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ANFIS BASED CONTROL OF SINGLE PHASE SWITCHED COUPLED INDUCTOR DC AC INVERTER FOR PHOTOVOLTAIC SYSTEMS

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Abstract

Nowadays, there is an increasing demand for low cost single-phase dc-ac inverters in many applications such as photovoltaic (PV), fuel cell, and battery powered systems. The conventional methods show the well-known full-bridge (FB) inverter referred to as buck inverter. The conventional methods show the well-known full-bridge (FB) inverter referred to as buck inverter. In this circuit, the inverter output voltage (Vo) cannot be greater than input voltage (Vin). In order to overcome the disadvantages of the conventional inverters, a large number of single-stage inverters are proposed. This project presents a new single-phase switched-coupled-inductor DC-AC inverter featuring higher voltage gain than the existing single-phase QZ-source and semi-Z-source inverters. Similar to the single-phase QZ-source and semi-Z-source inverters, the proposed inverter also has common grounds between the DC input and AC output voltages, which is beneficial especially for photovoltaic inverter systems. The inverter volume and maximum current flowing can be reduced significantly through the coupling of all inductors.

Keywords *:*PVpanel,Sensors,Microcontroller,Gatedriver,Inverter,Resistive load.

1. INTRODUCTION

The main purpose of this work is the optimal integration of photovoltaic energy resources in existing electrical distribution systems. In a conventional PV system many PV modules are connected in series to obtain a dc voltage suitable for ac utility line voltage. In series configuration, mismatch conditions could affect the PV system performance causing a lack of producible power. Usually in small-size applications the PV systems are affected by partial shading due to architectural and/or environmental issues. As a result, the total output power generated from the PV array decreases greatly, i.e. the efficiency of the generating electricity is lower. To overcome this defect, a micro-inverte photovoltaic module system(MPMS) has been proposed. In this system, an AC module composed of a small power dc-ac utility interactive inverter is mounted on each individual PV module. Generally, the features of MPMS are small volume, flexible and that the maximum power point decrease manufacturing and installation costs and raise the generating efficiency of the PV. Generally, the features of MPMS are small volume, flexible and that the maximum power point tracking (MPPT) can control indecently. So MPMS can decrease the manufacturing and installation costs and raise the generating efficiency of the PV. Here the AC module inverter should be of small volume, high efficiency and low cost. Various approaches based on distributed dc-dc converters or micro-inverter have been proposed to address these issues by increasing power conversion.

For lower DC voltage PV generating electricity, the existing technology mainly has the following two kinds: the single stage inverter generating AC utility line voltage by raising voltage transformer, another is two stage circuits, a dc-dc converter as font stage is used to get the sufficient DC-bus voltage for generating AC utility line voltage from the end stage inverter. In the former, the primary current of the transformer is larger so the switching loss is larger and the transformer itself produces power loss, hence, this system's efficiency is low too due to its two stage conversion. Besides, these two kinds of strategy result into big bulk. As a consequence they are not fit to MPMS.

2. PROPOSED METHOD

Operation of the proposed inverter and there are two operational modes during one switching cycle. In mode 1, switches and are turned-on, and is turned-off. In mode 2, switches and are turned-off, and is turned-on. Followings are the detailed mode analysis of the proposed inverter. 1S x S 2S 1S x S 2S in mode 1, the capacitor is charged. Gate driver is being charged and discharged during one switching period, its voltage has ripple and the ripple voltage depends on the output power. Therefore, when the voltage difference between and is high, relatively high surge (charging) current will flow through - - - - and the switching devices in this path (and) can be damaged. In order to limit the high surge current, a current limiting inductor is necessary. In this paper, the leakage inductance generated by the coupling of and serves as the current limiting inductor.

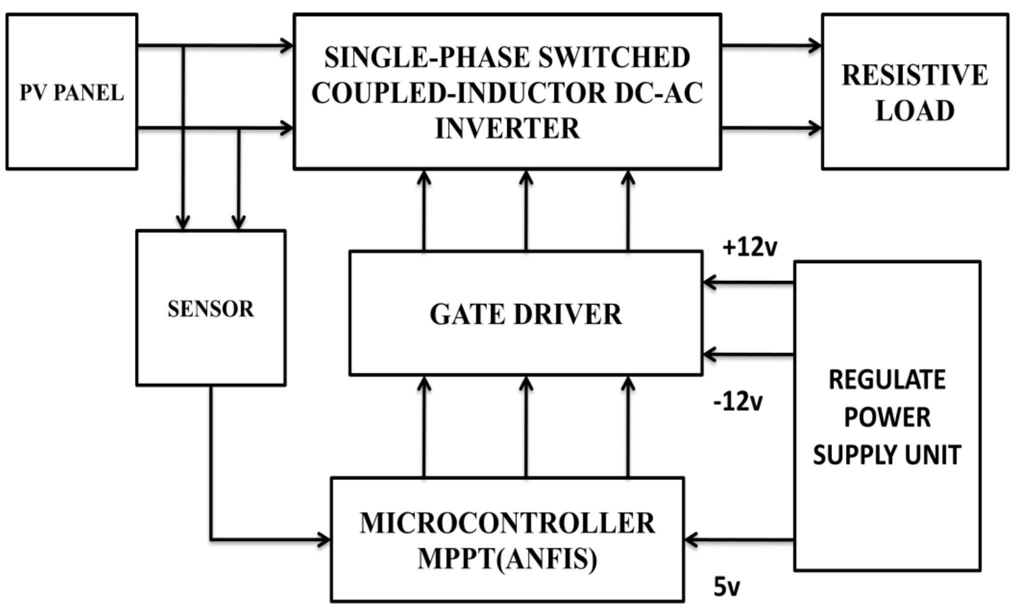

Fig.1 Block Diagram

3. DESIGN AND IMPLEMENTATION

Power Supply Unit

As we all know any invention of latest technology cannot be activated without the source of power. So it this fast moving world we deliberately need a proper power source which will be apt for a particular requirement. All the electronic components starting from diode to Intel IC's only work with a DC supply ranging from _+5v to _+12. we are utilizing for the same, the most cheapest and commonly available energy source of 230v-50Hz and stepping down , rectifying, filtering and regulating the voltage. This will be dealt briefly in the forth-coming sections. 10∝f/25v: for maintaining the stability of the voltage at the load side. O,1∝f: for bypassing the high frequency disturbances

Voltage Regulators

The voltage regulators play an important role in any power supply unit. The primary purpose of a regulator is to aid the rectifier and filter circuit in providing a constant dc voltage to the device. Power supplies without regulator have an inherent problem of changing dc voltage value due to variations in the load or due to fluctuations in the AC linear voltage. With a regulator connected to the DC output the voltage can be maintained within a close tolerant region of the desired output. IC7812 AND 7912 is used in this project for providing +12v and –12v DC supply.

Regulated Power Supply

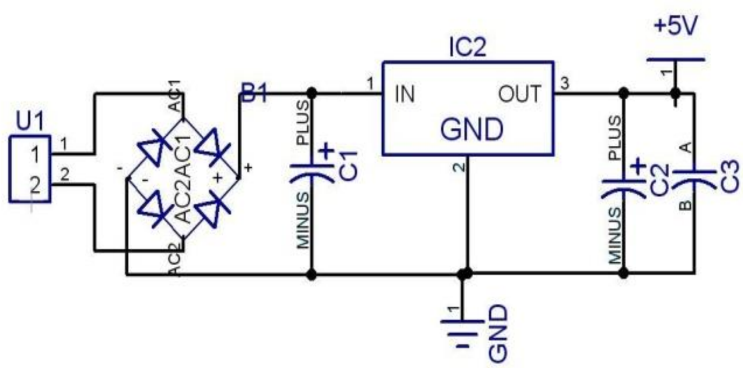

Fig.2 Circuit diagram of Regulated Power Supply

Input from transformer and gives a rectified output of 5 V which is been to my microcontroller. Here we use the fixed voltage regulator 7805.

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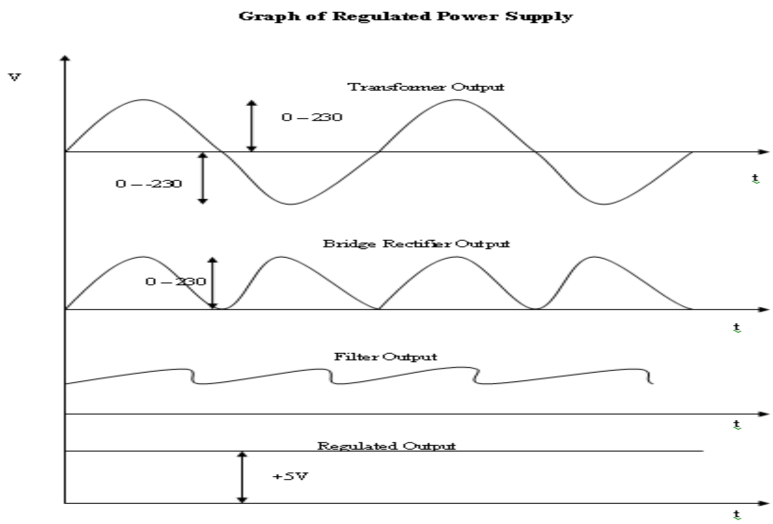

Fig.3 Regulated power supply

For direct current and relatively low frequencies, a voltage divider may be sufficiently accurate if made only of resistors; where frequency response over a wide range is required, (such as in an oscilloscope probe), the voltage divider may have capacitive elements added to allow compensation for load capacitance. In electric power transmission, a capacitive voltage divider is used for measurement of high voltage. This is the circuit diagram for the dual voltage regulator power supply. That can be designed by two fixed voltage regulator that is 7812&7912.the 7812 is positive regulation, 7912 is the negative regulation.

Dual regulated power supply

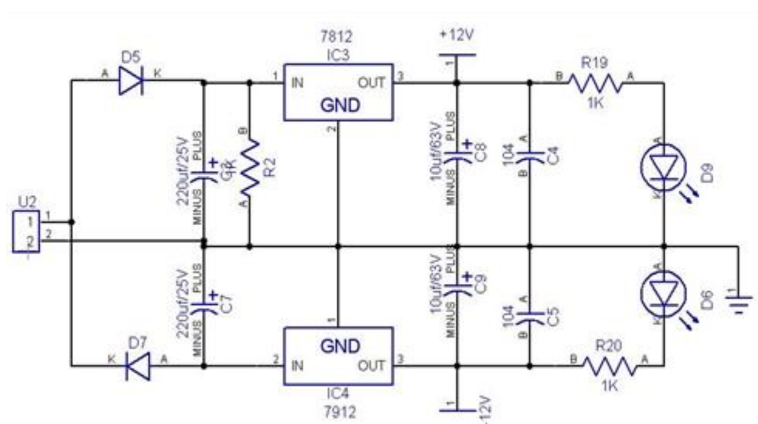

Fig.4 Dual regulated power supply

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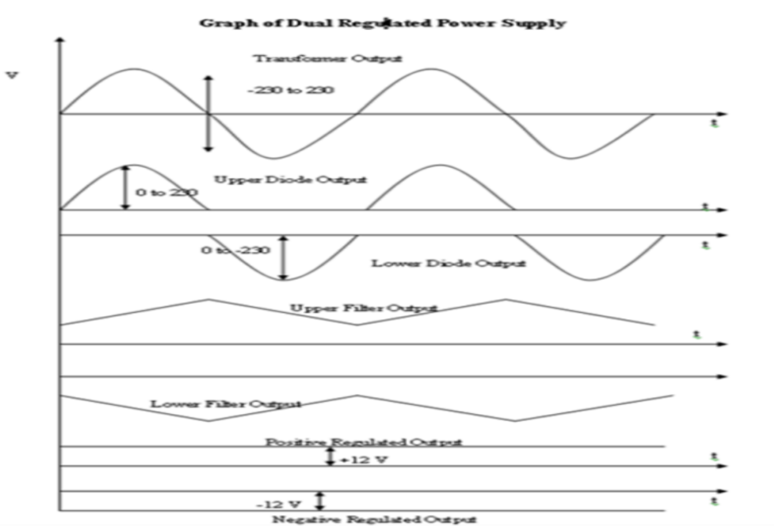

Fig.5 RPS Waveform

Opto Isolation Circuit

Since the MOSFET used to switch the capacitor voltage into the supply line there will be switching transients produced by them. These switching transients in turn will affect the pulses developed by the dsPIC30F2010 and by time the micro controller itself. So in order to protect the microcontroller and the control circuit from power circuit we are providing isolation circuit. The response of opto-coupler depends on the value of output resistance, this is designed based on the value of supply voltage and current withstand capability of photo transistor in opto-coupler IC.

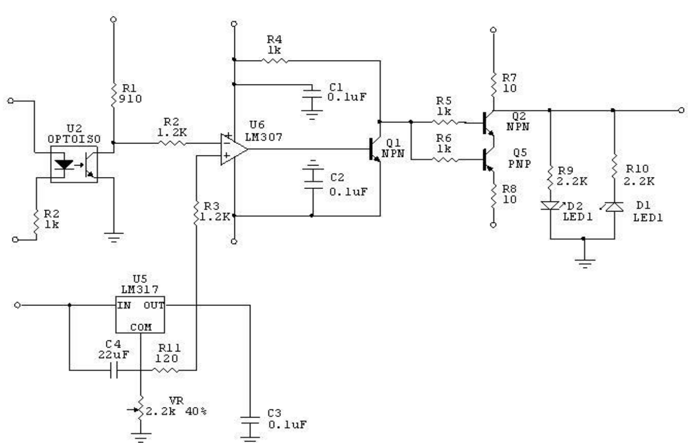

Fig.6 Opto Isolation Diagram Voltage divider Rule

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In electronics or EET, a voltage divider (also known as a potential divider) is a linear circuit that produces an output voltage (V_{out}) that is a fraction of its input voltage (V_{in}). Voltage division refers to the partitioning of a voltage among the components of the divider. An example of a voltage divider consists of two resistors in series or a potentiometer. It is commonly used to create a reference voltage, or to get a low voltage signal proportional to the voltage to be measured, and may also be used as a signal attenuator at low frequencies

$$V_{\mathrm{out}} = \frac{Z_2}{Z_1 + Z_2} \cdot V_{\mathrm{in}}$$

Proof:

$$V_{\mathrm{in}} = I \cdot (Z_1 + Z_2)$$

$$V_{\mathrm{out}} = I \cdot Z_2$$

$$I = \frac{V_{\mathrm{in}}}{Z_1 + Z_2}$$

$$V_{\mathrm{out}} = V_{\mathrm{in}} \cdot \frac{Z_2}{Z_1 + Z_2}$$

The transfer function (also known as the divider's **voltage ratio**) of this circuit is simply:

$$H = \frac{V_{out}}{V_{in}} = \frac{Z_2}{Z_1 + Z_2}$$

Six Step Three Phase Voltage Source Inverter

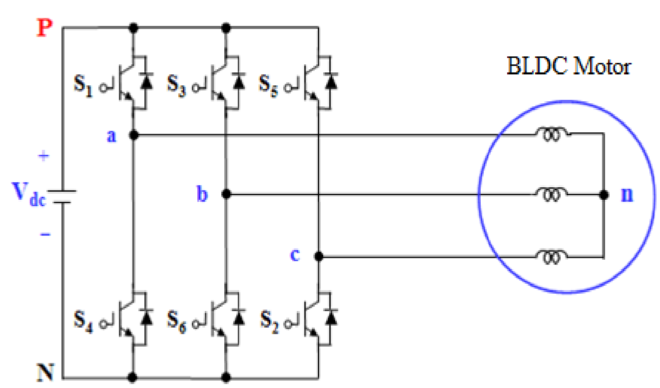

Fig.8 Three-Phase Voltage Source Inverter

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For the 180° mode VSI, each MOSFET conducts for 180° of a cycle. Like a 180° mode , 120° mode inverter also requires six steps, each of 60° duration, for completing one cycle of the output ac voltage. Where, S1 to S6 are the MOSFETs and the three phase load is assumed to be star connected. The MOSFETs are numbered in the sequence in which they are triggered to obtain voltages v_{ab},v_{bc},v_{ca} at the output terminals a, b and c of the inverter. The MOSFETs S1, S4; S3,S6 and S5,S2 are turned on with a time interval of 180 degrees. It means that S1 conducts for 180° of a cycle. MOSFETs in the upper group, i.e. S1, S3, S5 conduct at an interval of 120°. It implies that if S1 is fired at 0°then S3 must be fired at 120° and S5 at 240°. Same is true for lower group of MOSFETs. Thus as seen from the Fig.3.2 only three MOSFETs are conducting one from upper group and two from lower group or two from upper group and one from lower group.

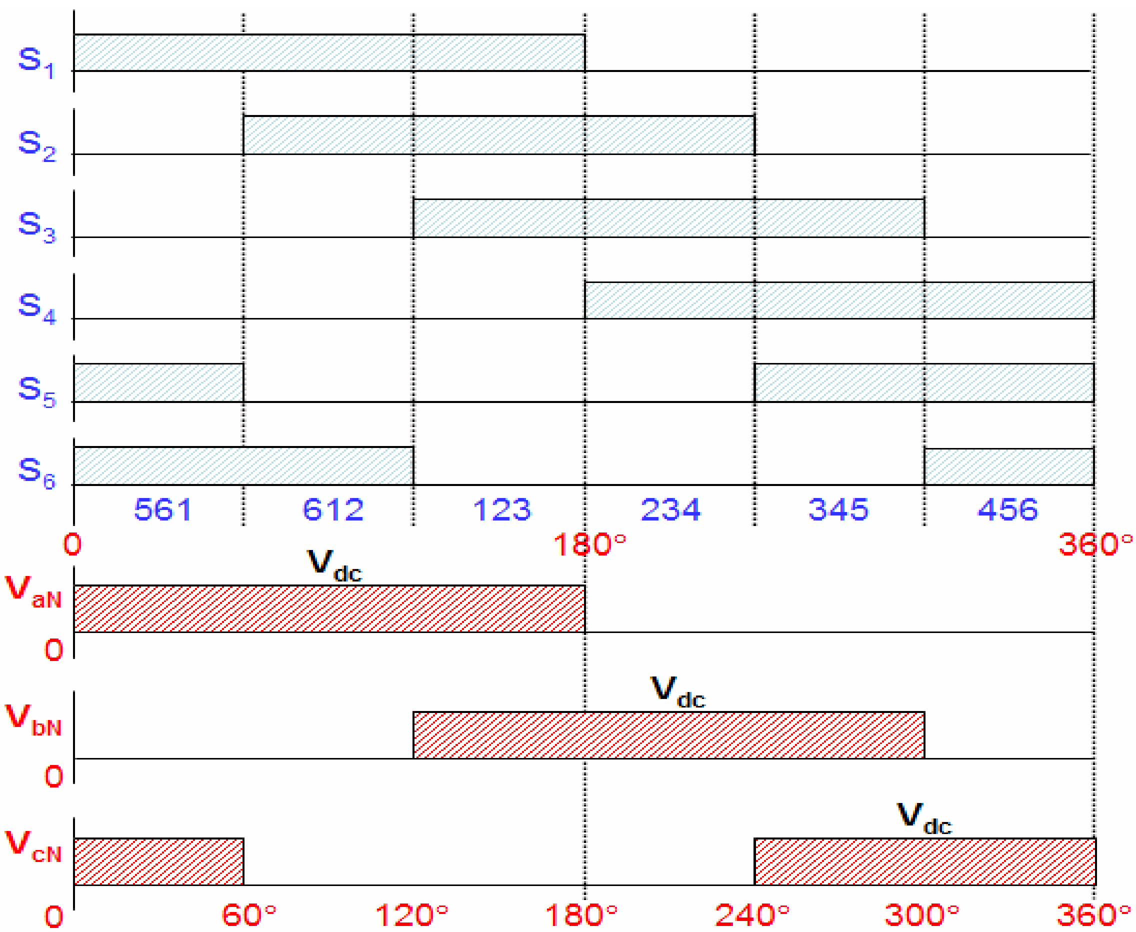

Fig.9 Voltage source inverter gate signals

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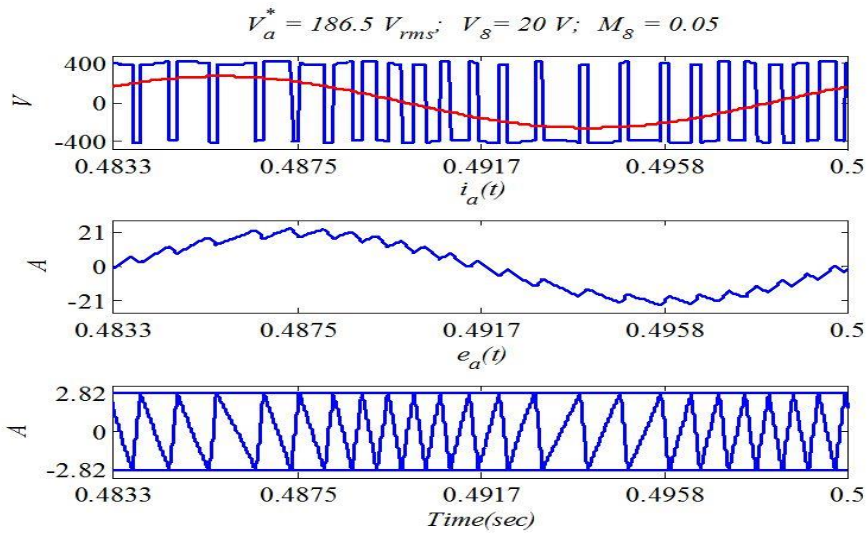

Fig.10 Six Inverter Voltage Vectors

4. SIMULATION DIAGRAM WITH RESULT

Generally PID, Fuzzy techniques are being used to control DC – DC converter. This paper presents a ANFIS controller based SEPIC converter for maximum power point tracking (MPPT) operation of a photovoltaic (PV) system. The ANFIS controller for the SEPIC MPPT scheme shows a high precision in current transition and keeps the voltage without any changes represented in small steady state error and small overshoot.

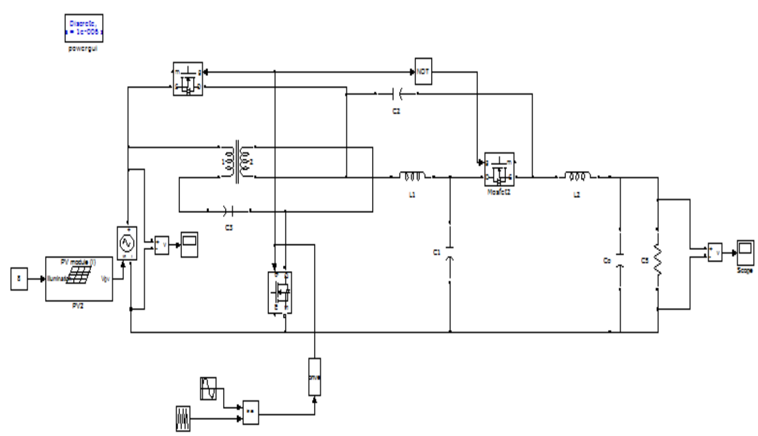

Fig.11 Simulation Diagram

The proposed scheme ensures optimal use of photovoltaic (PV) array, wind turbine and proves its efficacy in variable load conditions, unity and lagging power factor at the inverter output (load) side. The performance of the proposed ANFIS based MPPT operation of SEPIC converter is compared to those of

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the conventional PID and Fuzzy based SEPIC converter. The results show that the proposed ANFIS based MPPT scheme for SEPIC can transfer power to about 20 percent (approx) more than conventional system

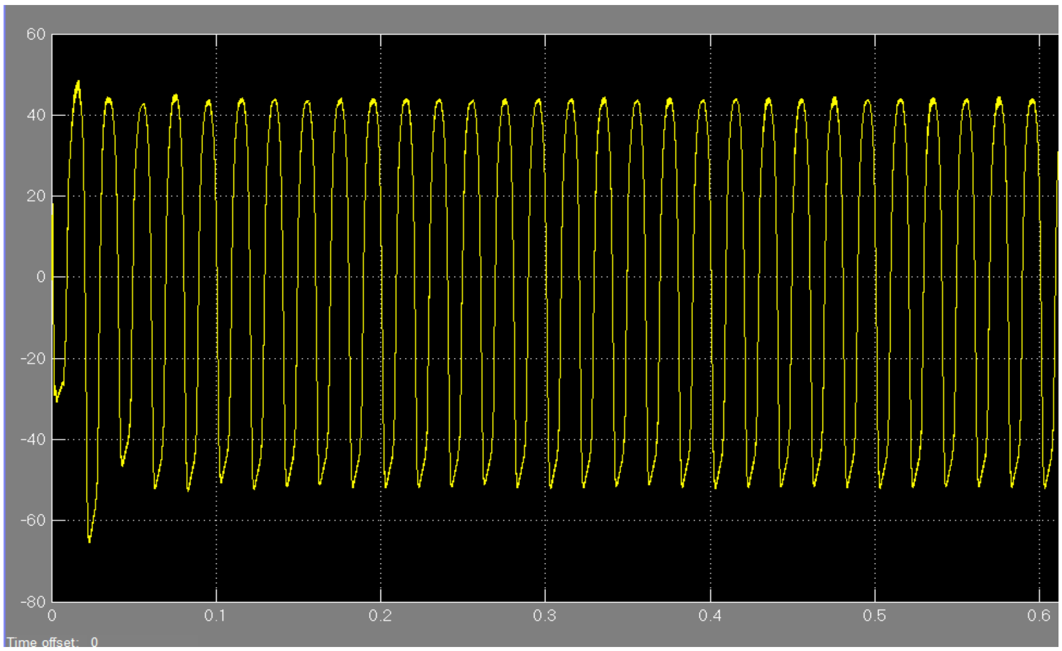

Fig.12 Simulation Output

Parameters	Existing system	Proposed system
Input voltage	12v	12v
Input current	0.38A	0.34A
Output voltage	31v	35v
Output current	0.058A	0.083A
Efficiency	52	78
Input power	4.6w	4.1w
Output power	1.642w	3.1w

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5. HARDWARE WITH DIAGRAM

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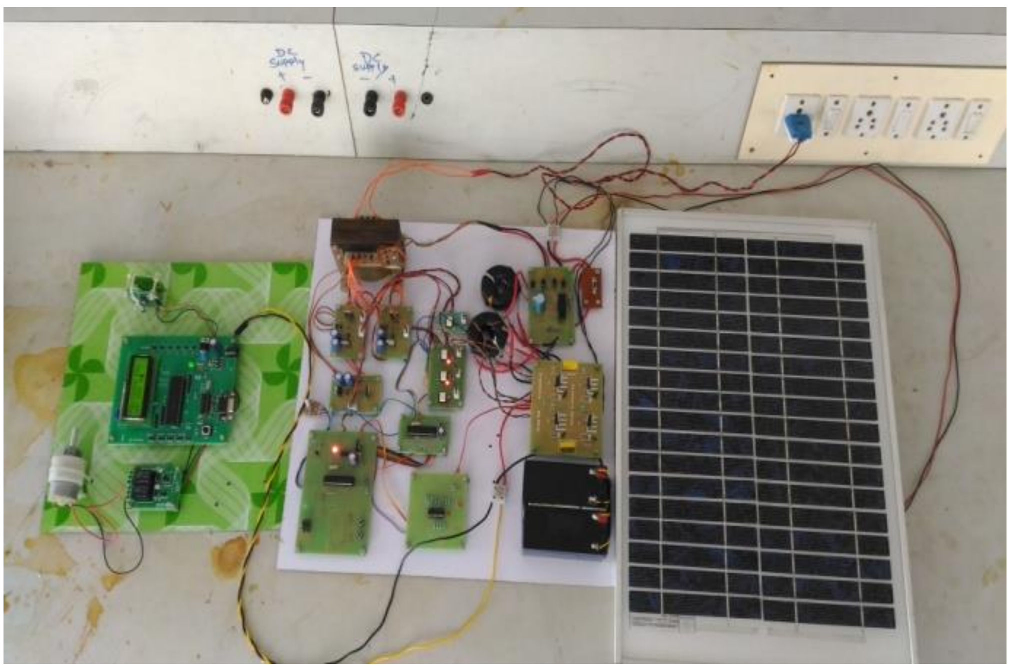

Fig.13 Hardware Output

CONCLUSION

This is of simple structure and can generate an AC output voltage than the dc input one, depending not only on the instantaneous duty cycle circuit is proposed.The single-phase switched coupled inductor DC-AC inverter was presented. It has an operation principle similar to that of a single-phase qZ-source inverter. With the addition of components, , and the coupled inductor, voltage gain of the proposed inverter can be extended to greater than 2. The magnetic integration of all inductors decreases the converter volume significantly and the proposed inverter has relatively simple gate signal generation. Moreover, similar to the single-phase qZ-source inverter and the TSTS-ZSI, the proposed inverter shares common grounds between the DC input and the AC output voltage. A 280-W prototype inverter was built and tested to verify operation of the proposed inverter.

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