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# OPTIMIZING PHOTO VOLTAIC PANEL OUTPUT LEVEL BY USING MICROELECTRONICS AND HYBRID MULTILEVEL INVERTER

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## ABSTRACT

The Main motive Of the article is to improving solar energy conservation and reducing harmonics to make pure sinusoidal wave form to load side by using microelectronic system and maximum power point tracking. in present scenario we are generating electricity in various sources likewise non renewable resources in thermal, nuclear, gas, hydro conversion but above mention resources is making environmental pollution and using heavy mechanical system there for various problem occurring in electricity generating time its one kind of solution for reducing electricity demands. another one resources is renewable energy domain is main art India and other courtiers also. why means renewable energy resources not polluting environmental and also make green city. we got awareness from renewable energy resources but various types contain renewable energy resources family likewise wind energy, solar, thermo conversion, biological conversion, geo thermal etc…so we are taking only for solar energy efficiency improvement. Generally we are know solar energy conversion process. sun energy is contain two parts likewise thermo conversion part another one is thermo radiation part . in current research and development, scientist making smart solar system and also using various technological area. nano technology and embedded technology, etc.. but we are using microelectronic system integrating with power electronics. *microelectronic system purpose is* *to controlling solar PV panel, another one part is using harmonics' reduction and* make pure sinusoidal wave from load side. in our research methodology contain n photo voltaic parts and super capacitor and dc to dc chopper, MPPT, Peripheral interface controller by using version of PIC16F877A, Hybrid multilevel inverter, gate driver circuit ,controller unit .The key Aim Of The scheme Is To make pure sinusoidal wave form supply side. Suggesting research result is will be obtained MAT Lab with FFT Algorithms' and PIC MC embedded with some embedded C coding this result also obtained MPLAB.

**KEYWORDS:** Renewable, PIC MC, Hybrid MLI, MPPT, FFT.

## INTRODUCTION

Solar photovoltaic (PV) is envisioned to be one of the key foundations of the future energy mix. The cost of units has deteriorated sharply over the last span and at the present time PV power generation unit with MW capacity are becoming a norm in many nations. Notwithstanding this cheering tendency, the per-watt cost or interest of PV energy is still substantially Affluent compared to its vestige fuel equivalent. The reason is clear; the share investment of Photo voltaic scheme project in terms of dollar per watt is expressively higher than the latter. There are all embracing research and expansion efforts to maximizing the photo voltaic energy quantity—mostly they are concentrated on improving the performance of pv system and also optimizing output levels of the solar cell effectiveness. However, this approach has its own restriction, primarily due to the physical boundaries of silicon itself. Recently, new and more exotic semiconductor constituents for PV cells are also being practiced, but the present cost of these technologies and development appears to be exorbitant. Accordingly, theyare mostly used in high-end goods, for example for space application purpose. The more cost-effective way to augment the recital of the PV connection is to deliberate the balance of system components, predominantly the power converter (inverter or charger). One possible area of development is to increase the efficiency of the maximum power point tracking (MPPT) algorithm. This is Because the MPPT comprises only of software codes that can be embedded within the power converter firmware, i.e. without an additional cost. The MPPT robotically locates the maximum power point (MPP)—that is the chosen operating voltage or current in order to achieve the maximum outputpower. Additionally, the tracking must be enthusiastic. Biosphere wide Energy Feasting Is Foretold To Rise Substantially there for Many research application using for Electricity. Among The electrical Energy Sources, Wind, geo thermal, biogas, see wave to electrical energy conversion scheme Solar Energy Are In receipt of Higher Curiosity ant interest consequently Their Potential. In current situation or now days, Wind Turbine and solar Systems Are mostly Used In Nations With High Wind Potential, solar photo voltaic system Like Germany, Denmark, Spain, India, UK Etc. Furthermore, advance Development for Large Projects scheme Are Continuing For India, China, japan And Other nations. The Setting up Of photovoltaic scheme Catalogues Also An sustainably increase, With Germany And Japan Foremost The Tilt Of The nations. and also this country Having The Largest amount of Capacity Mounted. Unrestricted availability of the electrical power sources source and there are very most eco-friendly of these scheme are their major recompenses over the outmoded energy sources such as lubricant oil and artificial and nature gas, but their competence and controlling process contain stranded as the major drawbacks and problem for conversion process . In totalling to this, the Conduction System Machinists are striking tough standards at what time both Wind turbine and Photo voltaic scheme are integrating the efficacy grid. Amongst most other electricity demands, power system steadiness and power quality problem are main requests but latterly, ride-through proficiencies for small grid turbulences, in the case of WT and PV systems have to be providing features. As a magnitude, many research and development exertions are put into the computerizing of these systems and in order to improving their behaviour and operation. in particular a few wind rotating panel methodology, virtually all WT and PV schemes are integrating the convenience function for grid through a Pulse width modulation ambitious Voltage Source Inverter. In this situation, the control stratagem of the inverter arrangements deal with the network integration of the distributed system, transmission system. There for the resemblances in hardware, originally the regulator scheme was applied to ambitions uses were also ported to DPGS. Nevertheless, due to more obstructive standard strains for power quality problem, other control scheme and controller methods .have also been explored. One of the most common control scheme applied to DPGS is based on Voltage Concerned with Control retaining a regulator for the dc-link voltage and a controller to regulate the inoculated current into the utility network. Recently, Proportional Resonant (PR) checker engrossed and also increased inquisitiveness due to its bigger behaviours over the outmoded PI regulators, when modifiable sinusoidal signals. Removal of the steady state blunder in single phase systems and reducing harmonics, switching operations. no need for connexion or voltage feed onward and easy fine-tuning stand as its main compensations. As previously tinted, the resonant frequency information is obligatory in their innermost model. This issue may be regarded as a shortcoming problems when executed in a grid tied system, due to frequency variations of the utility grid. This research article , deliberates the improvement of the photo voltaic system efficiency and reducing switching operations for conversion stage also make pure sinusoidal wave form because switching steps increased also increase harmonics level consequently we are integrating grid system there for other system power output also affected voltage, current harmonics from grid. Controller and gate driver circuit used in PIC microcontroller by purpose of reducing switching function and improving or load voltage capacity based photo voltaic panel output controlling function. control system for current order, in the case of network frequency deviations. Since the grid frequency may experience oscillations, it is sensible to use its rate as input in the Pi controller. This research proposes to use the harmonics estimation provided by a feed back loop with help of maximum power point tracking algorithm in order to obtain addictiveness of the regulator in respect to load or grid capacity. A depiction and main physiognomies of the PI controller is initially given. This is followed by the standard demands in respect to load capacity margins for both PV systems. Further on, the control scheme and the suggested solution are labelled. Contemplations about how the PIC MC interfacing system should be embedded are also given. Finally, investigational results authenticate the effectiveness of the suggested solution.

## 2. METHODOLOGY AND MATERIAL

The suggested methodology is for improving photo voltaic system output and make load capacity level based electricity supply is may single phase or three phase. Propped methodology contain various stages likewise signal functioning , signal conditioning etc… also various power electronics conversion stages there are storing unit chopper process, inversion process etc. consequently we are interfacing PIC MC with Maximum power point tracking, gate driver circuit, PI controller. initially we want power supply from PIC MC there for tapping power from switch board this part also contain bridge rectifier, step down transformer, filter circuit IC regulator, why means switch board output is AC but PIC MC only accept DC supply only there for using rectifier, filter is reduced ripple from DC output consequently DC supply flow to PIC microcontroller shown in figure 1. Other particulars are trigger based upon bridge part that means PIC microcontroller. Originally photo voltaic panel receive sunlight energy after the heat energy goes to conduction band and valance band structure . after electricity generation scheme was continuously occur. main note is photo voltaic panel output is variable direct current but we want to load side alternative current there for we are using some power electronics converter. always all research persons suggesting to using square wave inverter by purpose of direct current to alternative current but some problem contain square wave inverter in now days power electronics research suggest pulse width modulation inverter because pulse width modulation inverter output is make approximate sinusoidal wave form also pulse width modulation inverter cost wise very high it may single phase or three phase. there for our convenient we are using dc to dc chopper and hybrid multilevel inverter why means hybrid multilevel inverter have less switching operation, and also we are know dc to dc chopper principle that means variable dc converted fixed direct current. after fixed direct current flow hybrid multilevel inverter. the multilevel inverter made-up MOSFET or IGBT power semiconductor switches based upon single phase or three phase with some mode of operation after the alternative current flow to load. it may passive or active load. load capacity level is embedded with PIC microcontroller also multilevel inverter triggering device gate driver circuit is interfaced PIC microcontroller. also maximum power point tracking help of modify output level of photo voltaic output level.

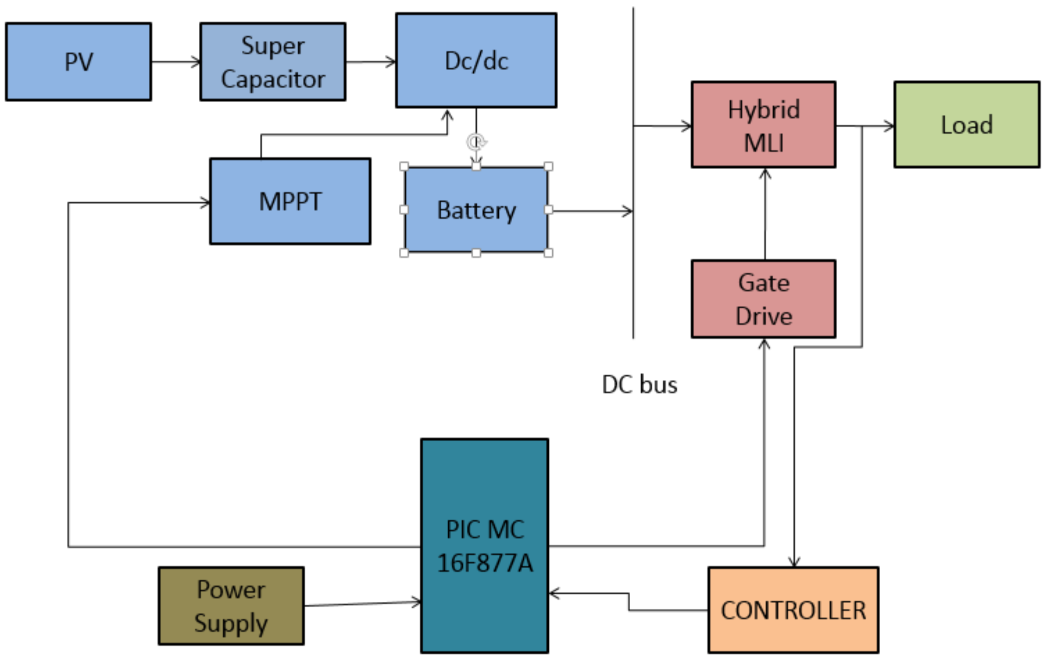



**Figure 1: Typical Block Diagram Optimizing PV cell output, minimizing Harmonics level.**

**3. PIC MC Pin Configuration With Interfacing Line**

PIC Microcontroller Is The Smallest Microcontrollers And Also Have Some Advanced Features That Can Be Programmed To Carry Out A Enormous Range Of Tasks Shown Figure 2. These Microcontrollers Are Found In Many Electronic Devices Such As Phones, Computer Control Systems, Alarm Systems, And Also Various Types Of PIC

Microcontroller Have Various Types Like Wise PIC16, PIC17 But In Our Convenient We Are Using PIC16F877A. Everypic16f77a Microcontroller Architecture Consists Of Some Registers And Stack Where Registers Function As Random Access Memory (RAM) And Stack Saves The Return Addresses. The Main Parts Of PIC Microcontrollers Are RAM, Flash Memory, Timers/Counters, EEPROM, I/O Ports, USART, CCP (Capture/Compare/ PWM Module), SSP, Comparator, ADC (Analog To Digital Converter), PSP (Parallel Slave Port), LCD And ICSP .The 8-Bit PIC Microcontroller Is Divided Into Four Types On The Basis Of Internal Architecture Such As Base Line PIC, Mid-Range PIC, Enhanced Midrange PIC And PIC18.In Our Project We Are Using Various Pins To Connected With External Components Likewise MPPT input Pin Was Connected PICMC RE0, PI controller input PIN During PIC RC4 ,RC5 , RC6 , RC7 ,RC8 Consequently gate driver circuit input pin connected Connected With PIC RB2 , RB3 Shown In Figure3.

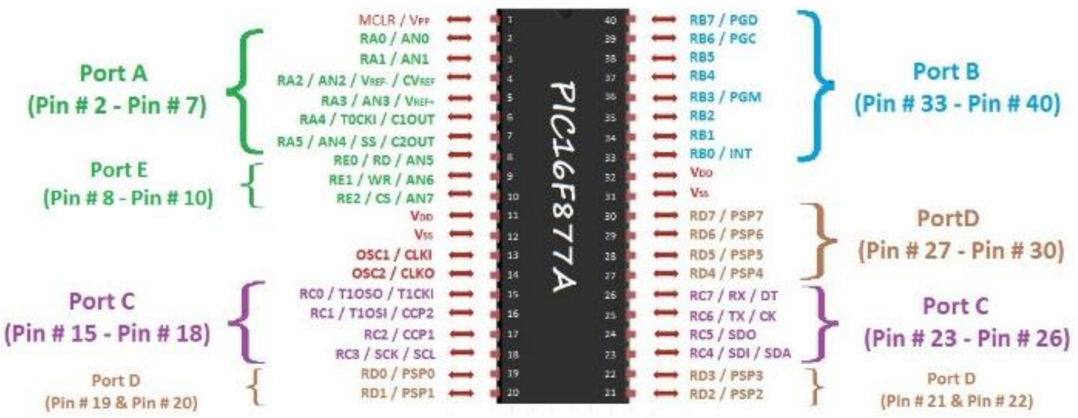



**Figure 2: PICMC Pin Configuration.**

**4. Suggesting Scheme PV output Line**

Modification for solar photo voltaic conventional System. To Implementing solar panel output l direct current and reducing number of switching operation for inverter output level. This Novel Outline Contain Of photo voltaic panel , dc to dc chopper, hybrid multilevel inverter, gate driver circuit, PI controller , maximum power point tracking , super capacitor, battery, PIC micro controller. the PIC micro controller was programed load capacity level that means load voltage level, current level, frequency level there for pic only trigger abnormal condition also control any abnormal condition from DC to DC output level and hybrid multilevel inverter gate driver circuit shown in figure 3. In current research is based upon smart grid there for we want to add additional features for our system likewise GPS receiver or GSM module by purpose of data acquisition and data controlling purpose.

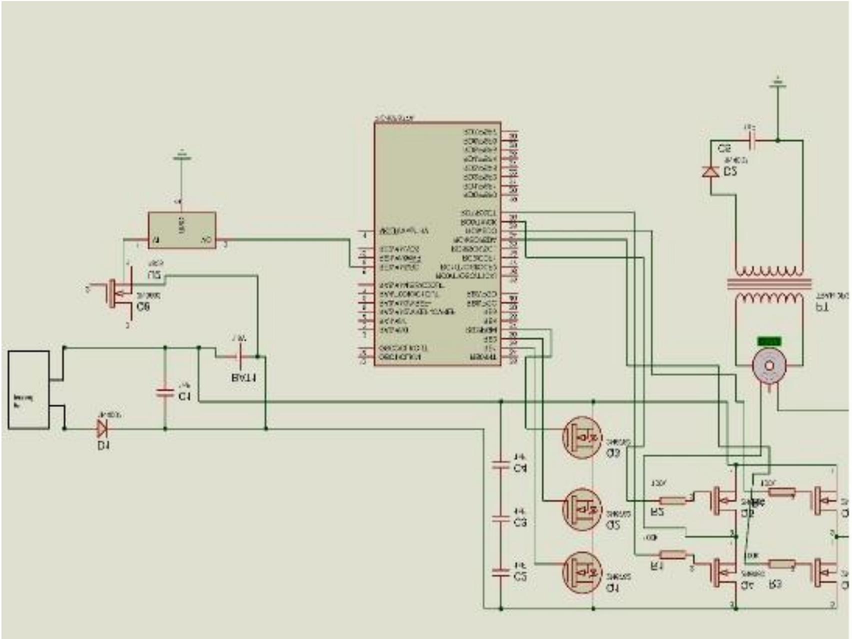


**Figure 3: PICMC With Interfacing External Peripherals.**

### 5. Software Simulation Circuit

After implementation the novel system design and hardware parts chart circuit is drawn in MAT lab simulation. The MAT lab Simulink too simulation circuit works appropriately. When this circuit's all parts element and portions work accurately then this circuit is initiated that is shown below description based Figures. First The simulation circuit of the proposed inverter which comprises 10 IGBT switches and 4 diodes for producing 31-output voltage levels is shown in the figure 5.1. To place the IGBT switches, select the power electronics block from the power system block. Connect the pulse generators to the gate terminal of each IGBT. Four electrical sources are chosen from electrical source block and each value are asymmetric and the diodes are taken from the power electronic component in the simpowersystem. The electrical sources are connecting in series with the IGBT and the diodes are connected in parallel with the sources. Then the series parallel connections are fed to the H-bridge inverter and the load is connected to the H-bridge inverter. From the voltage waveform given below we identified that the peak voltage of 75V is achieved. The peak voltage value is the sum of all four voltage source (5V+10V+20V+40V). The waveform has 31-levels in both positive and in negative side with zero as common, which occurs twice per cycle. The figure 6 .1 shows the single phase voltage waveform of the proposed hybrid multilevel inverter. Consequently we simulating three phase system inverter with induction motor load. The induction motor is taken as load for inverter from the electrical machines block in the simpower system. Since the phase displacement blocks are connected to each output of the single phase inverter to produce the proper phase delay between the each phase it is shown in the figure 5.2. To analyze various parameters like voltage waveform, current waveform, rotor speed and the electromagnetic torque of the induction motor scope is used. The output current waveform is used to analysis THD, which is select from powerful, then FFT analysis in which the signals are selected for the analysis and the THD will used to get displayed in FFT window. The proper switching sequence refer result and discussion table. Should be provided to the IGBT, the pulse generator is used to produce the reference pulse AND, NOT logic is used to produce the pulse for switches. For H-bridge inverter also AND, NOT logic is used. This method is simple and easy to adapt which are taken from the commonly used bloc.

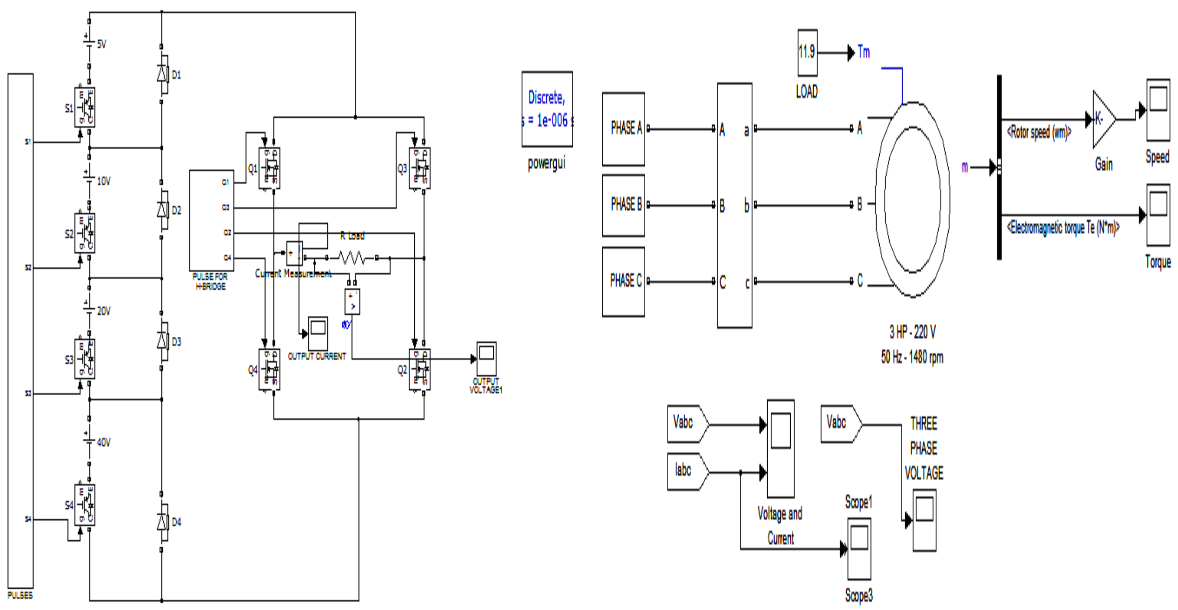



**Figure 5.1 & 5.2: Simulink model for single phase system and three phase system.**

### 5.1 Simulation Parameters

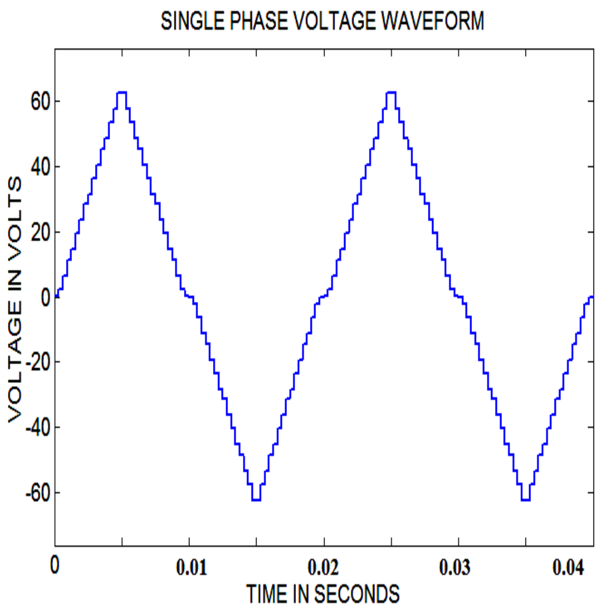
The following parameter are selected according to the induction motor specifications Electrical source

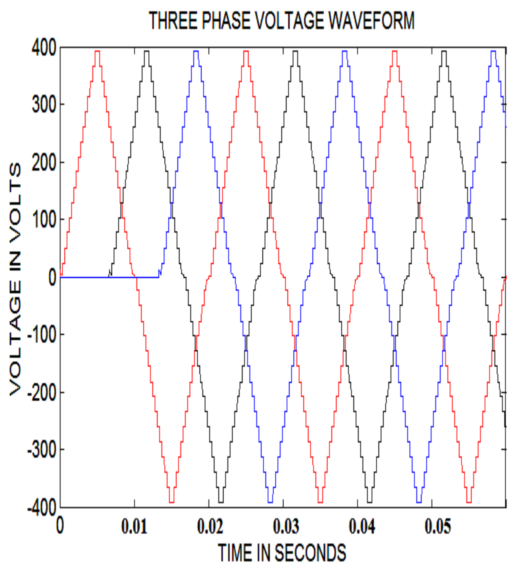
$V_1 = 26.55V$,, v2=52.5v, v3 = 105v, v4= 210 Motor Type: Induction motor, Number of Phase: 3-phase,

Stator resistance Rs =0.435 ohms, Rotor resistance Rr=0.816 ohms, Frequency=50 Hz, 3 HP, 220V.

## 6. RESULTS AND DISCUSSION

The Results Which Are Obtained From Software And The Hardware Work Done Are Discussed Below- The Program Which Is Obtained From MAT lab with Simulink tools Is Divided Into Various Parts Shown In Figure 6 parts. The computer simulation for the new topology of hybrid multilevel inverter has been done by using the MATLAB/SIMULINK. The output waveform has 31-levels in the positive side and 31-levels in the negative side and a zero level. This voltage levels are achieved with the help of four unequal voltage sources. The positive and negative waveforms are produced with the help of H-bridge inverter. The fig 6.2 shows the 31-level inverter output voltage waveform for peak voltage of 400V. Induction motor is connected as a load. The output waveform has 31-levels in both positive and negative half cycle that include zero level that occur twice in a cycle. It can be archived by connecting three separate single-phase and the phase delay is given with the help of phase delay block. The Fig 6.3 shows the current waveform for three-phase inverter. From the curve we found that initially the current taken by the motor is high after a certain time it reaches the steady state. The current taken by the motor at steady state is 25A. The fig6.4 shows the electromagnetic torque of the induction motor. Initially the starting torque of the induction motor is very high up to 200Nm. Then in the steady state it reaches up to 20 Nm and maintain as a constant. Since the motor is connected to constant full load. The fig 6.5 shows the rotor speed of the induction motor. It is observed in the graph the rotor speed of motor is 1480rpm under steady state. Since the motor is fully loaded and does not have any oscillation in the load.



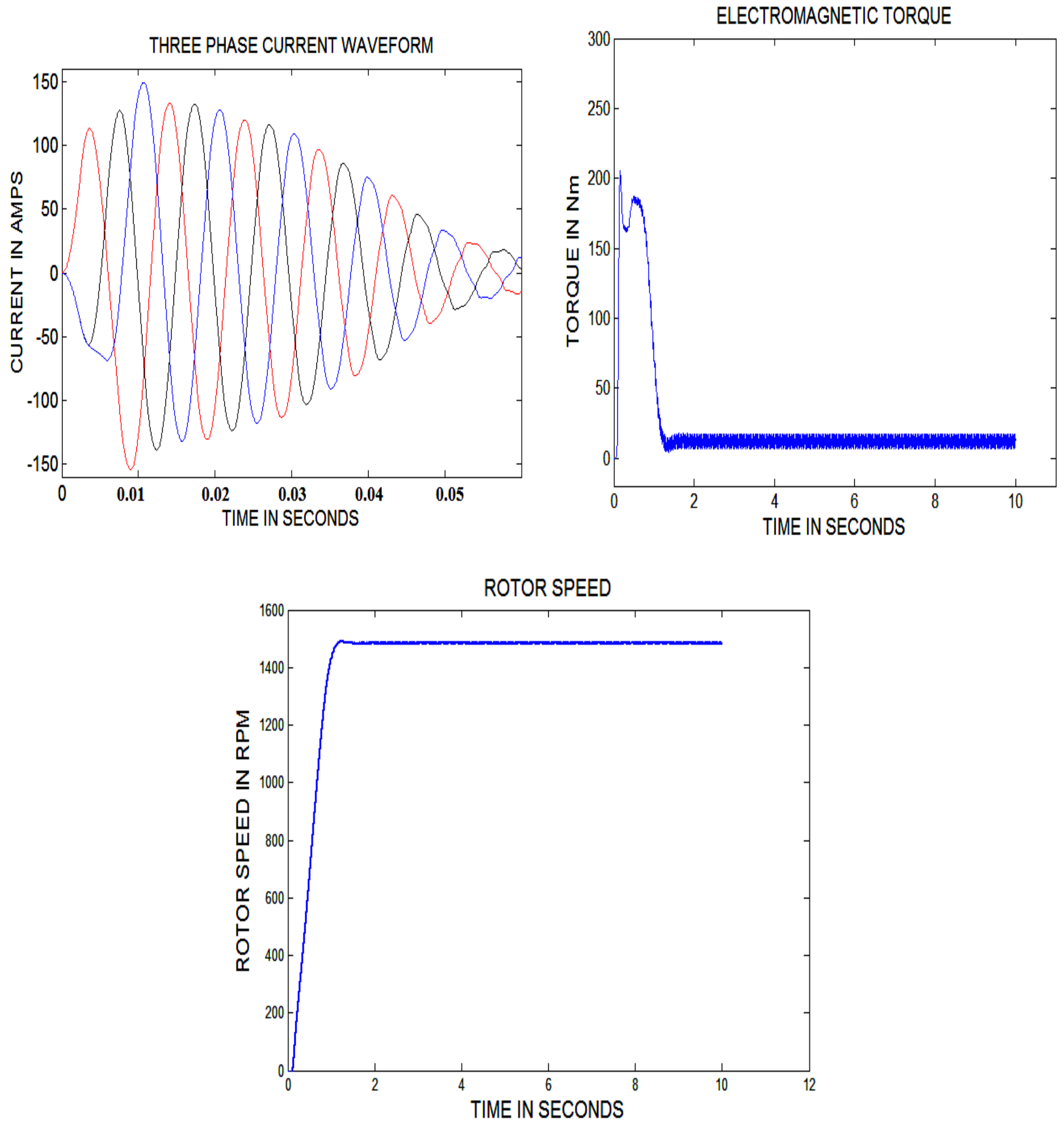



**Figure 6.1, 6.2, 6.3, 6.4, 6.5: Single phase voltage, three phase voltage, current, electromagnetic torque, rotor speed of motor.**

The output of the hybrid multilevel inverter is connected to the three-phase induction motor. This circuit is simulated in the MATLAB software and the output current waveform is analyzed for THD using FFT method. Here 50 cycles of load current are taken as a sample for FFT analysis. The maximum frequency of 150Hz is taken as a limit for clear visibility of the harmonic spectrum. The fig 7.1 shows the harmonic spectrum obtained from FFT analysis for conventional CHB inverter From the Fig 4.8 we identified that the amount of harmonics present in the output and the THD is found to be 13.15%. The fig 4.9 shows harmonic spectrum for proposed method and the harmonic content is found apparently low 1.99% compare to the conventional method which satisfies IEEE standards.

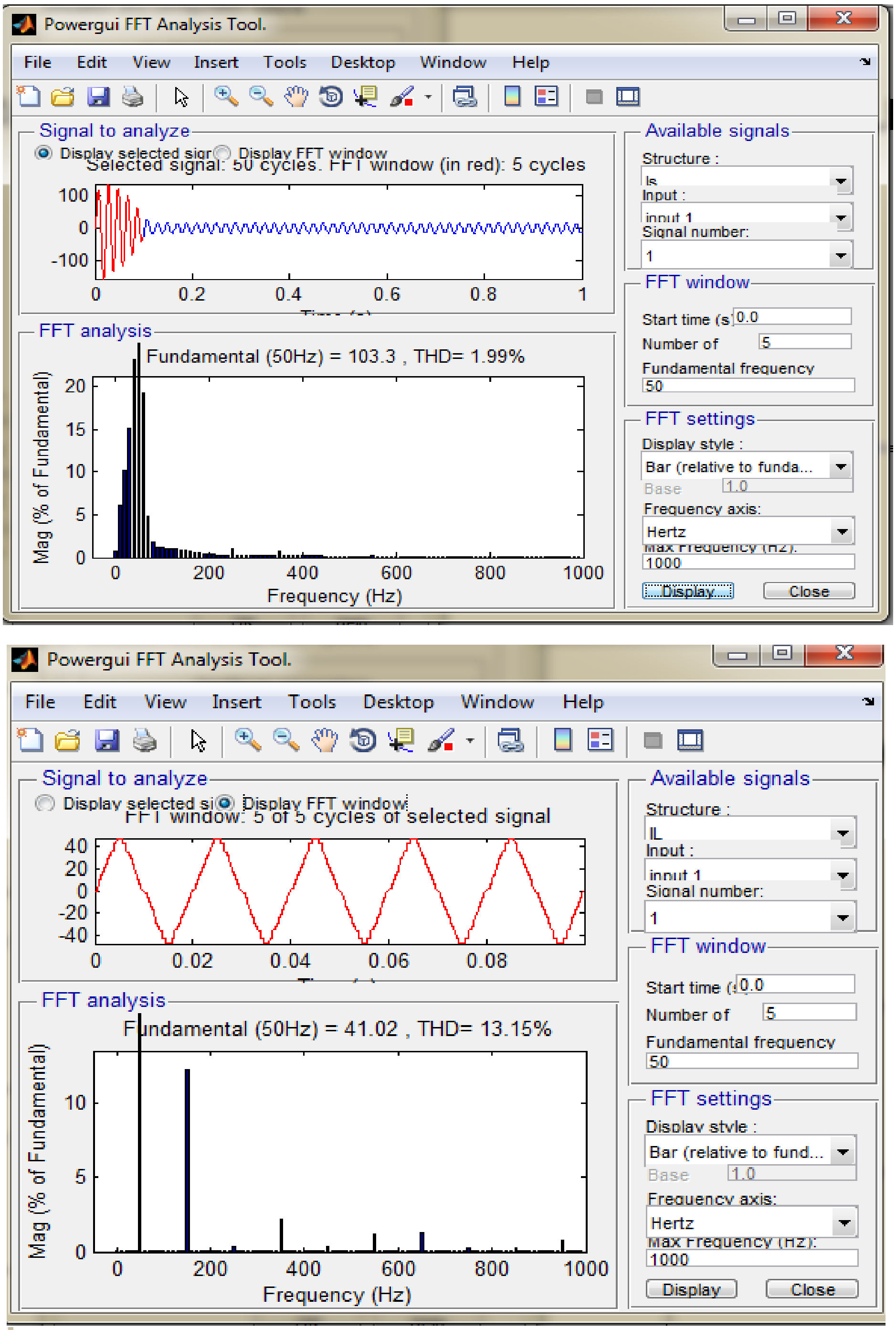



**Figure 7.1 & 7.2: FFT analysis for conventional method and proposed method.**

In this proposed inverter switching pulse is given to each IGBT by pulse generator. The fig 8 shows the simulation model of proposed modulation technique. Since the switch S1 is most frequently operated nearly 16 times per half cycle. The switching frequency of the switch S1 is about 1600Hz. Hence IGBT are selected as power switches due to its high switching frequency nearly 40 KHz. Since the proposed hybrid multilevel inverter is employed with open loop control, the pulse generator is directly used to produce switching pulse to the device. For both bye pass diode technique and common H-bridge technique pulse generator are used. Both the operations are independent to each other. By producing correct triggering pulse to the switch, the switching losses can be minimized.

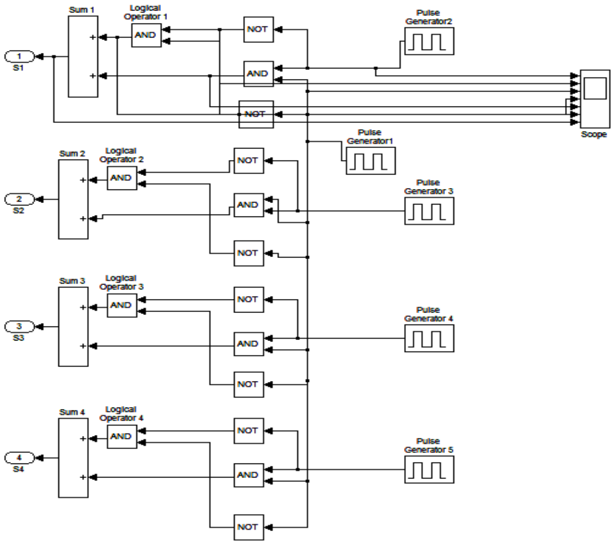



**Figure 8: Simulink Model of Switching pulse generator.**

The pulse generator 1 is used to generate the reference pulse in sample based and the width of the pulse is 50%, amplitude is 1 and the period of pulse is 0.01. The pulse generator 1 is taken as a reference for all switches S1, S2, S3, and S4. The fig 9 shows the pulse generator pulse waveform.

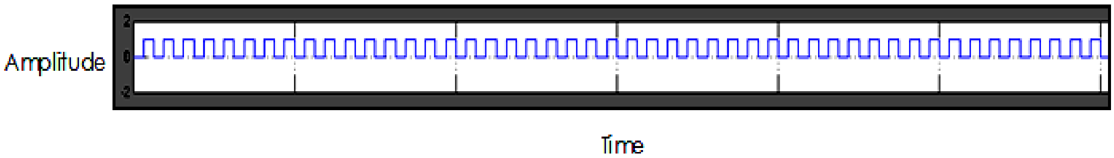



**Figure 9.1: Pulse Generator Waveform.**

The pulse generator 2 is used to generate switching pulse for switch S1. The amplitude of the pulse is 1 and the conduction period is 50%, time period is (1/1600). The fig 9.2 shows the switching pulse for S1.

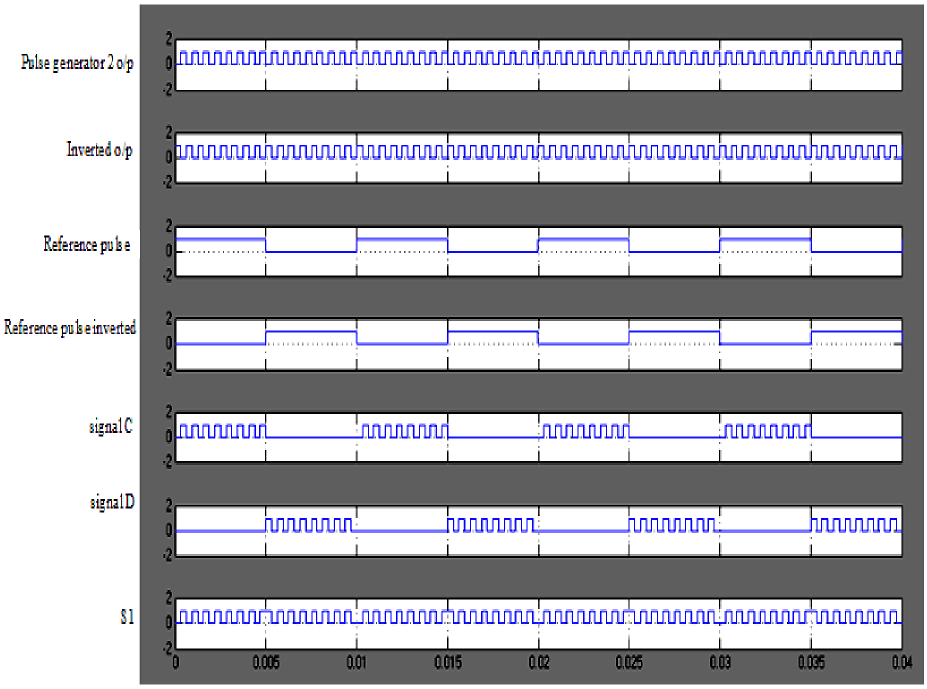



**Figure 9.2 Switching pulse for switch S1**.

The pulse generator 3 is used to generate switching pulse for switch S2. The amplitude of the pulse is 1 and the conduction period is 50%, time period is (1/800). The fig 9.3 shows the switching pulse for S2. The pulse generator 4 is used to generate switching pulse for switch S3. The amplitude of the pulse is 1 and the conduction period is 50%, time period is (1/400). The fig 9 .4 shows the switching pulse for S3.

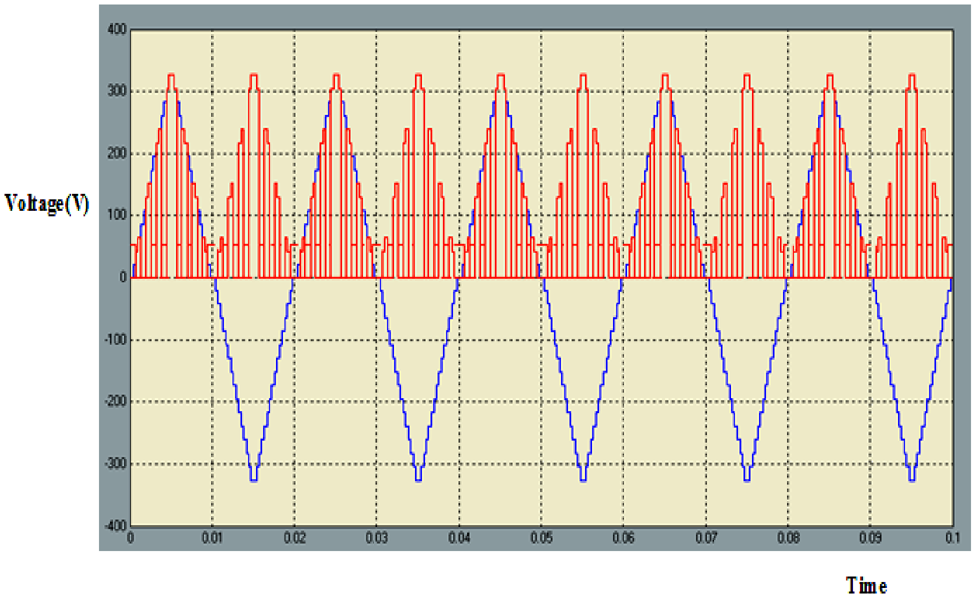



**Figure 9.3: Switching pulse for switch S2.**

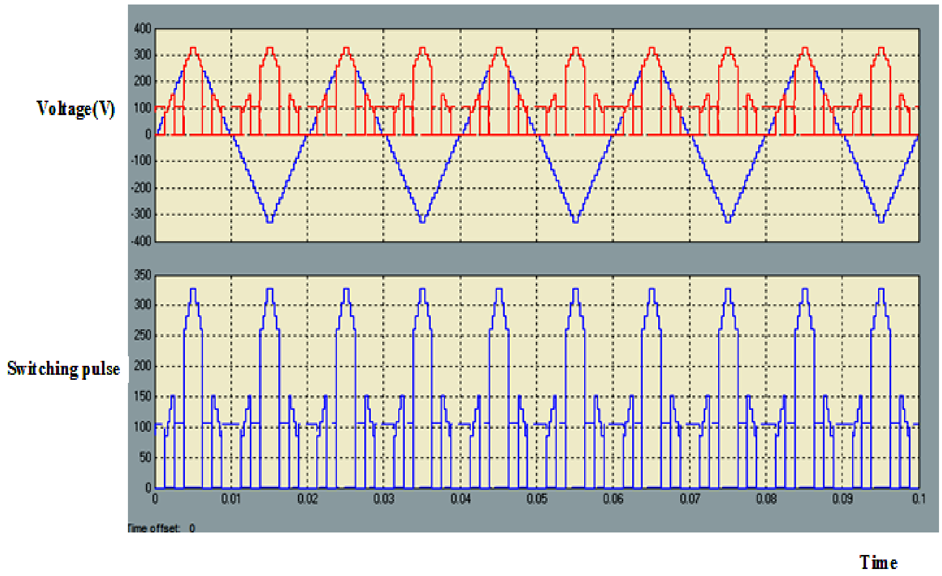



**Figure 9.4: Switching pulse for switch S3.**

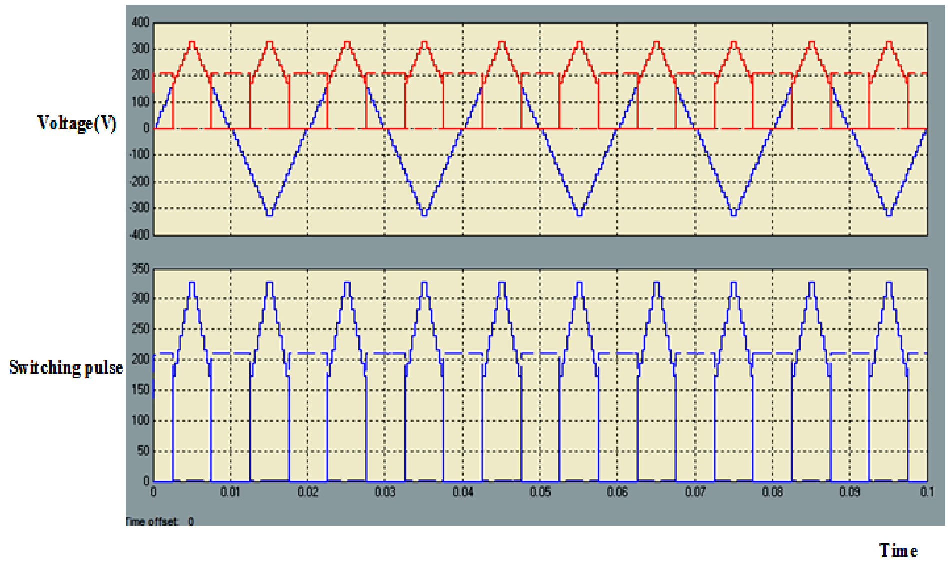



**Figure 9.5: Switching pulse for switch S4.**

The pulse generator 5 is used to generate switching pulse for switch S4. The amplitude of the pulse is 1 and the conduction period is 50%, time period is (1/200). The fig 9.5 shows the switching pulse for S4.Since the main inverter circuit is used to produce stair case voltage waveform only in positive half cycle so H-bridge circuit is used to produce both positive and negative sine waveform. Fig 10.1 shows the H-bridge inverter circuit. One switch in the upper leg and one switch in the lower leg will conduct same leg switches are does not get conduct at same time to avoid the short circuit and damage of the switches. Figure 10.2 shows Pulse For H-Bridge Inverter.

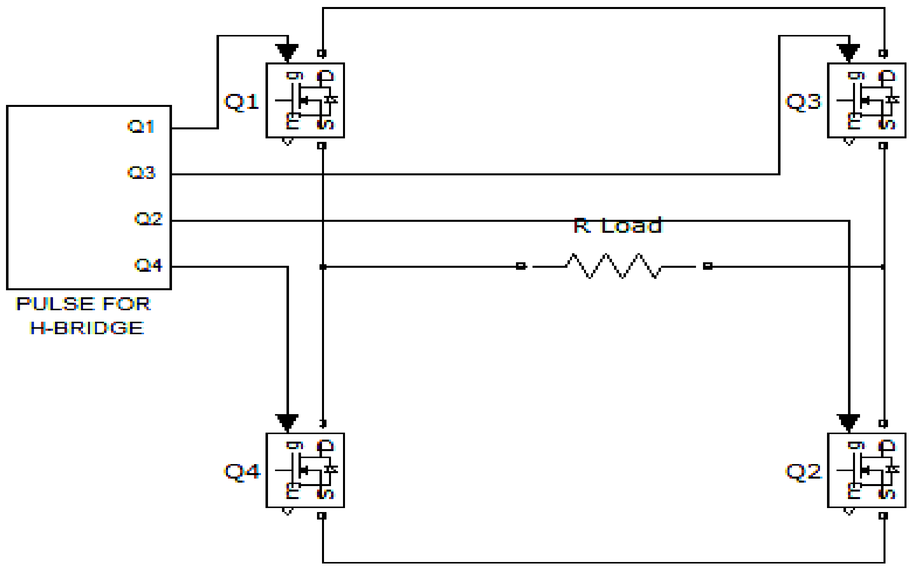



**Figure 10.1: H-Bridge inverter Circuit.**

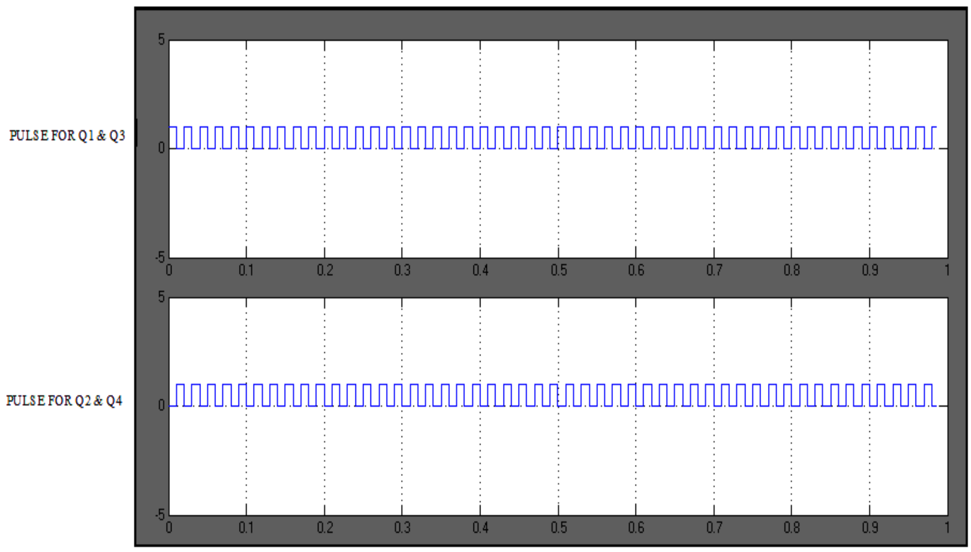



**Figure 10.2: Pulse For H-Bridge Inverter.**

The proposed hybrid multilevel inverter is compared with series parallel switched multilevel DC link inverter topology and new dual bridge multilevel DC-link inverter topology with some of key factors that affect the inverter operations. The important key factors like switching device bye pass diode, clamping diodes, DC split capacitors, DC source, output voltage levels THD are taken into account. The comparison results are shown in following table 1.

**Table 1: Comparison for proposal scheme.**

| Key Factors | Series Parallel Switched Mli | Dual Bridge Mli | Proposed Hybrid Mli |
|---|---|---|---|
| Switching Device | 10 | 10 | 8 |
| Bypase Diode | 1 | 2 | 4 |
| Clamping Diode | - | - | - |
| Dc split Capacitor | - | - | - |
| Dc Source | 3 | 3 | 4 |
| Voltage Levels | 15 | 15 | 31 |
| Thd | 8.28% | 8.18% | 5.66% |

From the above harmonic comparison table, we observe that the percentage of THD present in output of proposed inverter is low than the conventional method. These results indicate that the proposed inverter can be utilized for sensitive load and for standalone inverter operation. And also shown in figure 11 prototype model for hybrid multilevel inverter.

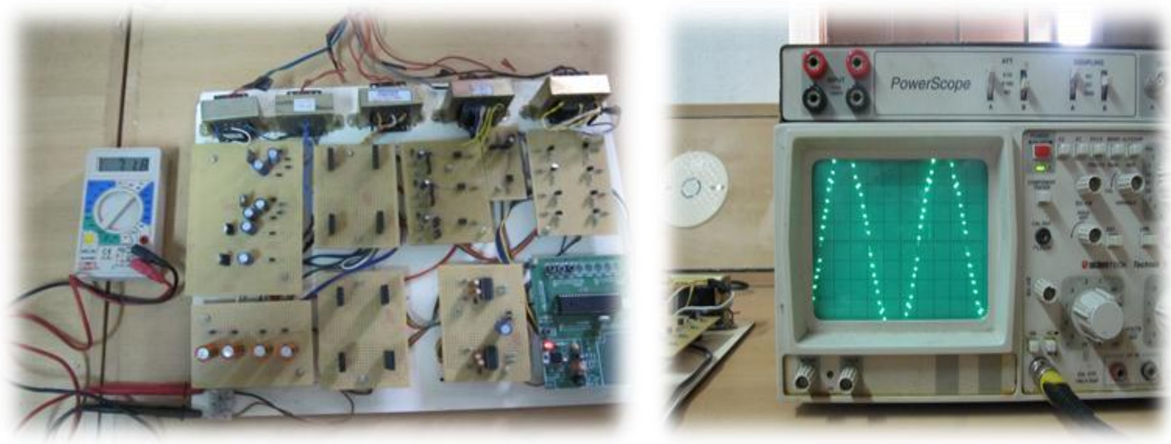



**Figure 11: Prototype Of Hybrid Multilevel Inverter and output voltage wave form.**

Hybrid Multilevel inverters offer enhanced output waveforms and lower Total harmonics distortion. This project presents a new topology of hybrid multilevel inverter with reduced number of switches. A bypass diode technique is introduced to the conventional H-bridge multilevel inverter topology which reduces the number of controlled switches in the system. Only one H-bridge is required for the single phase system, plus a switch and a diode for each voltage source. Due to involvement of high number of switches in the conventional method the harmonics, switching losses, cost and the total harmonics distortion are increased. This proposed topology increases the output voltage level with less number of switches. It dramatically reduces the switches for high number of levels that in turn reduces the switching losses; cost and low order harmonics and thus effectively improves Total harmonics distortion reduction To verify proposed hybrid multilevel inverter concept both simulation model and hardware prototype is developed and tested. Obtained from both the methods are analyzed. And the comparative study is made between hardware and simulation results a negligible deviation is observed between them.

## 7. CONCLUSION

This Paper Presents An improving solar photo voltaic panel output level and minimizing harmonic order from supply line. The major scope of the future work is hardware implementation of high power 31-level voltage source inverter for domestic home UPS. This system can be used for home UPS due to its nearby output sine waveform and less harmonic content. Since conventional home UPS inverter efficiency is only about 40%. The hybrid inverter use only less number of power switches so the inverter efficiency will be certainly high. The main applications of hybrid inverter are given below air conditioner, standalone inverter. This project secondary aim is to make pollution free nations developing the smart city.

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