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Pv Fed Induction Motor Drive System Using Transformer Less High Gain Boost Converter

[1]K.Sathyasaraj M.E.,(Ph.D) [2]Aswani Mohan,[3]Aiswarya .O,[4]Varsha Vasudev.K.P ,[5]Rahul.C.Raju

1,Assistant professor,Department of EEE,Indus College of Engineering
2, 3, 4U.G Students, Department of EEE,Indus College of Engineering

Abstract—**In this paper presents a boost dc-dc converter topology with novel capability of cancelling the input ripple at an arbitrarily preselected duty cycle.This is accomplished without increasing the count of the number of components in contrast to other solutions available in the literature. Inaddition the conversion features a high voltage gain without utilizing extreme values of duty cycle these features make the converter ideal to process electric converter ideal to process electric power coming from low voltage power generating sources such as renewable. By using these solar energy we are driving an induction motor and the speed control of induction motor is done by using v/f control method.**

Index Terms—**Current ripple cancelation, dc/dc converters, maximum power point tracking.**

I.INTRODUCTION

Many industrial processes require variable speed drives for various applications. The project aims to develop an AC drive for a single phase induction motor based on the variable voltage, variable frequency method. The core of the AC drive is the ATMEL 89C51 microcontroller which generates the required PWM signals to gate the H-BRIDGE inverter by which an AC supply of variable voltage and frequency required to drive the induction motor at different speed is achieved. This paper proposes boost dc-dc converter topology with novel capability of cancelling the input current ripple at an arbitrarily preselected duty cycle.In addition the converter features in high voltage gain without utilizing extreme values of duty cycle. The topology proposed in this paper corresponds to an improved and different version of an approach recently proposed in the literature. Herein, a dc–dc boost converter topology is proposed which combines two principles highly used in state of-the-art power converters: 1) At the converter's input, two inductors are interleaved for canceling the input current ripple,and 2) at the converter's output, an SC voltage multiplier is utilized to increase the voltage gain the voltage provided by a number of small power generatingsources such as renewable is usually low in amplitude. As a result of this, a boost-type architecture with alarge voltage gain is required to link this voltage to an inverter. Another important requirement for a converter in renewable energy applications (for example, in fuel cells) is to drain a continuous current with minimum ripple. Therefore, converters combining these two features are expected to find many application within the renewable-energy context.Given the current concerns of global warming, environmental pollution, energy security and industrial competitiveness, there is increasing pressure on industry to use modern, clean and efficient sources of energy. Now with the scarcity of conventional source of energy, the renewable source of energy like solar, wind and biomass-based technologies have shown considerable potential and are waiting to be tapped not just for domestic use but industrial energy purposes as well. Solar electrical energy generation provides several advantages with respect to other energy sources like it uses the inexhaustible world-wide available sunlight as a source of energy; it does not generate environmental pollutants.Solar cells are **unique** in that they directly convert the incident solar irradiation into electricity. Photovoltaic (PV) power management concepts are essential to extract as much power as possible from the solar energy. PV energy systems are being extensively studied because of their benefits of environmental friendly and renewable characteristics. Typically, several PV panels are connected in series to provide a high-voltage output Voltage and connect with the ac grid system. This paper focuses on the use of solar energy on induction motor drive which is by far the workhorse in industrial applications.The advancement of power semiconductor devices and the evolvement of several control techniques for converter topologies have made the induction motor drives to become the first choice for many industrial applications

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II. PROPOSED TOPOLOGY

The proposed topology is shown in Fig. 1(a). As the figure suggests, the topology contains two transistors ($s1$ and $s2$) ,three diodes ($d1$, $d2$, and $d3$), three capacitors ($C1$, $C2$,And $C3$), two inductors for energy storage ($L1$ and $L2$), and a small inductor ($L3$) for current limiting through $d3$. In practical implementation, $L3$ is around 100 times smaller than $L2$ and50 times smaller than $L1$. As a result of its reduced size, small-ripple approximations do not apply to $L3$, and hence, theselection of its inductance is based on the CCI between $C2$ and$C3$ [28]. Details on the procedure for its selection are provided in Section III-C .The transistors switch complementarily, i.e., when $s1$ is closed, $s2$ is open and vice versa. The operation of the converter may be explained considering the small-ripple approximation for the voltage across capacitors and continuous conduction mode for $L1$ and $L2$. The details on the circuit operation are conveniently introduced by employing several analytical waveforms, which are later validated via experiments. As shownin Fig. 1(b) and (c), the converter has two equivalent circuits resulting from the switch action. When $s1$ is on (and $s2$ isoff), the topology is represented by the equivalent circuit inFig. 1(b). During this time, the diode $d1$ is reversely biased, blocking the voltage across $C1$. Similarly, diode $d3$ is reversely biased, blocking the voltage across $C3$.

The current through *L*2forces the diode *d*2 to be closed since transistor *s*2 is open.The proposed topology is shown in Fig. 1(a). As the figure suggests, the topology contains two transistors (*s*1 and *s*2),three diodes (*d*1, *d*2, and *d*3), three capacitors (*C*1, *C*2,and *C*3), two inductors for energy storage (*L*1 and *L*2), and asmall inductor (*L*3) for current limiting through *d*3. In practical implementation, *L*3 is around 100 times smaller than *L*2 and50 times smaller than *L*1. As a result of its reduced size, small-ripple approximations do not apply to *L*3, and hence, the selection of its inductance is based on the CCI between *C*2 and*C*3 [6]. Details on the procedure for its selection are provided in Section III-C.The transistors switch complementarily, i. e., when *s*1 is closed, *s*2 is open and vice versa. The operation of the converter may be explained considering the small-ripple approximation for the voltage across capacitors and continuous conduction mode for *L*1 and *L*2. The details on the circuit operation are conveniently introduced by employing several analytical waveformswhich are later validated via experiments. As shownin Fig. 1(b) and (c), the converter has two equivalent circuitsresulting from the switch action. When *s*1 is on (and *s*2 isoff), the topology is represented by the equivalent circuit inFig. 1(b). During this time, the diode *d*1 is reversely biased,blocking the voltage across *C*1. Similarly, diode *d*3 is reversely biased, blocking the voltage across *C*3. The current L2 through forces the diode *d*2 to be closed since transistor *s*2 is open.

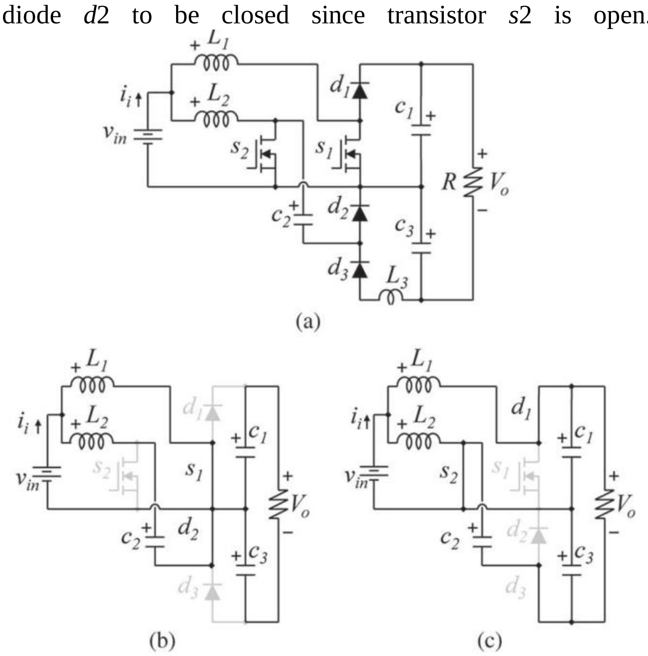

Fig. 1. (a) Circuit schematic of the proposed topology. (b) and (c) Equivalent circuit schematics for each switching state.

III.PROPOSED CIRCUIT ON PV FED

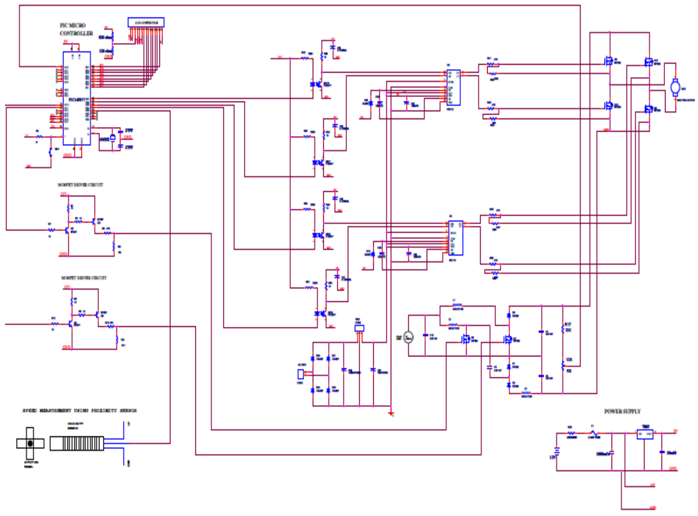

Fig.2.Circuit diagram

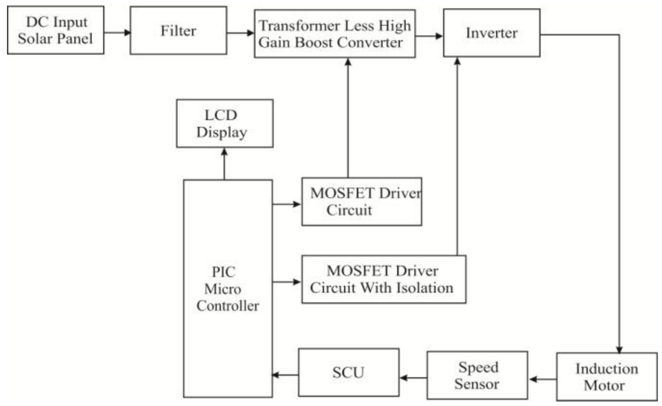

Fig.3.block diagram

Fig.1 shows the block diagram of the PV fed induction motor drive system using transformer less high gain boost converter.the block diagram consist of dc input solar panel,filters for reducing harmonics,transformer less high gain boost converter ,inverter for rectifying and to convert dc to ac. this ac output is used to drive induction motor. the speed of the induction motor is sensed by using a sensor.the operation principle and design consideration will be analyzed and described below.

IV PERFORMANCE ON PV FED INDUCTION MOTOR

A. DC ACTION OVER LM SERIES

The LM78XX series of three terminal regulators is availablewith several fixed output voltages making them useful in awide range of applications. One of these is local on cardregulation, eliminating the distribution problems associatedwith single point regulation. The voltages available allowthese regulators to be used in logic systems, instrumentation,HiFi, and other solid state electronic equipment. Althoughdesigned primarily as fixed voltage regulators thesedevices can be used with external components to obtain adjustablevoltages and currents.The

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LM78XX series is available in an aluminum TO-3 packagewhich will allow over 1.0A load current if adequate heatsinking is provided. Current limiting is included to limit thepeak output current to a safe value. Safe area protection forthe output transistor is provided to limit internal power dissipation.If internal power dissipation becomes too high for theheat sinking provided, the thermal shutdown circuit takesover preventing the IC from overheating.Considerable effort was expanded to make the LM78XX seriesof regulators easy to use and minimize the number ofexternal components. It is not necessary to bypass the output,although this does improve transient response. Input by passing is needed only if the regulator is located far from thefilter capacitor of the power supply.For output voltage other than 5V, 12V and 15V the LM117series provides an output voltage range from 1.2V to 57V.

Features

- Output current in excess of 1A
- Internal thermal overload protection
- No external components required
- n Output transistor safe area protection
- n Internal short circuit current limit
- n Available in the aluminum TO-3 package

Voltage Range

LM7805C 5V
LM7812C 12V
LM7815C 15V

B. PIC [INTERFACING CONTROLLER]

The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS (Complementary metal oxide semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory.The main advantage of CMOS and RISC combination is low power consumption resulting in a very small chip size with a small pin count. The main advantage of CMOS is that it has immunity to noise than other fabrication techniques.

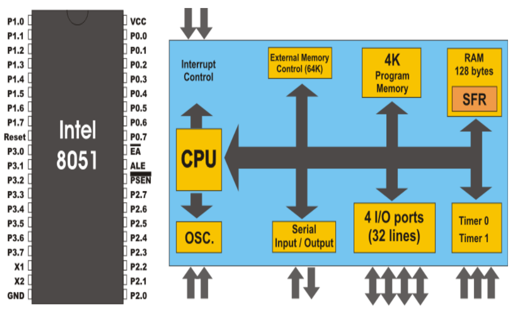

Fig.4.Block diagram of Microcontroller

The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS (complimentary metal oxide semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory. The main advantage of CMOS and RIS combination is low power consumption resulting in a very small chip size with a small pin count. The main advantage of CMOS is that it has immunity to noise than other fabricate techniques .Various microcontrollers offer different kinds of memories. EEPROM, EPROM, FLASH etc. are some of the memories of which FLASH is the most recently developed. Technology that is used in pic16F877 is flash technology, so that data is retained even when the power is switched off. Easy Programming and Erasing are other features of PIC 16F877.

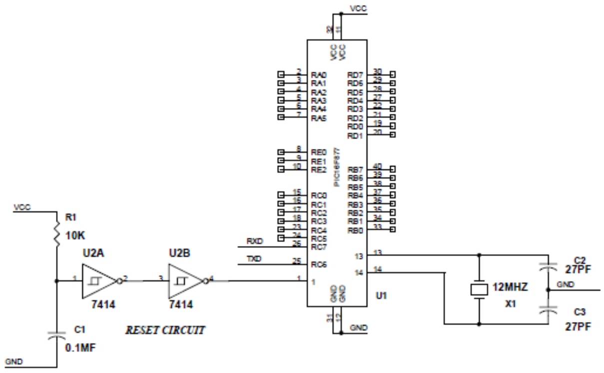

Fig.5.Pin diagram of Microcontroller

C. SENSOR [ANALYSING UNIT]

Proximity sensor:

Inductive proximity sensors are widely used in various applications to detect metal devices. They can be used in various environments (industry, workshop, lift shaft...) and need high reliability. Inductive proximity sensors generate an electromagnetic field and detect the eddy current losses induced when the metal target enters the field. The field is generated by a coil, wrapped round a ferrite core, which is used by a transistorized circuit to produce oscillations. The target, while entering the electromagnetic field produced by the coil, will decrease the oscillations due to eddy currents developed in the target. If the target approaches the sensor within the so-called "sensing range", the oscillations cannot be produced anymore: the detector circuit generates then an output signal controlling a relay or a switch.

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Fig 6.proximity sensor

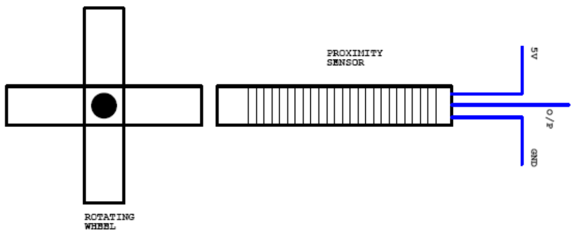


Fig.7.Speed measurement using proximity sensor

V PERFORMANCE DESIGN

The wheel type metal rod is fixed in the motor shaft. The proximity sensor is placed near the shaft. When the shaft is rotating, the metal rod is crossed the proximity sensors sequentially. So the sensor gives the pulse to the microcontroller. Now the microcontroller counts the pulse. By using this pulse count we can find revolution per minute which is equal to speed of the microcontroller.

D.PWMBASEDMOSFET

a)PWM

Pulse-width modulation (PWM) of a signal or power source involves the modulation of its duty cycle, to either convey information over a communications channel or control the amount of power sent to a load.

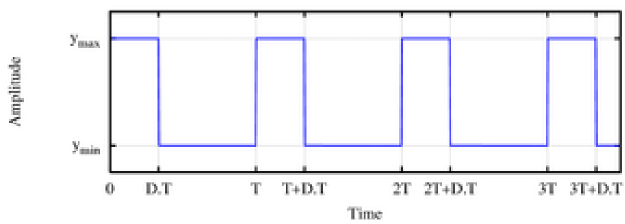
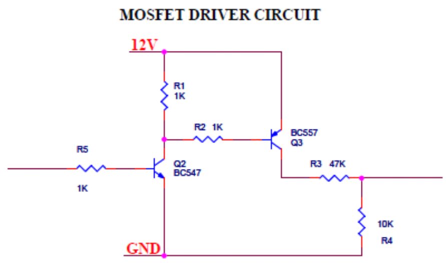


Fig.7:a square wave,showing the definitions of ymin,ymax and D

b) DESCRIPTION OVER OPERATION ON PV FED

This circuit is mainly designed to control the speed of the AC induction motor and DC motor. The MOSFET are used to control the speed of the motor by varying the supply voltage to the motors. The MOSFET is switched with very high speed with the help of PWM waves. The PWM waves are generated by the PIC microcontroller. The PWM time period and duty cycle is controlled by the software.In the microcontroller we are generating two PWM waves with different time period. They are used to drive the two set of MOSFET drivers through AND gate. So the AND gate is used to change the switching time between the two set of MOSFET drivers. When the duty cycle of both the PWM waves is high, the output of the AND (IN1) gate is high which is given to transistor network. The transistor network is consists of BC 547 and BC 557 transistor. Now the both the transistor is conducting, due to that 12v is given to MOSFET Q1 and Q2 gates. So the MOSFET are switched ON and delivered the output on the center tapped transformer. In the center tapped transformer, the DC input is given to middle terminal and other two end terminals are connected in the each of the MOSFET drivers Drain terminal. The DC input negative terminal is connected in the source terminal. Similarly in the next of duty cycle, another AND gate (IN2) output is high which drive another set of MOSFET drivers.Due to high switching speed the given DC input is converted to related sine wave which is step up through the transformer. This AC voltage is delivered in the transformer secondary. This AC voltage can be used to drive the AC induction motor. Suppose if you want to drive the DC motor the corresponding AC voltage is rectified through bridge rectifier.



E.SIGNAL CONDITIONING UNIT

The signal conditioning unit accepts input signals from the analog sensors and gives a conditioned output of 0-5V DC corresponding to the entire range of each parameter. This unit also accepts the digital sensor inputs and gives outputs in 10 bit binary with a positive logic level of +5V. The calibration voltages* (0, 2.5 and 5V) and the health bits are also generated in this unit. Microcontrollers are widely used for control in power electronics. They provide real time control by processing analog signals obtained from the system. A suitable isolation interface needs to be designed for interaction between the control circuit and high voltage hardware. A signal conditioning unit which provides necessary interface between a high power grid inverter and a low voltage controller unit

F.INDUCTION MOTOR

Induction motors derive their name from the way the rotor magnetic field is created. The rotating stator magnetic field induces currents in the short circuited rotor. These currents produce the rotor magnetic field, which interacts with the stator magnetic field, and produces torque, which is the useful mechanical output of the machine.

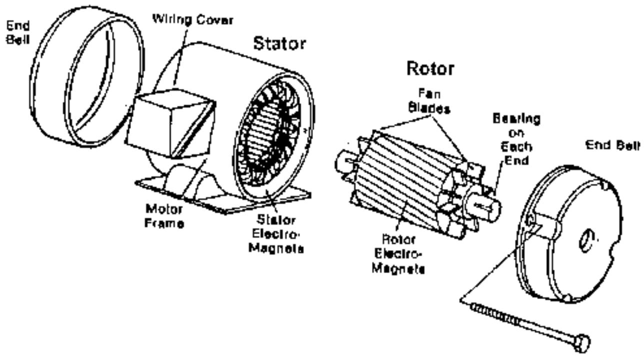


Fig.8.Induction motor

VI RESULT AND DISCUSSION

In the V/Hz control, the speed of induction motor is controlled by the adjustable magnitude of stator voltages and frequency in such a way that the air gap flux is always maintained at the desired value at the steady-state. Sometimes this scheme is called the scalar control because it focuses only on the steadystate dynamic. It can explain how this technique works by looking at the simplified version of the steadystate equivalent circuit as seen. According to in this figure, the stator resistance (Rs) is assumed to be zero and the stator leakage inductance (Lls) is embedded into the (referred to stator) rotor leakage inductance (Llr) and the magnetizing inductance, which is representing the amount of air gap flux, is moved in front of the total leakage inductance (Ll = Lls + Llr). As a result, the magnetizing current that generates the air gap flux can be approximately the stator voltage to frequency ratio. Its phasor equation (for steady-state analysis) can be seen as:

$$\tilde{I}_m \cong \frac{\tilde{V}_s}{j\omega L_m} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

If the induction motor is operating in the linear magnetic region, the Lm is constant. Then,can be shown in terms of magnitude as:

$$I_m = \frac{\Lambda_m}{L_m} \cong \frac{V_s}{(2\pi f)L_m} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where, V and Λ are their magnitude of stator voltage and stator flux, and $\tilde{V}$ is the phasor representation, respectively.

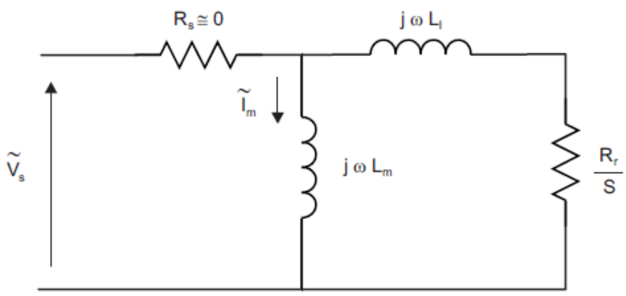


Fig.9. Simplified Steady-State Equivalent Circuit of Induction Motor

From the last equation, it follows that if the ratio V/f remains constant for any change in f, then flux remains constant and the torque becomes independent of the supply frequency. In order to keep ΛM constant, the ratio of Vs / f would also be constant at the different speed. As the speed increases, the stator voltages must, therefore, be proportionally increased in order to keep the constant ratio of Vs/f. However, the frequency (or synchronous speed) is not the real speed because of a slip as a function ofthe motor load. At no-load torque, the slip is very small, and the speed is nearly the synchronous speed. Thus, the simple open-loop Vs/f (or V/Hz) system cannot precisely control the speed with a presence of load torque. The slip compensation can be simply added in the system with the speed measurement. In practice, the stator voltage to frequency ratio is usually based on the rated values of these variables. The typical V/Hz profile can be shown. Basically, there are three speed ranges in the V/Hz profile as follows

At 0-fc Hz, a voltage is required, so the voltage drop across the stator resistance cannot be neglected and must be compensated for by increasing the Vs. So, the V/Hz profile is not linear. The cutoff frequency (fc) and the suitable stator voltages may be analytically computed from the steady-state equivalent circuit with Rs ≠ 0. At fc-frated Hz, it follows the constant V/Hz relationship. The slope actually represents the air gap flux quantity as seen in. At higher frated Hz, the constant Vs/f ratio cannot be satisfied because the stator voltages would be limited at the rated value in order to avoid insulation breakdown at stator windings. Therefore, the resulting air gap flux would be reduced, and this will unavoidably cause the decreasing developed torque correspondingly. This region is usually so called "field weakening region". To avoid this, constant V/Hz principle is also violated at such frequencies. As the speed increases, the stator voltages must, therefore, be proportionally increased in order to keep the constant ratio of Vs/f.

The following simulation result of SPD control of Induction motor and its operations flow are deeply analyzed and its Boost topology were discussed and its corresponding Inverter out sourcing were proposed as follow in the simulation flow diagrams. In fig.10 deals with Voltage and Current Analysis , fig.11 disused and shows the inverter outsourcing through the PV FED induction motor with Transformer less High Gain boost converter.

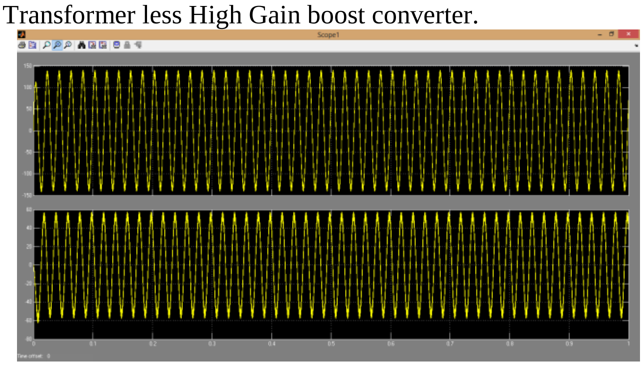


Fig 10.Voltage and Current Analysis

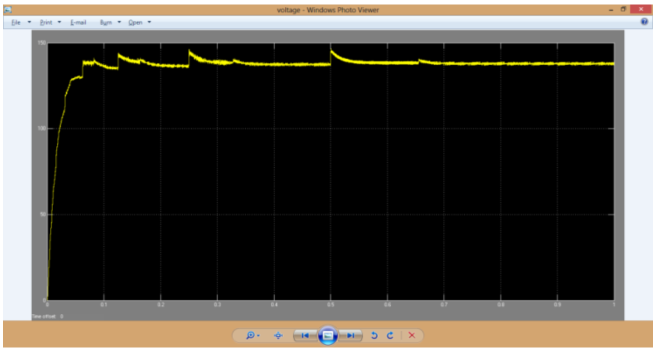


Fig.11.Inverter Outsourcing

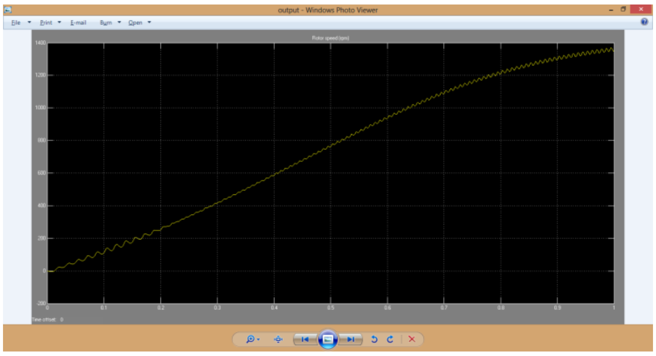


Fig.12.SPD control output of induction motor

VII.CONCLUSION

This paper has proposed a boost dc–dc converter topology with the novel capability of canceling the input current ripple at an arbitrarily preselected duty cycle. This is accomplished without increasing the count of the number of components. In addition, the converter features a high voltage gain without utilizing extreme values of duty cycle or boosting transformers. These features make the converter ideal to process electric power coming from low-voltage power-generating sources, such as renewable. Since we are using V/f control method we can vary voltage and frequency as per requirement of torque and speed. Efficiency can be adjusted with the designed of Induction motor at required torque.

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