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Solar Power Employing Sepic Converter Driven BLDC Motor for Elevator System

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***Abstract*— The drastic reduction in the cost of power electronic devices and annihilation of fossil fuel in the near future invites us to use photovoltaic generated electrical energy for various applications. The collector just collects the emission that fall on it and converts a portion of it to other form of power (either electricity or heat). During night time or when there is a heavy cloud cover, the amount of energy produced by the collector will be reduced. The storage unit can store the excess energy produced during the periods of maximum productivity and release it when the productivity drops. The single-ended primary-inductor converter (SEPIC) is a kind of DC/DC converter allowing the electrical potential (voltage) at its output to be larger than, fewer than, or equivalent to that at its input. The production of the SEPIC is restricted by the duty cycle of the power transistor. The INC-CONDUCTANCE algorithm is used for tracking the maximum point at which the desirable amount of solar energy is obtained. The production of the SEPIC converter is dc supply but the BLDC motor runs on ac source only hence the obtained dc source has to be converted to ac source with the help of inverter. The elevator is variable speed system; the operation of the elevator is controlled by the BLDC motor [2]. The height of the building is sensed and accordingly the speed of the motor is controlled. The speed of the motor depends upon the voltage and the frequency hence the feedback from the elevator is sent to the inverter to adjust the voltage and the frequency so that the speed of the motor can be controlled for the desirable operation of the elevator system.**

Index terms— SEPIC, BLDC, MPPT

I. INTRODUCTION

Microelectronic VLSI circuits and designs with low power dissipation is something that the mobiles, laptops

The availability of solar source is abundant in country like India (tropical region), hence this project explains the efficient usage of solar power for more applications. The output of the solar power is not constant it keeps on varying; this may lead to inefficient functioning of load connected to the source. Therefore to avoid this issue converters are used to modify the output of the solar cell according to the operation of load. The converter used here is SEPIC (Single Ended Primary Inductor Converter). It is the advanced version of Buck-Boost converters allowing the voltage at its output to be greater or smaller than that of the input side [6]. The output of the SEPIC is controlled by the duty cycle of the controlled transistor switches.The speed of the motor for the elevator operation is controlled by input to the Inverter. A controller is designed to control the speed of the motor according to the load variations. The elevator system used here is variable speed and variable load system. The load and the speed of the elevator keeps on varying and the BLDC motor should operate accordingly for better operation of the system[14].

EXISTING SYSTEM

In existing system figure 1. the solar energy gets trapped in the PV (Photo Voltaic) cell [8]. The DC output from the solar panel is increased or decreased to desired level with the help of ZETA converter. The output of the

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ZETA converter is dc source. The dc source is converted to ac source as the BLDC (Brushless DC motor) motor runs on ac source[11]. The VSI (Voltage Source Inverter) is used to convert the dc to ac source. The output from the inverter helps in running the BLDC motor. The application in this system is water pump. The working of the water pump is controlled by the operation of BLDC motor.

The ZETA converter is shown in figure 2. The existing system explains about the usage of ZETA converters for increasing and decreasing the output of solar cell. An Zeta converter exhibit two dissimilar mode of function. The first approach is obtained once the transistor is ON and instantly, the diode D is inversely polarized. During this period, the current through the inductor L1 and L2 are drawn from the voltage source E. This mode is the charging mode. The second mode of operation starts when the transistor is OFF and the diode D is directly polarized. This stage or mode of operation is known as the discharging mode since all the energy stored in L2 is now transferred to the load R.
During this period, the current through the inductor L1 and L2 are drawn from the voltage source E. This mode is the charging mode. The second mode of operation starts when the transistor is OFF and the diode D is directly polarized[12]. This stage or mode of operation is known as the discharging mode since all the energy stored in L2 is now transferred to the load R. The Disadvantages of existing system are Speed/torque characteristics are non-linear,Low efficiency (85%),Large in size and weight.The ZETA converter requires large flying capacitors, high input ripple, High cost.

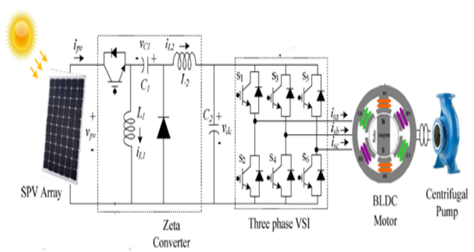

Figure 1 Circuit diagram of existing system

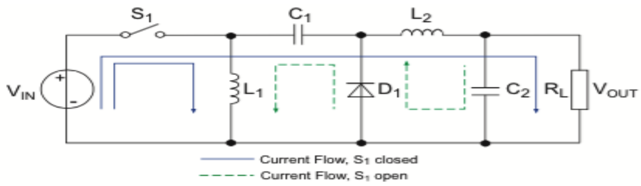

Figure 2 Circuit diagram of Zeta converter

PROPOSED SYSTEM

The light energy from the sun is trapped in the solar panel; this energy is called the solar energy. The solar energy is stored in the battery for future uses. The INC-CONDUCTANCE algorithm is used for tracking the maximum point at which the desirable amount of solar energy is obtained [4]. The source of energy obtained from the solar panel is dc source. The solar energy is not constant, it keeps on varying hence a converter is used to amplify or reduce the voltage according to the desired level. Here SEPIC converter is used as a converter to buck or boost the input voltage obtained from the solar panel. The output of the SEPIC converter is dc source but the BLDC motor runs on ac source only hence the obtained dc source has to be converted to ac source with the help of inverter. Here the inverter used is VSI (Voltage Source Inverter). The input to the inverter is dc source and the obtained output is ac source of desirable value. The obtained output from the inverter is supplied to the BLDC motor for its working. The elevator system is controlled by the BLDC motor. The elevator is variable speed system; the operation of the elevator is controlled by the BLDC motor[10]. The height of the building is sensed and accordingly the speed of the motor is controlled. The speed of the motor depends upon the voltage and the frequency hence the feedback from the elevator is sent to the inverter to adjust the voltage and the frequency so that the speed of the motor can be controlled for the desirable operation of the elevator system.

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CIRCUIT DIAGRAM

The solar power can be used by converting it to electrical power. So an apparatus called solar panel is worn which can transfer the daylight energy into electrical power. Solar panel is a cluster of solar cell. Solar cells based on the theory of photoelectric effect. While solar panels are positioned in the sunlight, photons will hit the exterior and emits electrons [3]. As a consequence electron hole pair is formed in the solar cell. While external path is coupled to the solar cell, electrons stream in the path and the current is generated. Maximum power point tracking (MPPT) is a method used normally with photovoltaic (PV) solar systems to exploit power origin under all circumstances[7]. In spite of the ultimate objective of the solar power, though, the vital problem addressed by MPPT is to facilitate the effectiveness of power transmit from the solar cell depends on both the quantity of sunlight declining on the solar panels and the electrical uniqueness of the load. This load feature is called the maximum power point and MPPT is the practice of ruling this point and custody the load quality there.

Here are four type of MPPT algorithm. The most complex is the incremental conductance. In the incremental conductance scheme, the controller actions incremental changes in PV group current and voltage to forecast the outcome of a voltage transform [16]. This process require extra calculation in the controller, but can track shifting conditions more hastily than the perturb and observe method (P&O). Like the P&O algorithm, it can generate oscillations in power production. This scheme utilize the incremental conductance (dI/dV) of the photovoltaic group to figure the sign of the modify in power with revere to voltage (dP/dV).

The single-ended primary-inductor converter (SEPIC) is a form of DC/DC converter allow the electrical potential (voltage) at its production to be better than, less than, or identical to that at its effort. The output of the SEPIC is restricted by the duty cycle of the power transistor. SEPICs are valuable in application in which a battery voltage can be beyond and beneath that of the regulator's intentional output.

The DC-AC inverters generally function in a pulse width modulated (PWM) approach and switch among a few diverse circuit topologies, which means that the inverter is a nonlinear, exclusively piecewise smooth structure. Three phase inverters are commonly worn for high control applications[5]. With SPWM control, the convenient switches of the inverter are restricted by association of a sinusoidal control indication and a triangular switching indication. The sinusoidal direct waveform determine the preferred fundamental frequency of the inverter production, as the triangular waveform decide the switch frequency of an inverter[9]. The relation of the frequencies of the triangle signal to the sinusoid is referred to as the inflection frequency part.

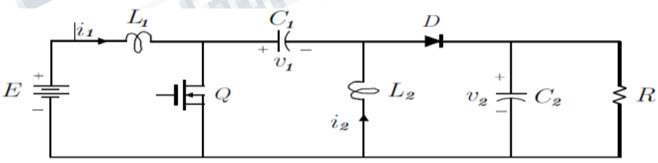

Figure 3 Circuit diagram of SEPIC converter

RESULTS AND DISCUSSION

DC INPUT VOLTAGE

The Figure 4 shows the input voltage from the solar panel. The maximum range of the solar energy output is 10V. The x-axis describes about the duration i.e. Time. The y-axis describes about the amplitude of the voltage trapped in the solar panel.

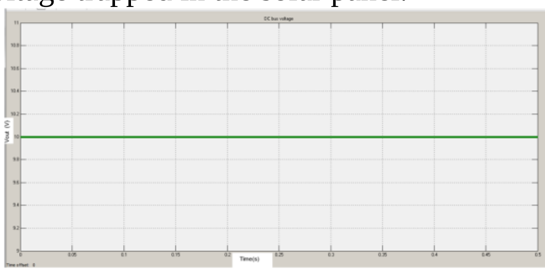

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Figure 4 DC input voltage

SEPIC CONVERTER OUTPUT VOLTAGE

The Figure 5 shows the output voltage obtained from the SEPIC converter. The conventional converter can only amplify the output voltage up to 60V, but the SEPIC converter can amplify the input voltage of 12V to output voltage of maximum 140V. The x-axis explains about the amplitude of the output voltage and the y-axis is duration i.e. Time.

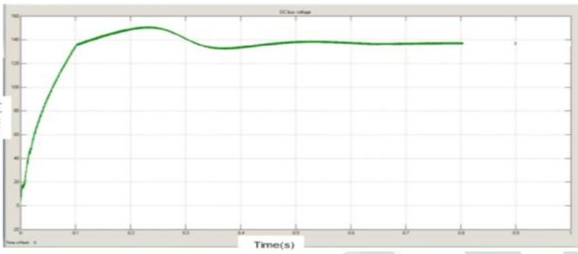

Figure 5 Output voltage of SEPIC converter

INVERTER OUTPUT VOLTAGE

The Figure 6 shows the output voltage obtained from the inverter. An inverter is the device that converts dc source to ac source[1]. The dc source of 140V is amplified to ac source of nearly 150V and a frequency of 50Hz. The x-axis shows the amplitude increase in the voltage and the y-axis is duration i.e. Time.

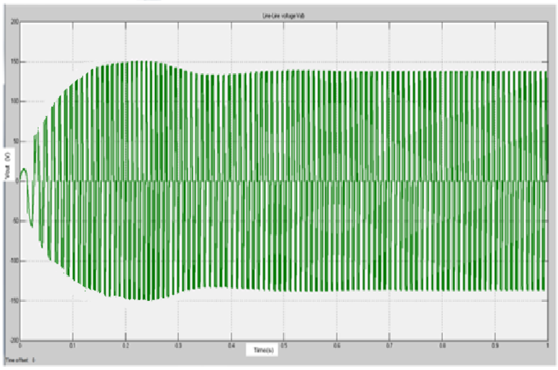

Figure 6 Output voltage of inverter

MOTOR SPEED OUTPUT

The Figure 7 shows the output obtained from the motor for variation in speed. The speed of the motor plays a vital role in the operation of the elevator system. The system designed can run at minimum speed of 700rpm and at a maximum speed of 1000rpm. The output shown below is for the speed of 1000rpm[15]. The x-axis explains about the variation in speed and the y-axis explains about the duration i.e. Time.

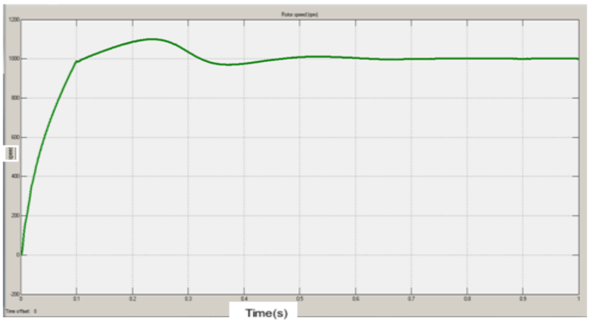

Figure 7 Motor speed output

CONCLUSION

The PV array-SEPIC converter fed VSI-BLDC motor-elevator has been proposed and suitably demonstrated through simulated results and experimental validations[13]. The proposed system has been designed and modeled appropriately to accomplish the desired objective and validated to examine various performances at different speed of the BLDC motor. The performance evaluation has justified the combination of SEPIC converter and BLDC motor for PV array based elevator system. The system under study has shown various desired functions such as MPPT extraction of the PV array, soft starting of BLDC motor, fundamental frequency switching of VSI resulting in a reduced switching losses, speed control of BLDC motor without any additional control and an elimination of phase current and DC link voltage sensing , resulting in reduced cost and complexity. The proposed system has operated successfully even under minimum solar irradiance.

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