ishizaka,H.Oishi and H.Okada

[9]A Double Switch Single-Stage PFC offline switcher operating in ccm with high efficiency and low cost by pietro scalia

[10]A High Performance Single Phase AC-DC Rectifier With Input Power Factor Connection by Prasad N.Enjeti