International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8, Issue-1, May 2019

Implementation of Multilevel Inverter for Controlling Induction Motor

Sindhuja.S, Abirami.P, Pushpavalli.M, Sivagami.P

Abstract*: *Multilevel inverters hold appealing highlights and its utilized as a part of extensive variety of applications. The utilization of more switches in the ordinary design represents a confinement to its wide range application. In this paper new multilevel converter has been proposed. The seven level inverter output has been accomplished by altering customary topology of five level inverter and inverter configuration primarily engaged to diminish the aggregate harmonic distortion of the output to improve the performance of the framework. switching loss highly decreased by diminishing the quantity of the switches utilized. the number of levels has been increased. Along these lines, a restored 7-level multilevel inverter topology is presented incorporating minimal number of unidirectional switches, gate trigger circuitry, decreasing size and establishment cost. Energy created at the time of braking is additionally used efficiently by regenerative braking.

Index Terms*: *multilevel inverter, PID control, Induction motor.

I. INTRODUCTION

Multilevel inverters keep on in consideration as a result of their high voltage operation ability, very less loss in switching, good efficiency and less EMI. Nabae et al (1981) presented the term multilevel [1]. Multilevel inverters are well used in control applications, as multilevel inverters can meet the expanding interest of power quality related with diminished Loss in power and lower EMI. The most appealing highlights of a multilevel inverter are, high output voltage, low distortion, dv/dt value is low, switching frequency is minimum, small common mode voltage generation is possible. There are various principle sorts of multilevel inverters: diode- clamped, flying capacitor, cascade H- bridge inverter, Hybrid multilevel inverter [2-4].

Figure 1 represents the block of proposed inverter system. The Input AC supply is given to the step down transformer. Rectified DC voltage is given to inverter to drive the AC motor. The AC motor connected through the inverter circuit block. Speed sensor is used to sense the motor Speed. The Speed sensing block output is given to the Micro controller.

The Micro controller analyses the feedback signal and reference signal. After the analyzing the condition the desire signal is send to the Gate driver block. Gate driver will Amplify the controller signal and send to the inverter.

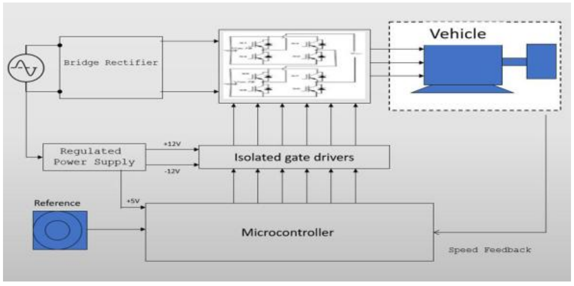

Fig .1: Complete block diagram of the system.

It also isolates the inverter and control block. The Microcontroller analyses the feedback signal and reference signal to maintain the speed of the motor. Number of switches will be reduced by unique switching logic.

II. OPERATING MODES OF PROPOSED INVERTER

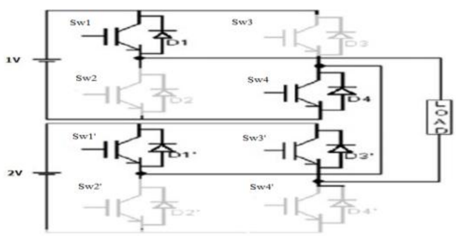

Fig. 2.1: Operating mode 1

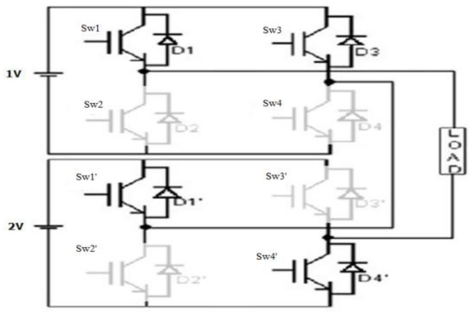

Fig. 2.2: Operating mode 2

Revised Manuscript Received on 30 May 2019.

***** Correspondence Author

Sindhuja.S*, Assistant professor, Department of EIE, Sathyabama Institute of Science and Technology, Chennai, India.

Abirami.P, Assistant professor, Department of EEE, Sathyabama Institute of Science and Technology, Chennai, India.

Pushpavalli.M, Assistant professor, Department of EEE, Sathyabama Institute of Science and Technology, Chennai, India.

Sivagami.P, Assistant professor, Department of EEE, Sathyabama Institute of Science and Technology, Chennai, India.

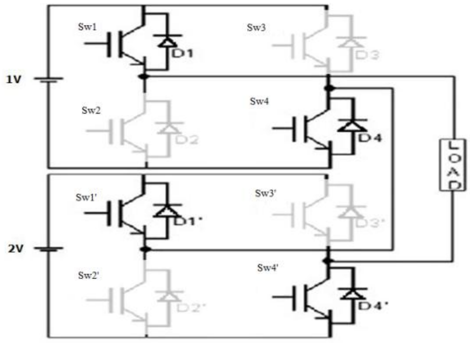

Fig. 2.3: Operating mode 3

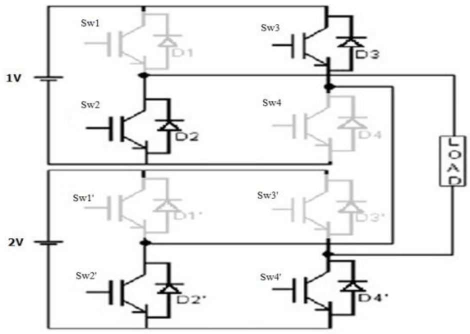

Fig. 2.4: Operating mode 4

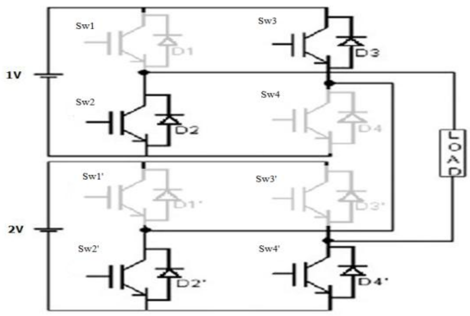

Fig 2.5: Operating mode 5

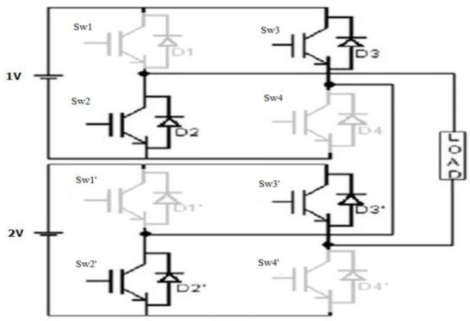

Fig 2.6: Operating mode 6

Figure 2.1 represents the first operation mode of inverter. It shows that 1voltage is applied to the first level of inverter. The switches Sw1, Sw4, Sw1' and Sw3' are active and it forms a close loop. Figure 2.2 represents the second operating mode the input of 2 voltages is applied which makes the switches Sw1, Sw3, Sw1' and Sw4' are active. Figure 2.3 represents the third operating mode, the switches Sw1, Sw4, Sw1', Sw4' are active where other switches are inactive. Figure 2.4 represents the circuit diagram for the operating mode 4, when a negative voltage of -1V is applied. Here the switches Sw2, Sw3, Sw2' and Sw4' are active. Figure 2.5 shows the circuit diagram for the operating mode 5, here the switches Sw2, Sw3, Sw2' and Sw4' are active. Figure 2.6 shows the circuit diagram for the operating mode 6, when a negative voltage of -3V is applied. Here Sw2, Sw3, Sw2' and Sw3' are active.

III. SIMULATION PERFORMANCE ANALYSIS

The simulation has been done using MATLAB. Figure 3.1 represents matlab simulation circuit of the multilevel inverter topology. Each MOSFET has been pulsed by the pulse generator. A resistor load is connected to the circuit and figure 3.2 represents the output of proposed inverter. Input of 50 voltages is applied to first level and output of 150 voltages is obtained. The FFT analysis for both 5 level and 7 level multilevel inverter has been done and compared.

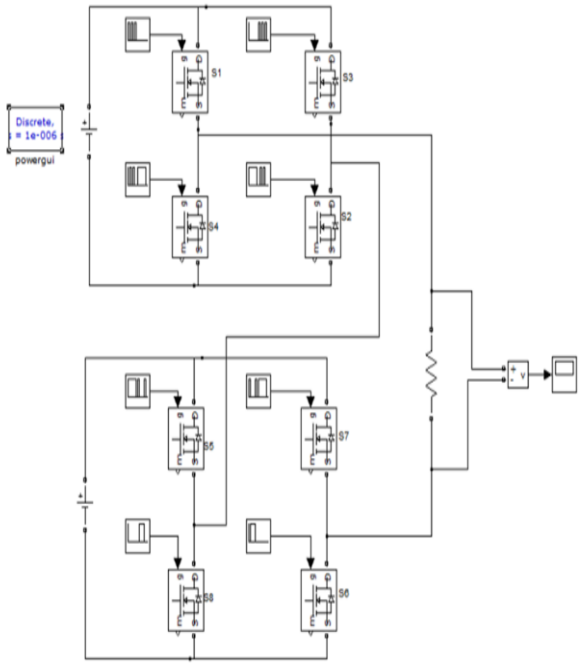

Fig. 3.1: Proposed multilevel inverter with unequal voltage.

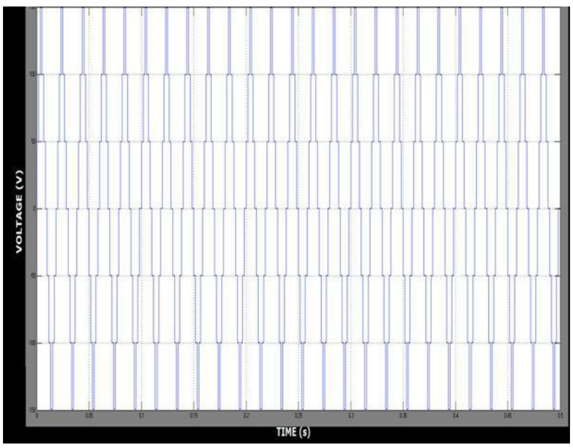

Fig 3.2: Output of proposed inverter circuit.

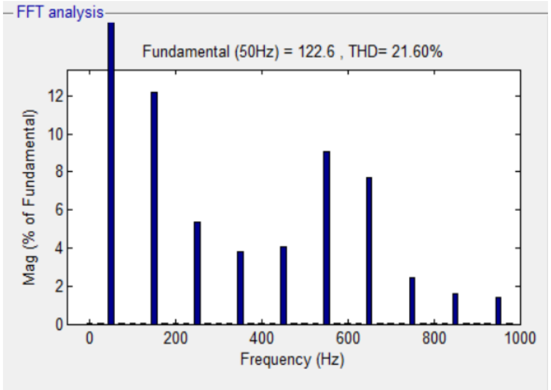

Fig 3.3: FFT analysis of the inverter.

The inverter consists of 2 bridges and produces seven level line-line voltage. The induction motor responses can be controlled by the proposed multilevel inverter; the simulation results are shown in figure 3.4 to fig 3.8. In the figure 3.4 the open loop simulation of the proposed inverter is shown.

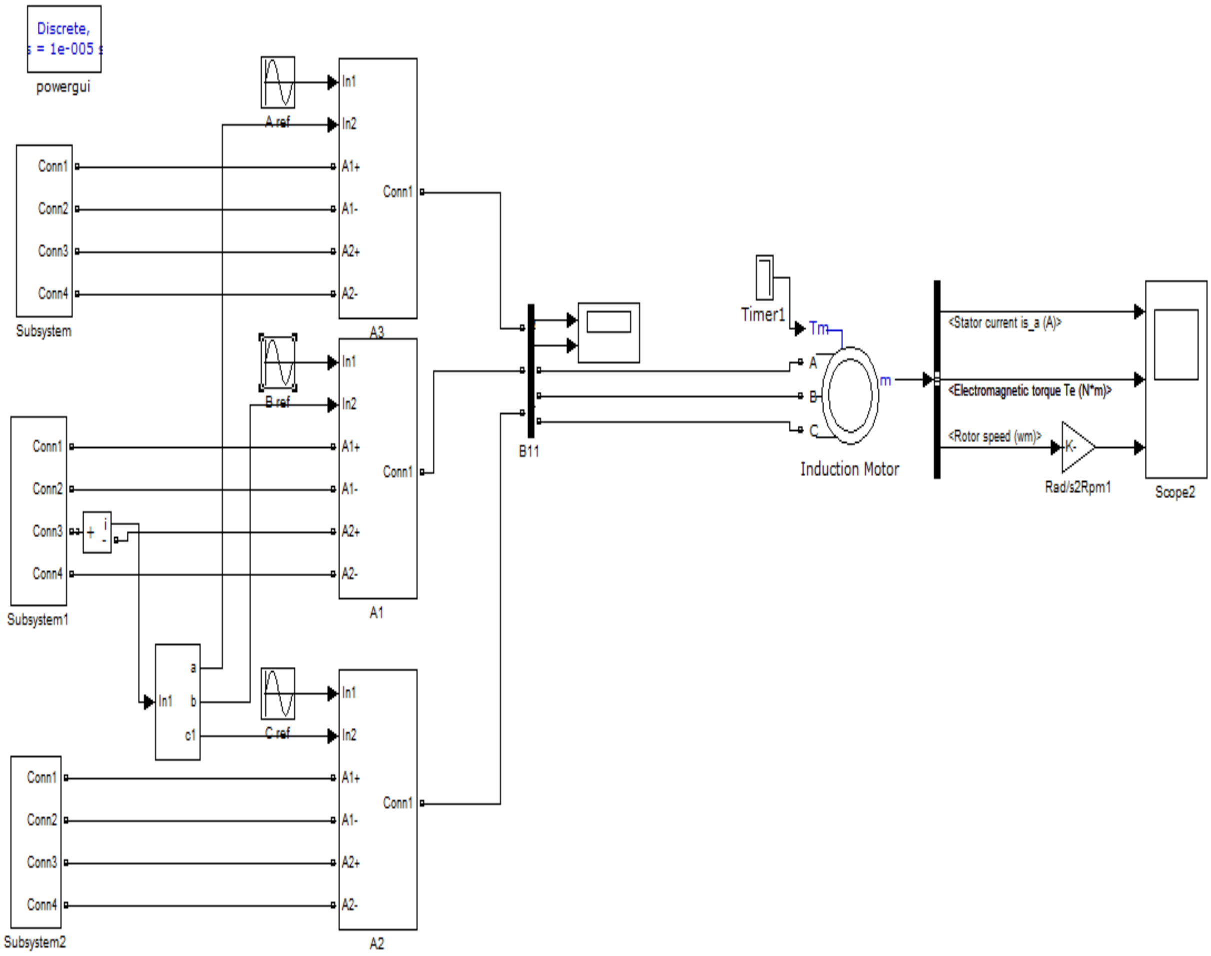

Fig 3.4: Simulation of The Open Loop System.

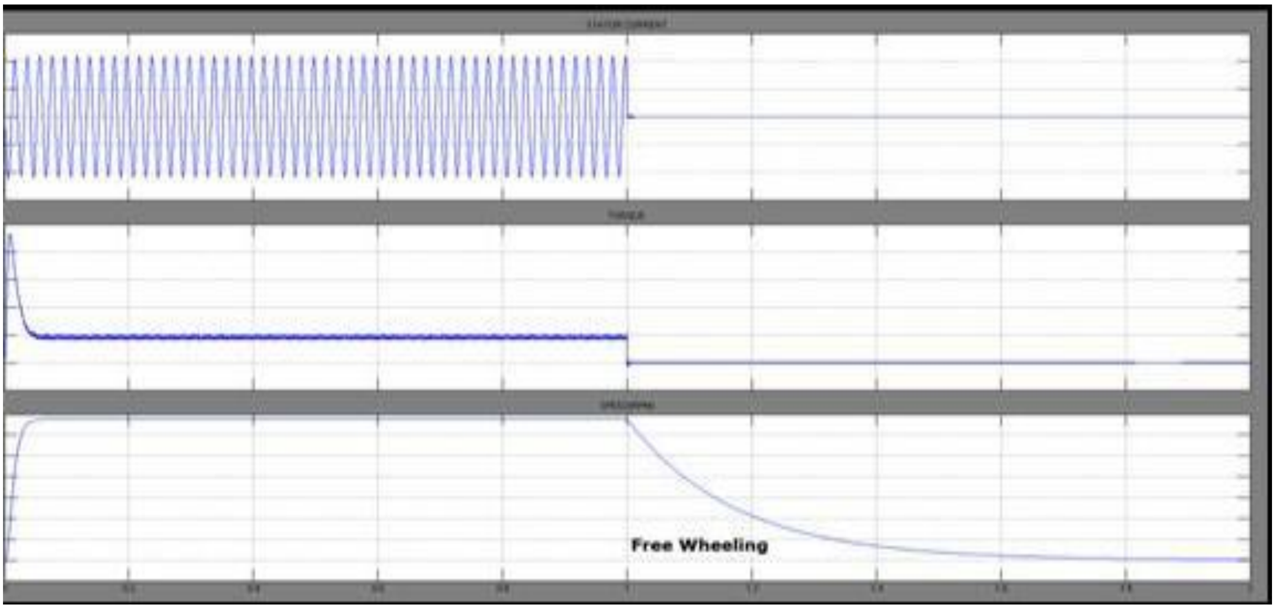

Fig 3.5: Output of Open Loop System

.

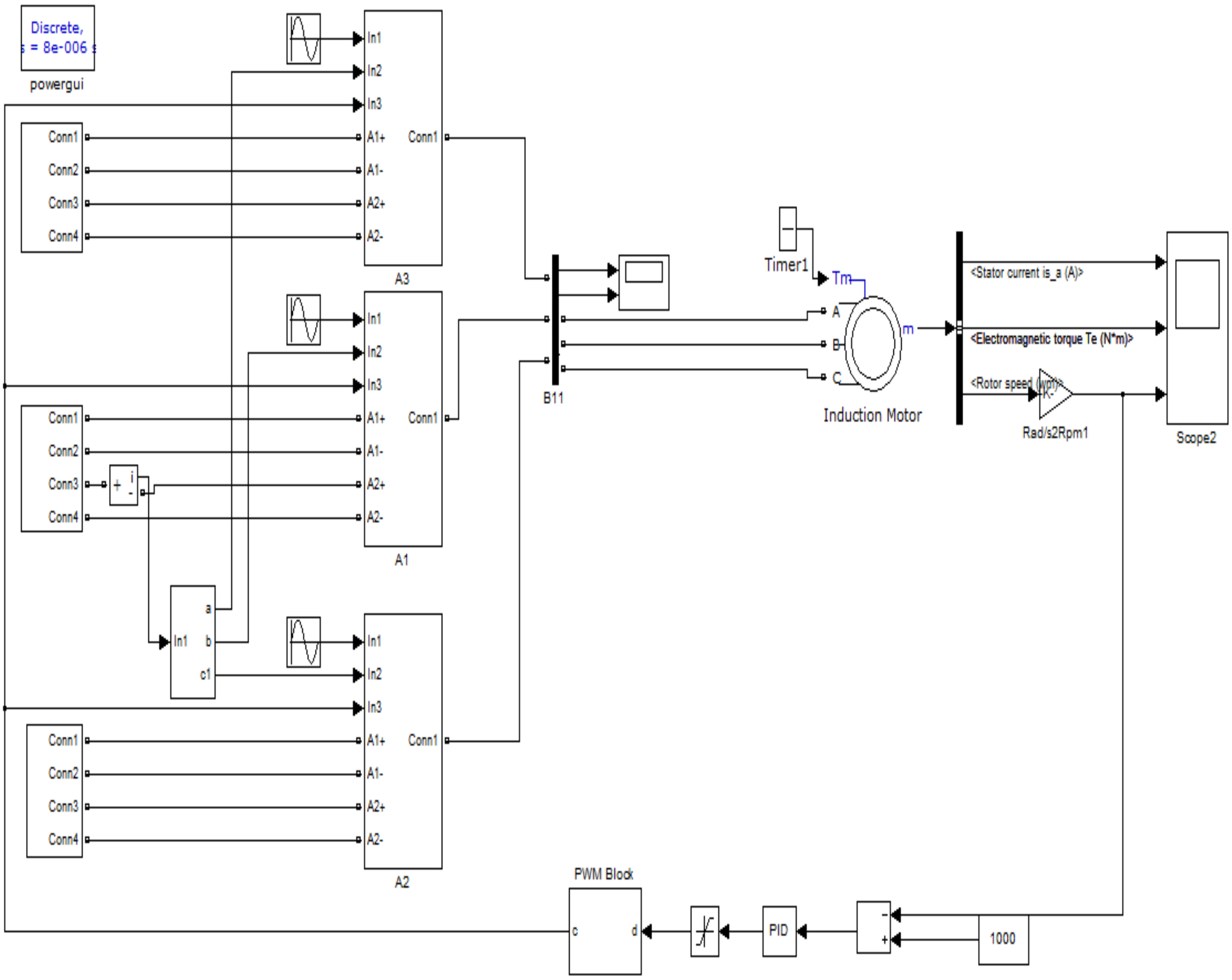

Fig. 3.6: PID based Speed control of Induction motor using multilevel inverter.

International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8, Issue-1, May 2019

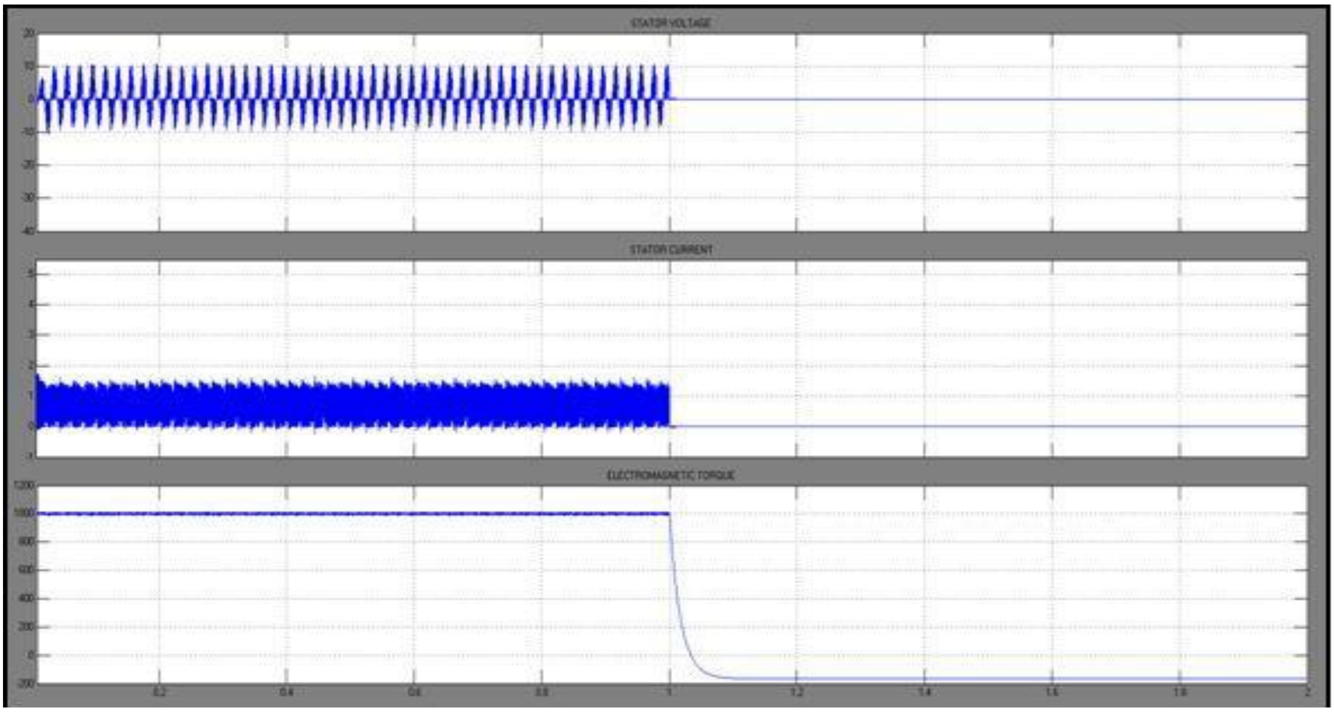

Fig. 3.7: Output of Closed Loop System

Figure 3.6 shows the simulation of proposed inverter using PID controller to control the speed of the motor. The performance of the motor is measured by considering the electromagnetic torque and the rotor speed. The figure 3.7 shows the output of the closed loop system, here the freewheeling of the motor has been stored which in used as an input for the system and the stator voltage, stator current and electromagnetic torque has been shown.

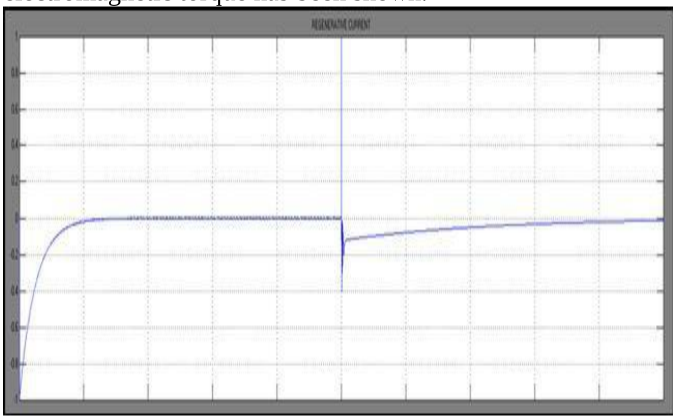

Fig 3.8: Regenerative Current

The figure 3.8 shows the graph of the regenerative current, this regenerative current is generated from the freewheeling of the motor, and this energy is stored for the future use.

IV. HARDWARE IMPLEMENTATION

The proposed inverter hardware implementation is shown in figure 4.1, which we have shown with reference with real time demonstration. AC supply from the transformer is given to rectifier and the rectified DC signal is fed into inverter circuit. Tap transformer give required supply to RPS drive the isolate gate drivers. The output of microcontroller is fed into isolate gate driver which strengthen the signal and supplies to the inverter. The desired output of 30 voltage is measured across the resistor load.

Fig 4.1: Proposed Inverter hardware circuit

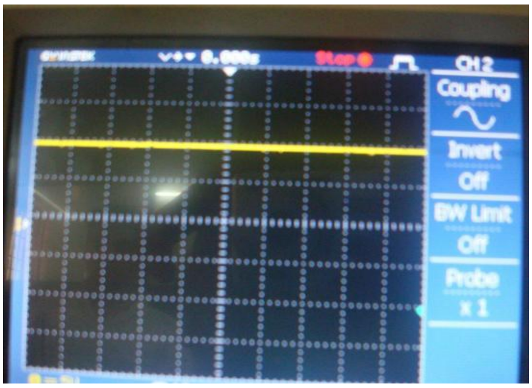

Fig 4.2: Input to First Level of Multilevel Inverter

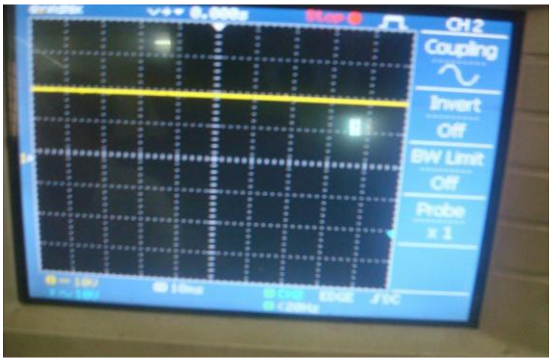

Fig. 4.3: Input to Next level of Multilevel inverter.

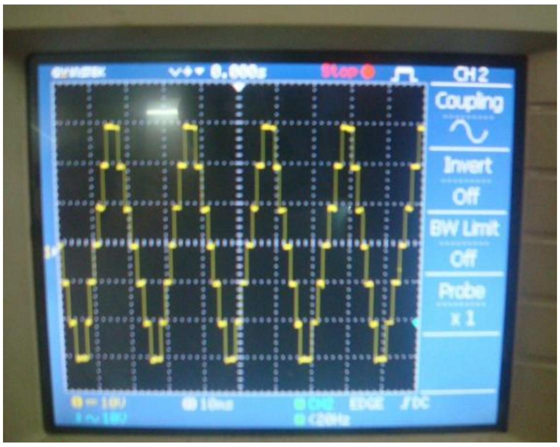

Fig 4.4: Output of the Proposed Inverter.

V. CONCLUSION

The modified inverter provides seven level output using unequal voltage at input side. Thereby, reducing the number of components used. the designed new switching logic to get the desired output with reduced THD. Proposed inverter has special features: unique switching logic, reduced number of switches which results in reducing the switching loss, total harmonic distortion is reduced significantly. Regenerative braking is also simulated. For the proposed system closed loop control with PID controller is efficient and cost effective. An experimental laboratory prototype has been built in order to validate the proposed technique. Experimental results confirm the accuracy of proposed technique.

REFERENCES

1. Nabae. A et al., " A new neutral-point clamped pwm inverter." IEEE transactions on industrial applications, Vol.IA-17, no.5, pp.518-523. 1981.
2. F. Ma, Z. He, Q. Xu, A. Luo, L. Zhou, M. Li, "Multilevel power conditioner and its model predictive control for railway traction system", *IEEE Trans. Ind. Electron.*, vol. 63, no. 11, Nov. 2016.
3. Y. Cheng, C. Qian, M. L. Crow, S. Pekarek, and S. Atcitty, "A comparison of diode-clamped and cascaded multilevel converters for a STATCOM with energy storage", IEEE Trans. Ind. Electron., vol. 53, no. 5, pp. 1512– 1521, Oct. 2006.
4. J. Rodriguez, S. Bernet, B. Wu, J. O. Pontt, and S. Kouro, "Multilevel voltage-source-converter topologies for industrial medium-voltage drives", IEEE Trans. Ind. Electron., vol. 54, no. 6, pp. 2930– 2945, Dec. 2007.