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Fuzzy Based PV System for Speed Control of Three Phase Induction Motor Using SEPIC Converter

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Abstract: **This project presents a single-stage solar photovoltaic (SPV) system based on SEPIC converter with fuzzy logic controller is convert the dc supply into three phase supply. The proposed system is to run the three phase induction motor. The output of an SPV system is connected to the SEPIC converter, this output is compared with the fuzzy logic controller using reference voltage. The fuzzy logic controller output is given to the gate signal of SEPIC converter. Since voltage sources inverter has advantages like minimum harmonic distortion and can operate on constant voltage levels. The SEPIC converter is controlled the speed of an induction motor with fuzzy logic controller For a voltage sources inverter, switching angles at fundamental frequency are obtained by solving the selective harmonic elimination equations in such a way that the fundamental voltage is obtained as desired and certain lower order harmonics are eliminated. Here design and implementation of this work has been done by using the MATLAB/SIMULINK software.**

Keywords: **PV ARRAY, SEPIC Converter, Fuzzy Logic Controller, Speed Controller.**

I. INTRODUCTION

The most important aspect of a solar cell is that it generates solar energy directly to electrical energy through the solar photovoltaic module, made up of silicon cells. Although each cell outputs a relatively low voltage if many is connected in series, a solar photovoltaic module is formed. In a typical module, there can be up to 36 solar cells, producing an open circuit voltage. Although the price for such cells is decreasing, making use of a solar cell module still requires substantial financial investment. Thus, to make a PV module useful, it is necessary to extract as much energy as possible from such a system.

The DC/DC SEPIC converter is responsible for transferring maximum power from the solar Photovoltaic module to the load using fuzzy logic controller. The simplest way of implementing an Maximum Power Point Tracking is to operate a Photovoltaic array under constant voltage and power reference to modify the duty cycle of the dc-dc SEPIC converter using fuzzy logic controller. This will keep operation constant at or around the maximum peak power point. The fuzzy logic controllers are control the output voltage of an SEPIC converter and also control the speed of an induction motor.

The basic concept about the design and implementation of Single Stand-alone PV panel, DC-DC SEPIC Converter, fuzzy logic controller and voltage source inverter respective feedback models are discussed in the following chapters.

The chapters are organized in the manner such that to give the broad idea about the implementation of stand-alone single PV panel as the input source, feedback models for SEPIC converter blocks using Simulation models with the help of MATLAB/SIMULINK Software.

2. PROPOSED SYSTEM CONFIGURATION

2.1. Block Diagram:

The proposed system consists of solar panel, SEPIC converter, Fuzzy Logic converter, Speed controller and Induction motor.

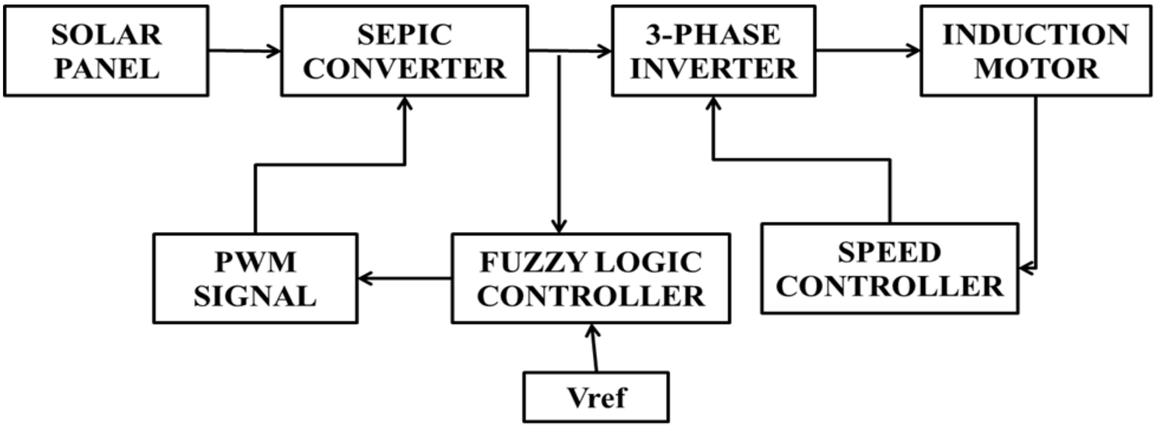

Fig: Proposed System Block Diagram

The photovoltaic system based SEPIC converter with fuzzy logic controller of fed induction motors drives simulation are shown in below. The solar photovoltaic system is to convert the heat energy into electrical energy. The solar radiation is strikes the solar panel , the solar cell is get heated the electrons flow from covalent bond to the conduction band , the electrical energy is produced in the form of dc supply. This output is given to the SEPIC converter is control the voltage from the solar panel with fuzzy controller.

3. SIMULATION DIAGRAM

3.1 Over all Simulation Diagram:

The output voltage from the PV cell is controlled in SEPIC converter with fuzzy logic controller. The fuzzy controller compares the reference signal and the PV cell output signal. The fuzzy output is connect to the gate pulse of an SEPIC converter. The photovoltaic output is controlled and give the constant output voltage to the voltage source inverter. The output of an inverter is connecting to a fed induction motor.

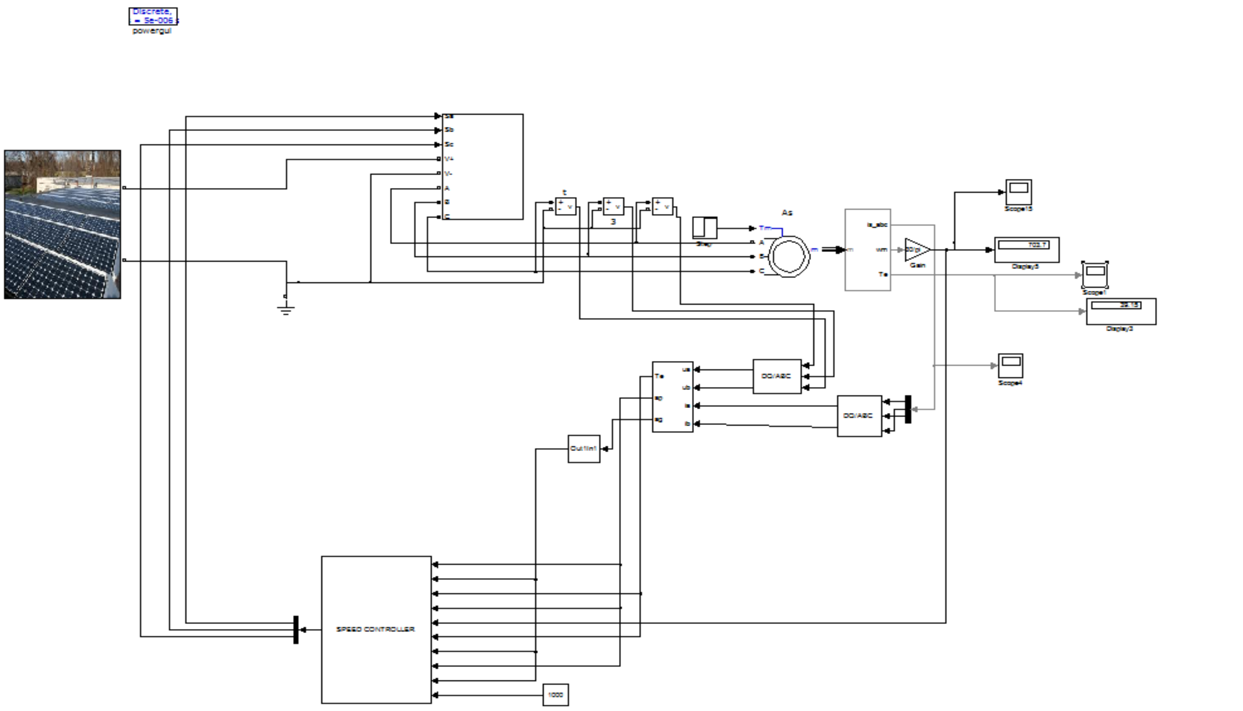

Fig. Simulation Diagram for Proposed System

3.2 Simulation Model of PV System:

The simplest model of a PV cell is shown in equivalent circuit Figure 6.1 below that consists of an ideal current source in parallel with an ideal diode. The current source represents the current the current generated by photons, and its output is constant under constant temperature and constant incident radiation of light. There are two key parameters frequently used to characterize a PV cell shorting together the terminals of the cell, the photon generated current will flow out of the cell as a short-circuit current(Isc) thus, Iph=ISC. When there is no connection to the PV cell (open circuit) the photon generated current is shunted internally by the intrinsic p-n junction diode. This gives the open circuit voltage(V) It is seen that the temperature changes affect mainly the PV output current .The PV cell output voltage is a function of the photocurrent that mainly determined by load current depending on the solar irradiation level during the operation.

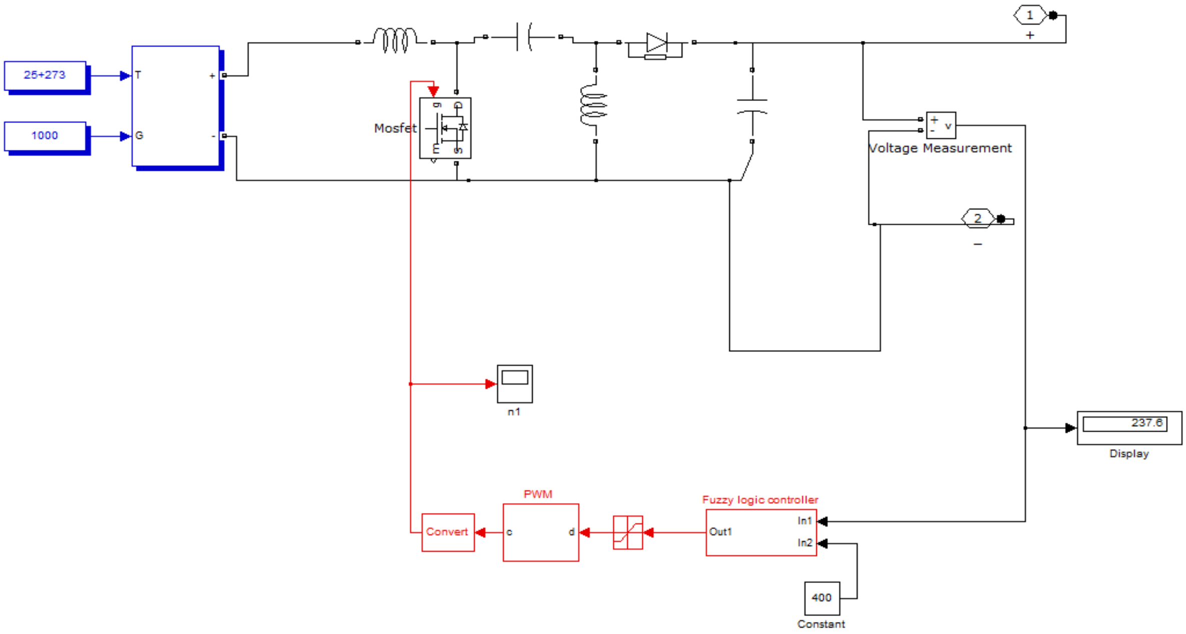

Fig: Simulation Model of PV System

3.3 Simulation Model of SEPIC Converter:

The simplest model of SEPIC converter is shown in figure. The SEPIC converter is a boost converter; it is to step up the voltage level. The output voltage from the pv panel is low up to 50V, the SEPIC converter is to convert the minimum voltage level into maximum voltage level. The thyristor is switch is MOSFET, the fuzzy logic controller is to control the output voltage in the SEPIC converter by gate pulse of the MOSFET.

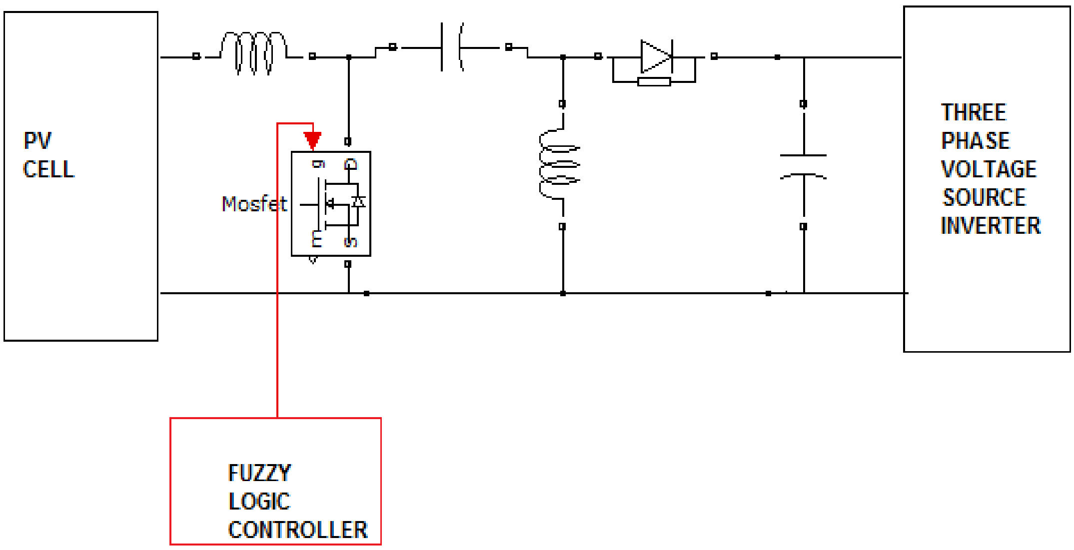

Fig. Simulation Model of SEPIC Converter

3.4 Simulation Model of Fuzzy Logic controller:

The simplest models of fuzzy logic controller are shown in figure. The fuzzy logic controller is to control the speed of an induction motor and to produce the constant output voltage from the solar photovoltaic cell. The fuzzy logic controller controls the SEPIC converter by means of gate signal. The fuzzy logic controller compare the output voltage from the SEPIC converter and the reference voltage, then the output signal from the fuzzy controller is given to the gate pulse of the SEPIC converter. If any voltage variation is present in the SEPIC converter the fuzzy logic controller is control the voltage variation in SEPIC converter by means of gate signal. The fuzzy logic controller act as a comparater.

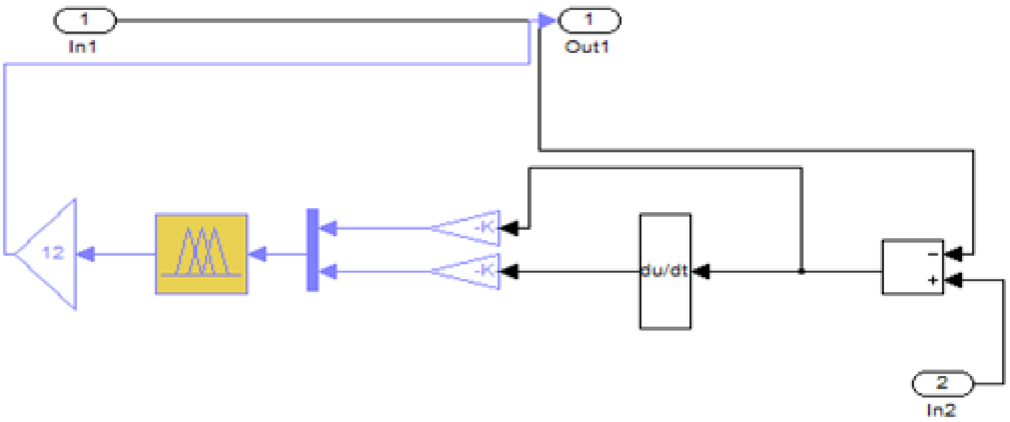

Fig. Simulation Model of Fuzzy Logic Controller

3.5 Simulation model of Three Phase inverter:

The simulation diagram of an three phase inverter is shown in the figure. The output from the SEPIC converter in the form of dc supply is connected to the three phase inverter. The inverter is to convert the dc supply in to an three phase ac supply. The three phase ac supply is given to the three phase induction motor.

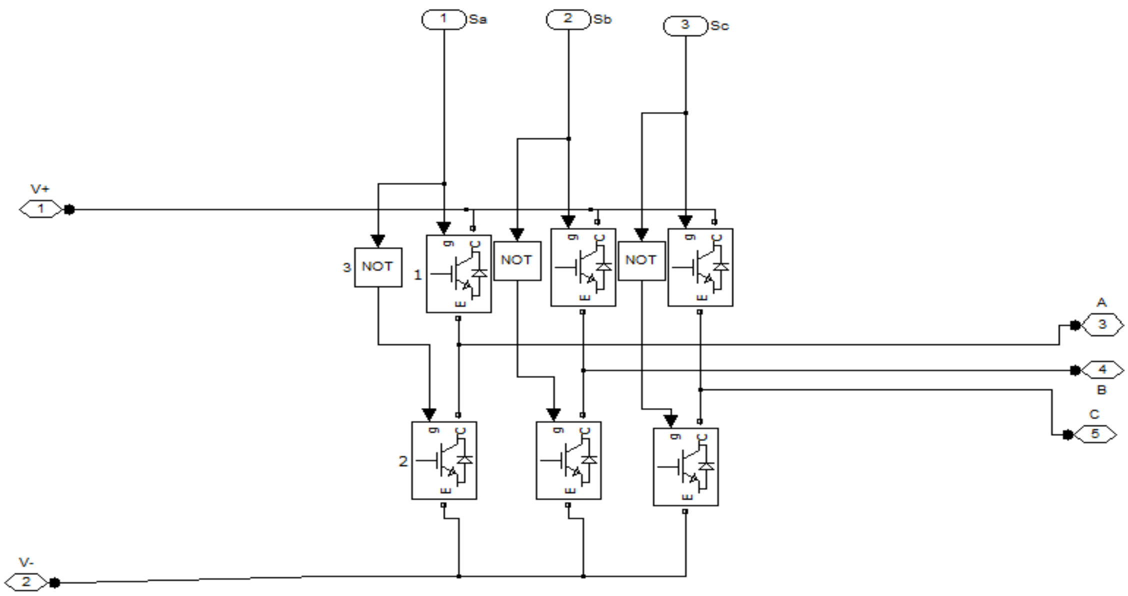

Fig. Simulation Model of Three Phase Inverter

3.6 Simulation Model of Speed Control in FED Induction Motor:

The speed control of an fed induction motor to control the speed in a certain limiting speed.

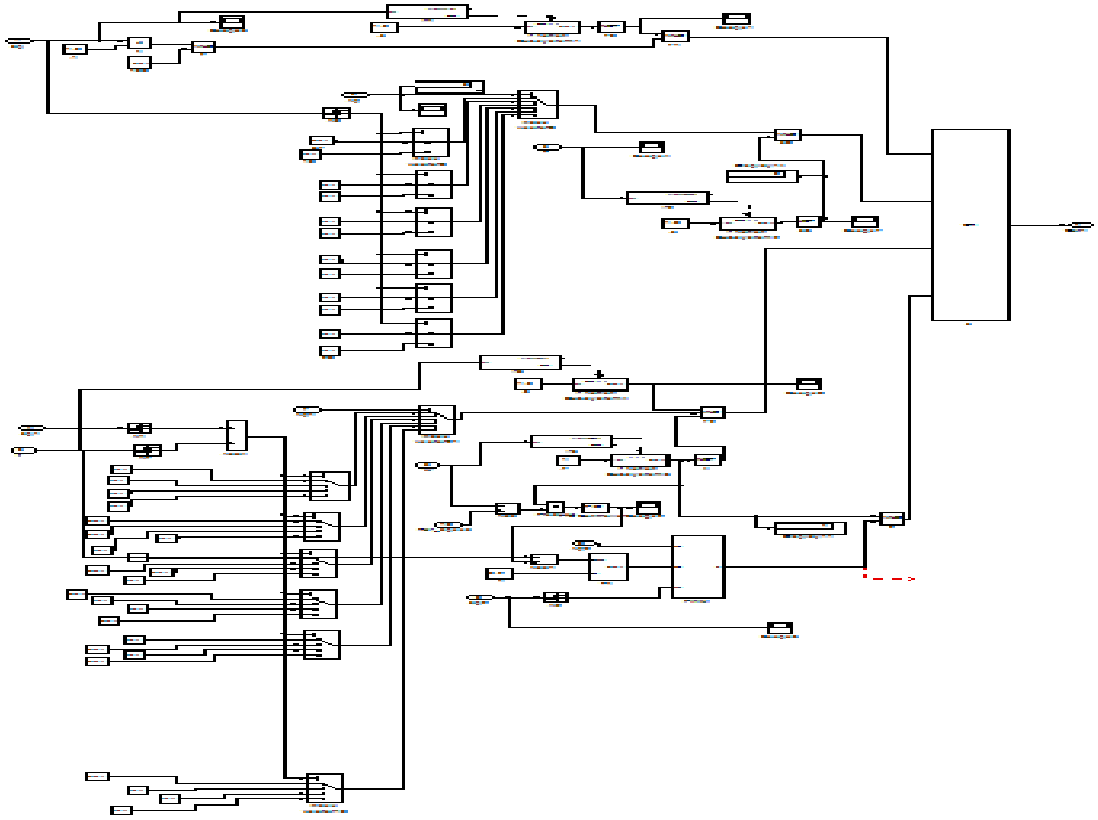

Fig. Simulation Model of Speed Controller

4. SIMULATION RESULTS

4.1. Solar Power:

The output of the PV is shown in Figure. The PV output of 24 V is obtained by adjusting the values of temperature. The amount of power produced by the PV system depend on the amount of PV radiation .The power output can therefore be optimized by choosing a correct system configuration corresponding to a given load.

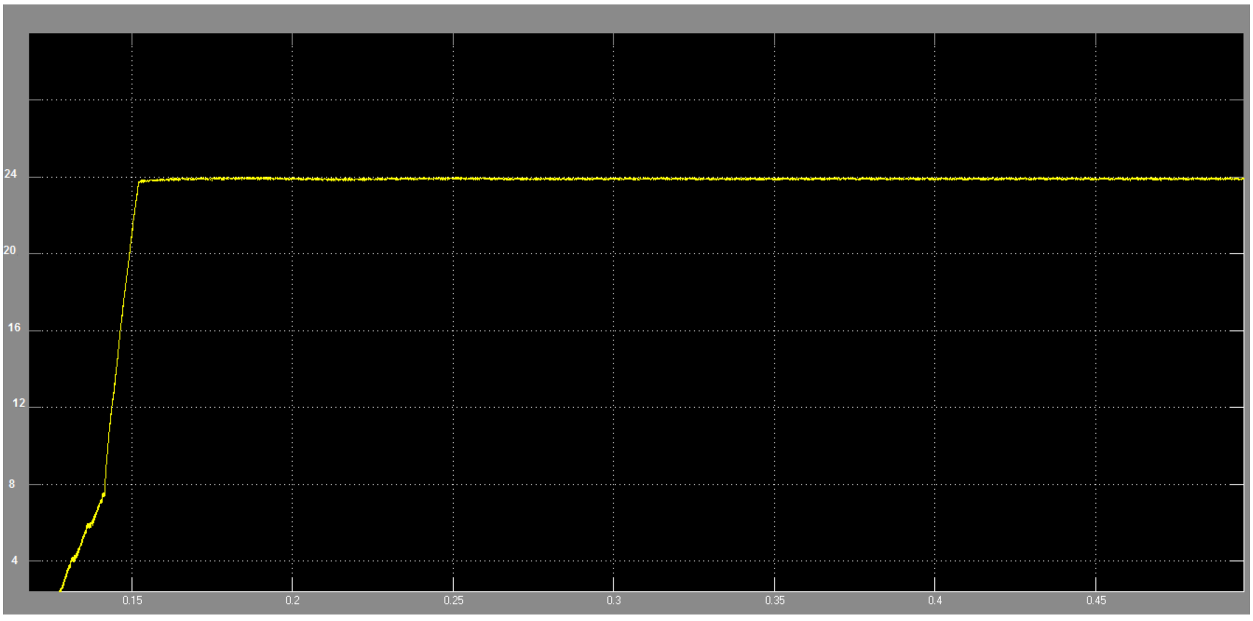

Fig. Output Voltage Waveform of a PV Panel

4.2 Three Phase Inverter:

The output voltage waveform of an three phase inverter are shown in the figure.The three phase inverter converts the DC voltage into three phase voltage. The output voltage is connected to the asynchronous machine or a induction motor. The induction motor is rotates at the rated speed. The three phase output voltage from the voltage source inverter initial few milli seconds or fraction of seconds some imbalance voltage is induced. After 0.15 fractions of seconds the three phase voltage is balance, the phase shift is 120. Because of input from the inverter is photovoltaic cell. Initial 0.15 seconds voltage imbalance, after 0.15 seconds the three phase voltage is balanced.

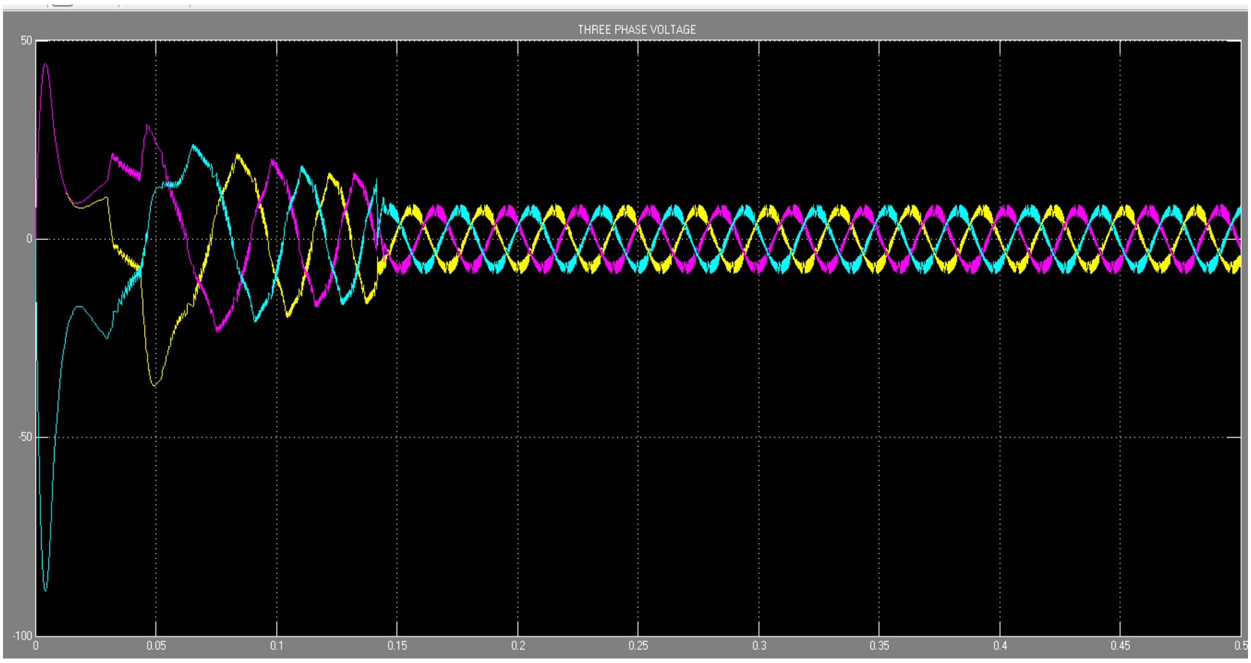

Fig. Output Voltage Waveform Of Three Phase Inverter

4.3 SEPIC Converter:

The output waveform of SEPIC converter are shown in figure. The output voltage of an PV panel is upto 50V dc supply. This minimum voltage is step up maximum voltage in SEPIC converter. In this project the voltage is step up to 400V. in this figure the SEPIC converter converts 50V to 400V(399.2V to 399.8V).

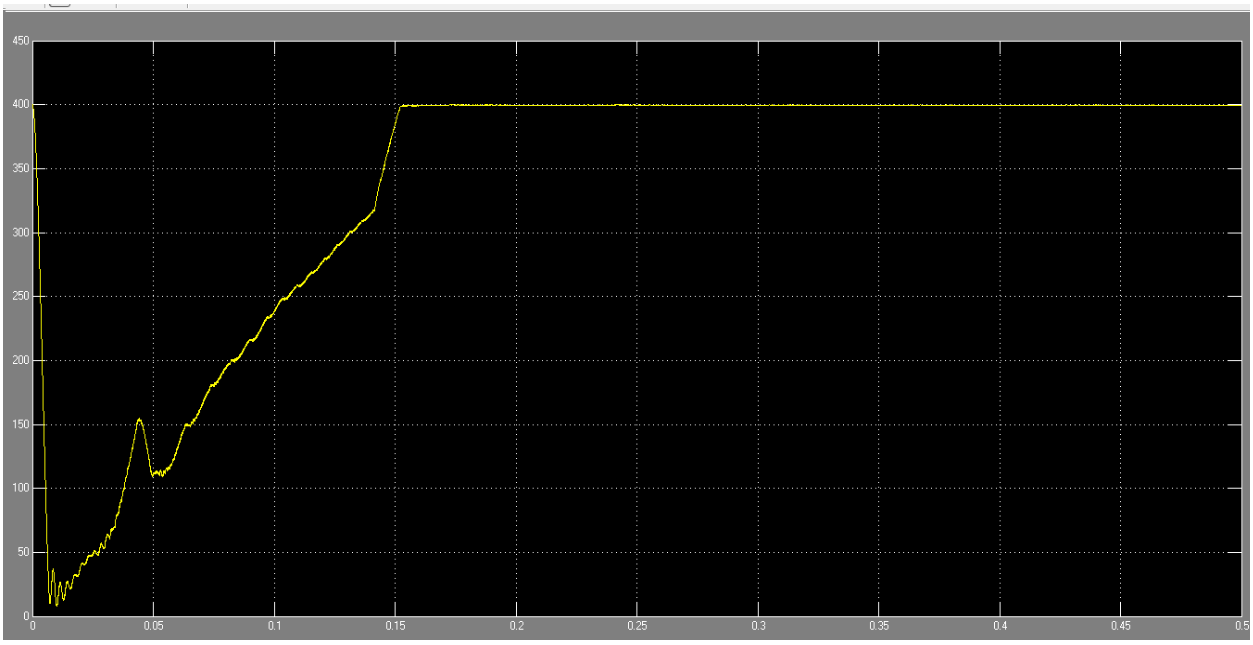

Fig. Output Waveform for an SEPIC Converter

4.4 Speed of an Induction Motor:

The output waveform for speed of an asynchronous machines or a induction motor are shown in figure. Initial the speed of an induction motor is zero, and then the speed of an induction motor will increased gradually to high speed. At initial conduction the speed is zero, after milli seconds the speed of an induction motor is increased gradually. After 0.15 seconds the fed induction motor runs at the rated speed.

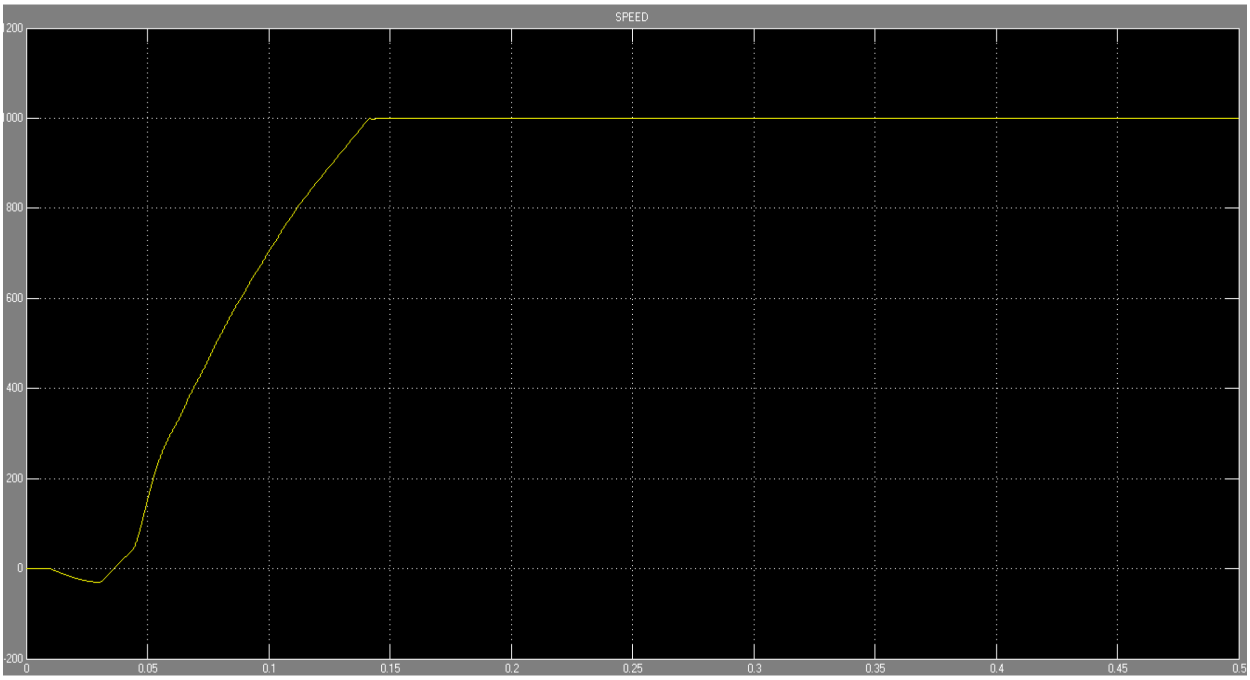

Fig. Output Waveform for Speed of an Asynchronous Machines

4.5 Torque of a Fed Induction Motor:

The output waveform for torque of an fed induction motor are shown in the figure. Initial the torque of an fed induction motor is high, the starting torque of an fed induction motor is high. Initial torque of induction motor is up to 85 within fraction of seconds. After 0.15 seconds the torque is decreased and to maintain in constant output and speed of an induction motor.

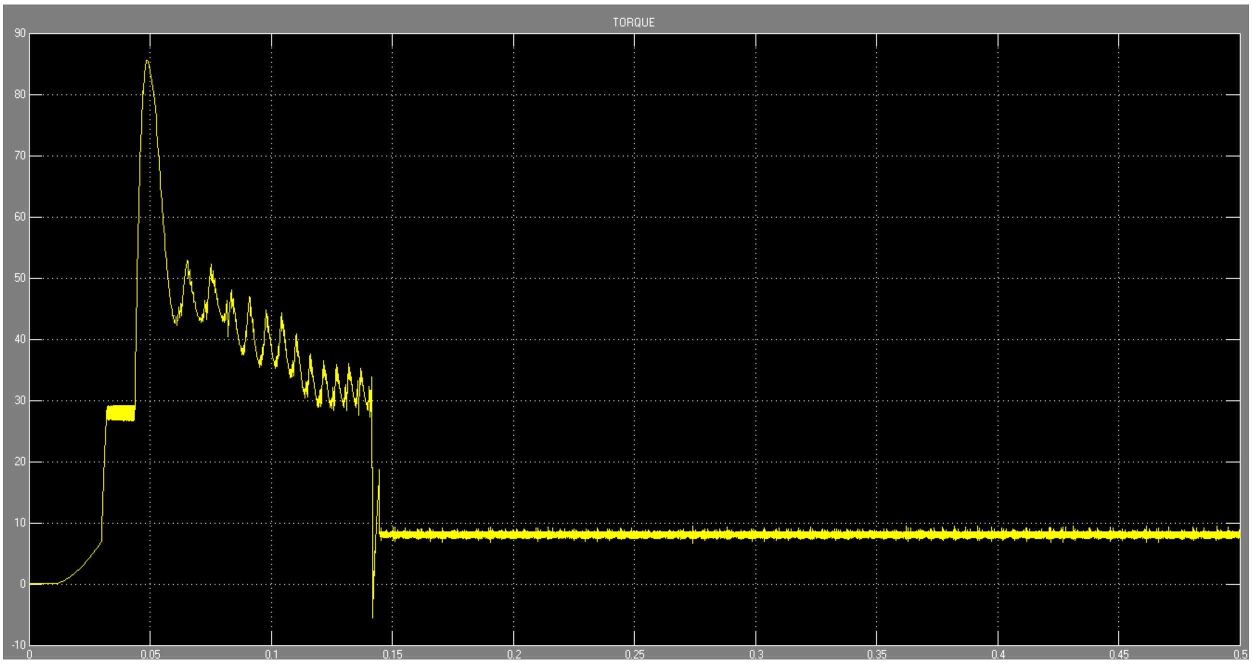

Fig. Output Waveform for Torque of a Fed Induction Motor

4.6 Speed Controller:

The output waveform for speed control of an induction motor is shown in the figure. The output from the three phase voltage source inverter is varied based on the solar radiation. This output variation is control by using the speed controller, the speed variation is occur within 1second, after the speed of an induction motor is constant.

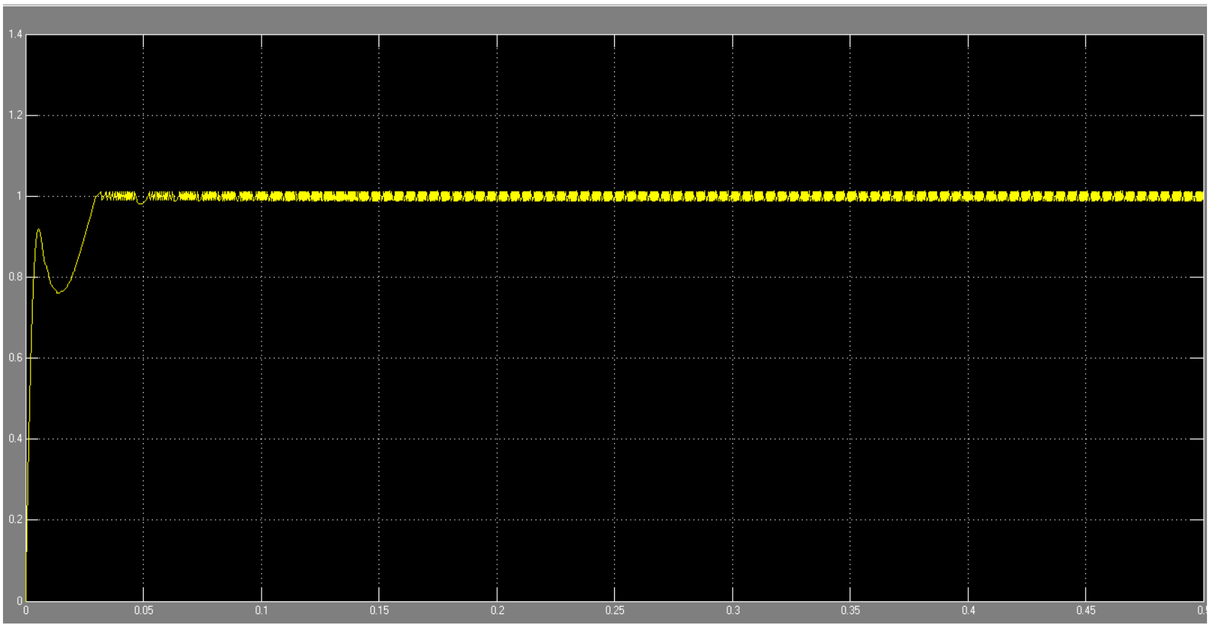

Fig. Output Waveform for Speed Controller

5. CONCLUSION

The simulation and implementation of single-stage, dual purpose, three-phase grid interfaced SPV have been carried out with power quality improvement in the distribution system. An incremental conductance-based MPPT technique has been used for estimating reference dc link voltage. The dc link voltage has been regulated to reference value using a PI controller and proposed control algorithm. The performance of proposed single stage grid interfaced SPV system along with harmonics compensation, power factor correction, and grid currents balancing has been found satisfactory and meeting IEEE standards. Improvement in existing ALST algorithm has been proposed along with modifications to incorporate feature of solar power injection into the grid. An ILST-based control algorithm has been used for the fundamental current extraction along with instantaneous compensation for PV power for fast dynamic response. The features of proposed control algorithm have been found simple to implement, fast convergence, and it requires very less computational effort. The transient responses of SPV system are found satisfactory. A wide range of simulation and experimental results has been found for supporting the satisfactory operation of the proposed dual purpose grid interfaced SPV generating system.

REFERENCES

[1] Bhim Singh, Fellow, IEEE, Chinmay Jain, Member, IEEE, and Sagar Goel, Student Member, IEEE,"ILST Control Algorithm of Single-Stage Dual Purpose Grid Connected Solar PV System", ieee transactions on power electronics, vol. 29, no. 10, October 2014

[2] M. A. Mahmud, Member, IEEE, H. R. Pota, and M. J. Hossain, Senior Member, IEEE,"Nonlinear Current Control Scheme for a Single-Phase Grid-Connected Photovoltaic System", ieee transactions on sustainable energy, vol. 5, no. 1, january 2014

[3] Pooja Sharma and Vivek Agarwal, Senior Member, IEEE,"maximum power extraction from a partially shaded pv array using shunt-series compensation", ieee journal of photovoltaics, vol. 4, no. 4, july 2014

[4] Francisco paz, student member, ieee, and martin ordonez, member, ieee ."zero oscillation and irradiance slope tracking for photovoltaic mppt", ieee transactions on industrial electronics, vol. 61, no. 11, november 2014

[5] Haitham abu-rub, senior member, ieee, atif iqbal, senior member, ieee, sk.moinahmed, member, ieee, fang z. peng, fellow, ieee, yuan li, member, ieee, and ge baoming, member, ieee," quasi-z-source inverter-based photovoltaic generation system with maximum power tracking control using anfis", ieee transactions on sustainable energy, vol. 4, no. 1, january 2013

[6] Gobinath.K1, Mahendran.S2, and Gnanambal.I3"New cascaded H-bridge Multilevel Inverter with Improved Efficiency" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, April 2013

[7] Faete Filho, Helder Zandonadi Maia, Tiago H. A. Mateus,and Burak Ozpineci "Adaptive Selective Harmonic Minimization Based on ANNs for Cascade Multilevel Inverters With Varying DC Sources", IEEE may 2013.

[8] G. Ma, W. Qu, G. Yu, Y. Liu, N. Liang, and W. Li, "A zero-voltage switching bidirectional dc–dc converter with state analysis and soft switching- oriented design consideration," IEEE Trans. Ind. Electron., vol. 56, no. 6, pp. 2174–2184, Jun. 2009.

[9] R. T. Naayagj, N. E. Mastorakis "Performance verification of dual active bridge dc-dc converter" Recent Researches in Applications of Electrical and Computer Engineering ISBN: 978-1-61804-074.

[10] J. Everts, J. Van den Keybus, F. Krismer, J. Driesen, and J. W. Kolar, "Switching control strategy for full ZVS soft-switching operation of a dual active bridge AC/DC converter," in Proc. IEEE 27th Ann. Appl.Power Electron. Conf. Expo., pp. 1048–1055, Feb. 2012.

[11] M. H. Kheraluwala and R. W. De Doncker, "Single phase unity power factor control for dual active bridge converter," in Proc. IEEE Ind. Appl.Soc. Annu. Meet., vol. 2, pp. 909–916, Oct. 1993.

[12] B. Zhao, Q. Song, and W. Liu, "Efficiency characterization and optimization of isolated bidirectional dc–dc converter based on dual-phase-shift control for dc distribution application," IEEE Trans. Power Electron., vol. 28, no. 4, pp. 1711–1727, Apr. 2013.

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