Multilevel Inverter Topology

Niralkumar Rakholiya
UG Student
Department of Electrical Engineering
Uka Tarsadia University

Rutam Garsodiya
UG Student
Department of Electrical Engineering
Uka Tarsadia University

Ajay Virani
UG Student
Department of Electrical Engineering
Uka Tarsadia University

Hiren Sidhpuria
Assistant Professor
Department of Electrical Engineering
Uka Tarsadia University

Abstract

Recently multilevel inverters are emerged as very important factor in high power and medium voltage application. Number of inverter topologies have been introduced and used for various applications. Among these inverters cascaded MLI is used because of its advantages over other MLIs. Different control techniques are available to control these inverters. Simulation outputs of three phase five level cascaded H-Bridge, Diode clamped, Flying capacitor MLIs are analyzed in MATLAB software.
Keywords: Topologies of various multilevel inverters, MATLAB Simulations, Conclusion

I. INTRODUCTION

The Inverter is an electrical device which converts direct current (DC) to alternate current (AC). The inverter is used for emergency backup power in a home. The inverter is used in some aircraft systems to convert a portion of the aircraft DC power to AC. The AC power is used mainly for electrical devices like lights, radar, radio, motor, and other devices.

Now a day's many industrial applications have begun to require high power. Some appliances in the industries however require medium or low power for their operation. Using a high power source for all industrial loads may prove beneficial to some motors requiring high power, while it may damage the other loads. Some medium voltage motor drives and utility applications require medium voltage. The multi-level inverter has been introduced since 1975 as alternative in high power and medium voltage situations. The Multi-level inverter is like an inverter and it is used for industrial applications as alternative in high power and medium voltage situations.

II. TYPES OF MULTI-LEVEL INVERTER

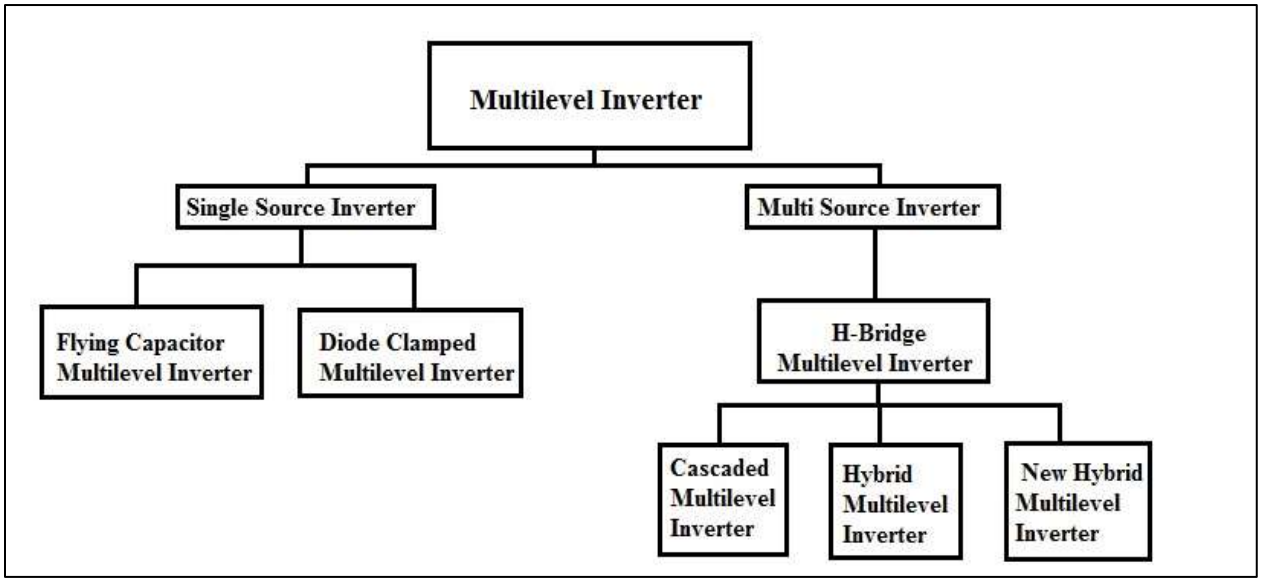

Fig. 1: Types of multilevel Inverter

III. FLYING CAPACITOR MULTILEVEL INVERTER

The main concept of this inverter is to use capacitors. It is of series connection of capacitor clamped switching cells. The capacitors transfer the limited amount of voltage to electrical devices. In this inverter switching states are like in the diode clamped inverter. Clamping diodes are not required in this type of multilevel inverters. The output is half of the input DC voltage. It is drawback of the flying capacitors multi-level inverter. It also has the switching redundancy within phase to balance the flaying capacitors. It can control both the active and reactive power flow. But due to the high frequency switching, switching losses will takes place.

A. Applications of Flying Capacitors Multilevel Inverter

- Induction motor control using DTC circuit
- Static VAR generation
- Both AC-DC and DC-AC conversion applications
- Converters with Harmonic distortion capability
- Sinusoidal current rectifiers

B. MATLAB Simulation

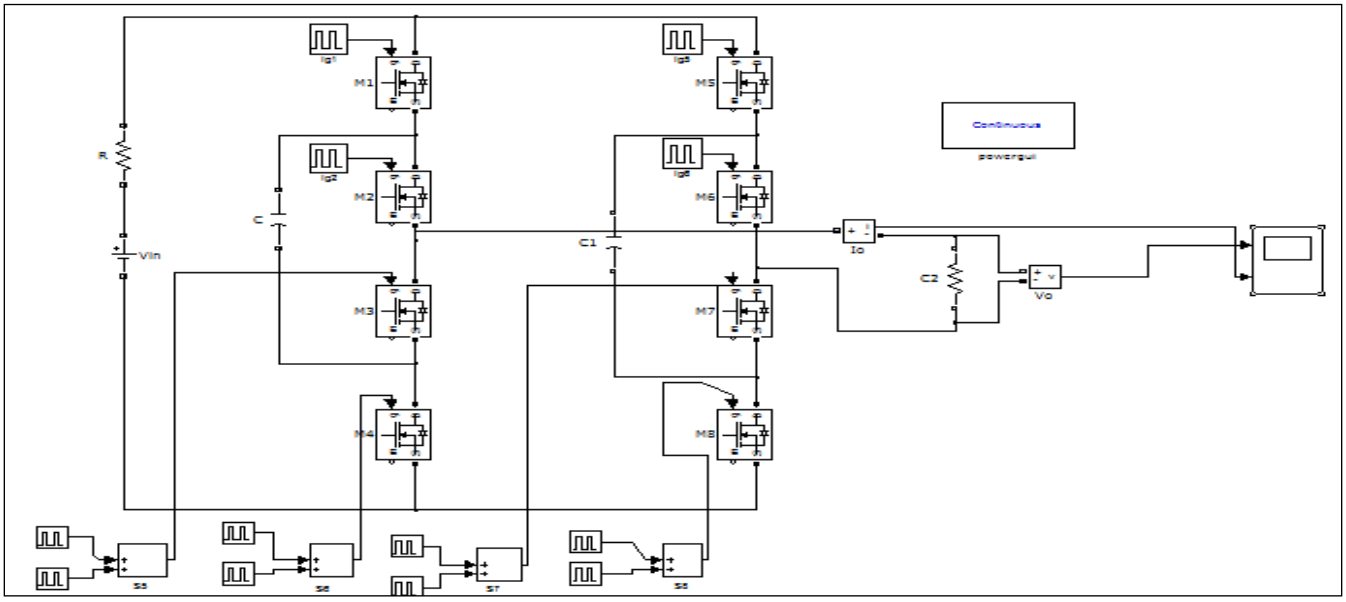

Fig. 1.1: Circuit diagram of Flying Capacitor multilevel Inverter

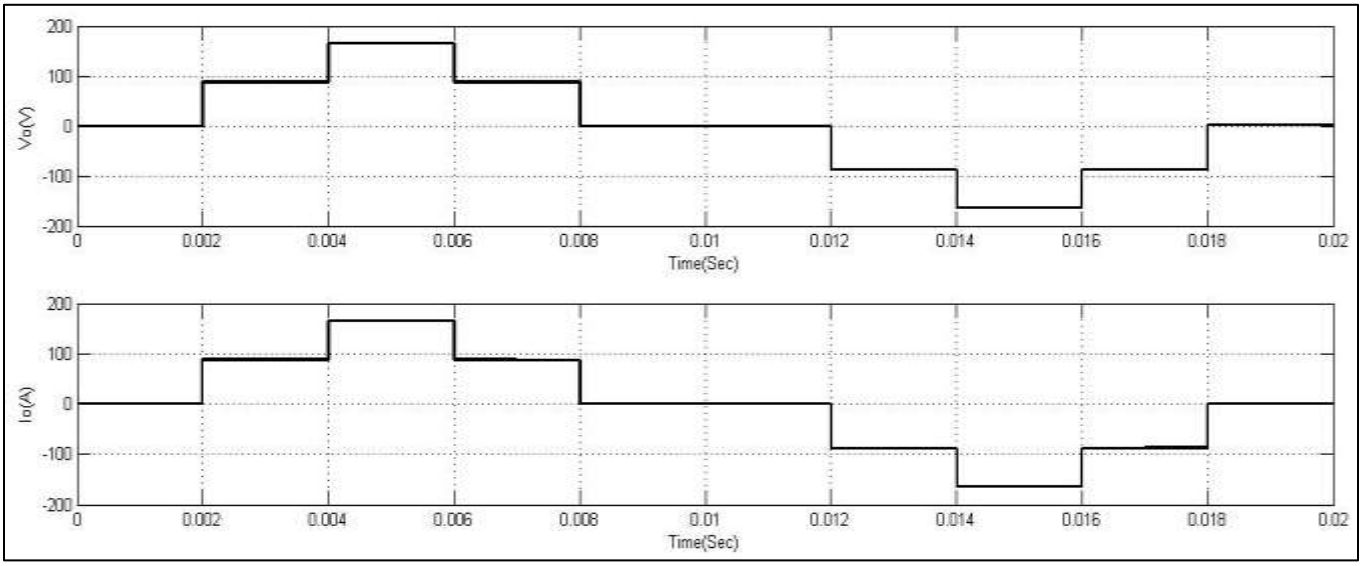

Fig. 1.2: Output Voltage and Current wave

IV. DIODE CLAMPED MULTI LEVEL INVERTER

The main concept of this inverter is to use diodes and provides the multiple voltage levels through the different phases to the capacitor banks which are in series. A diode transfers a limited amount of voltage, thereby reducing the stress on other electrical devices. The maximum output voltage is half of the input DC voltage. It is the main drawback of the diode clamped multilevel inverter. This problem can be solved by increasing the switches, diodes, capacitors. Due to the capacitor balancing issues, these are limited to the three levels. This type of inverters provides the high efficiency because the fundamental frequency used for all the switching devices and it is a simple method of the back to back power transfer systems.

A. Applications of Diode Clamped Multilevel Inverter

1) Static VAR compensation
2) Variable speed motor drives
3) High voltage system interconnections

B. MATLAB Simulation

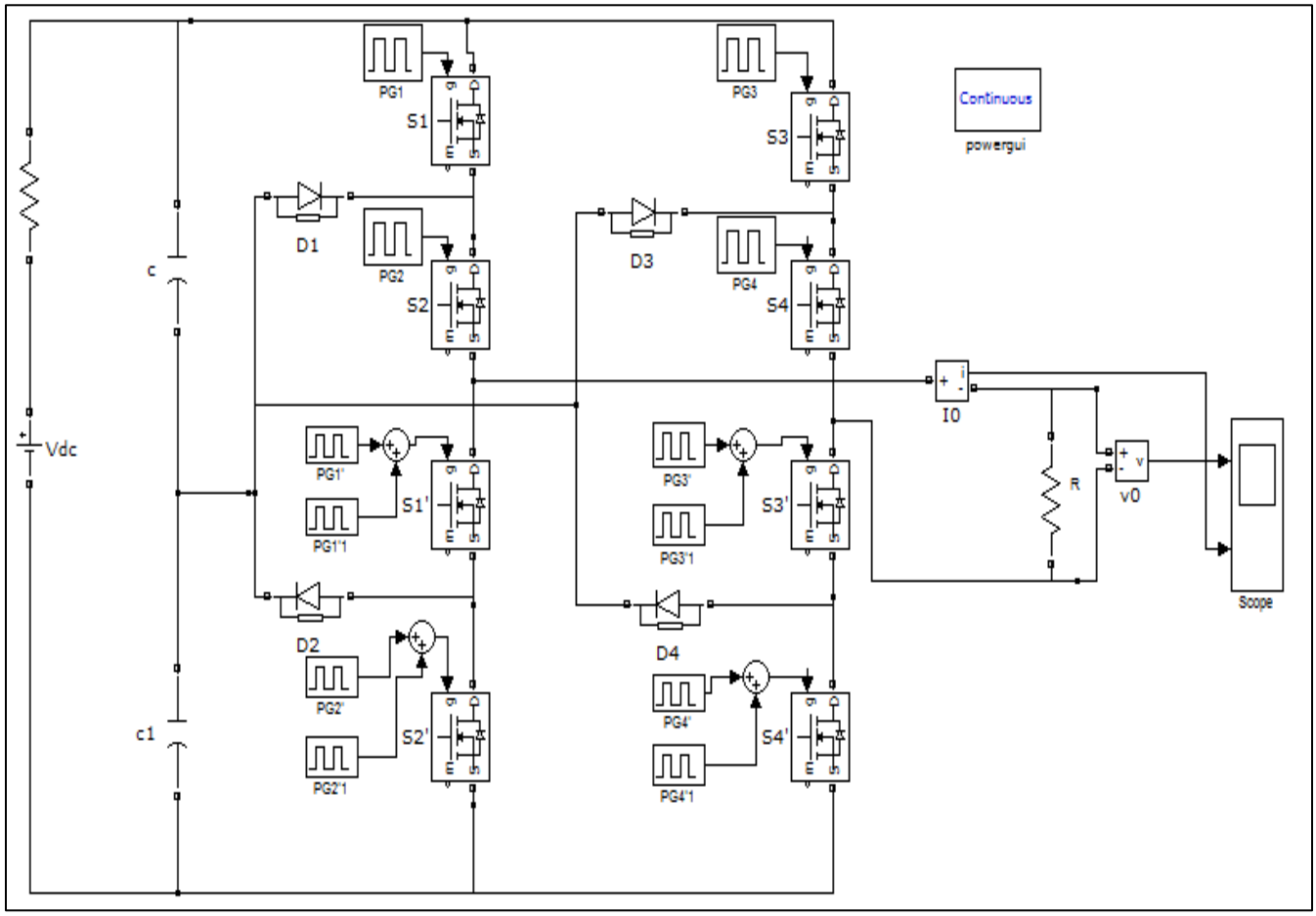

Fig. 2.1: Circuit diagram of Diode Clamped multilevel Inverter

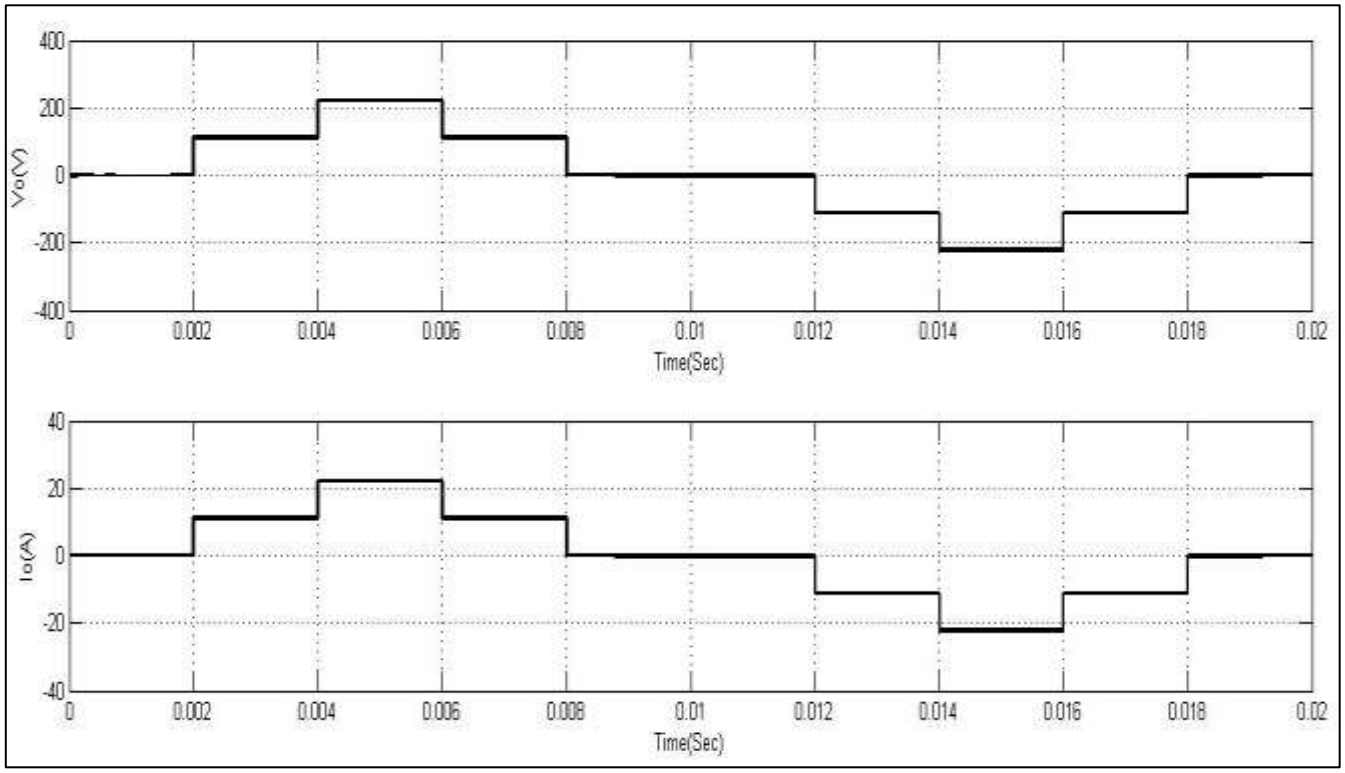

Fig. 2.2: Output Voltage and Current waveform

V. H-BRIDGE MULTILEVEL INVERTER

The cascaded H-bride multi-level inverter is to use capacitors and switches and requires less number of components in each level. This topology consists of series of power conversion cells and power can be easily scaled. The combination of capacitors and switches pair is called an H-bridge and gives the separate input DC voltage for each H-bridge. It consists of H-bridge cells and each cell can provide the three different voltages like zero, positive DC and negative DC voltages. One of the advantages of this type of multi-level inverter is that it needs less number of components compared with diode clamped and flying capacitor inverters. The price and weight of the inverter are less than those of the two inverters. Soft-switching is possible by the some of the new switching methods.

Multilevel cascade inverters are used to eliminate the bulky transformer required in case of conventional multi-phase inverters, clamping diodes required in case of diode clamped inverters and flying capacitors required in case of flying capacitor inverters. But these require large number of isolated voltages to supply the each cell.

A. Applications of Cascaded H-Bridge Multilevel Inverter

- Motor drives
- Electric vehicle drives
- DC power source utilization
- Power factor compensators
- Back to back frequency link systems
- Interfacing with renewable energy resources.

B. MATLAB Simulation

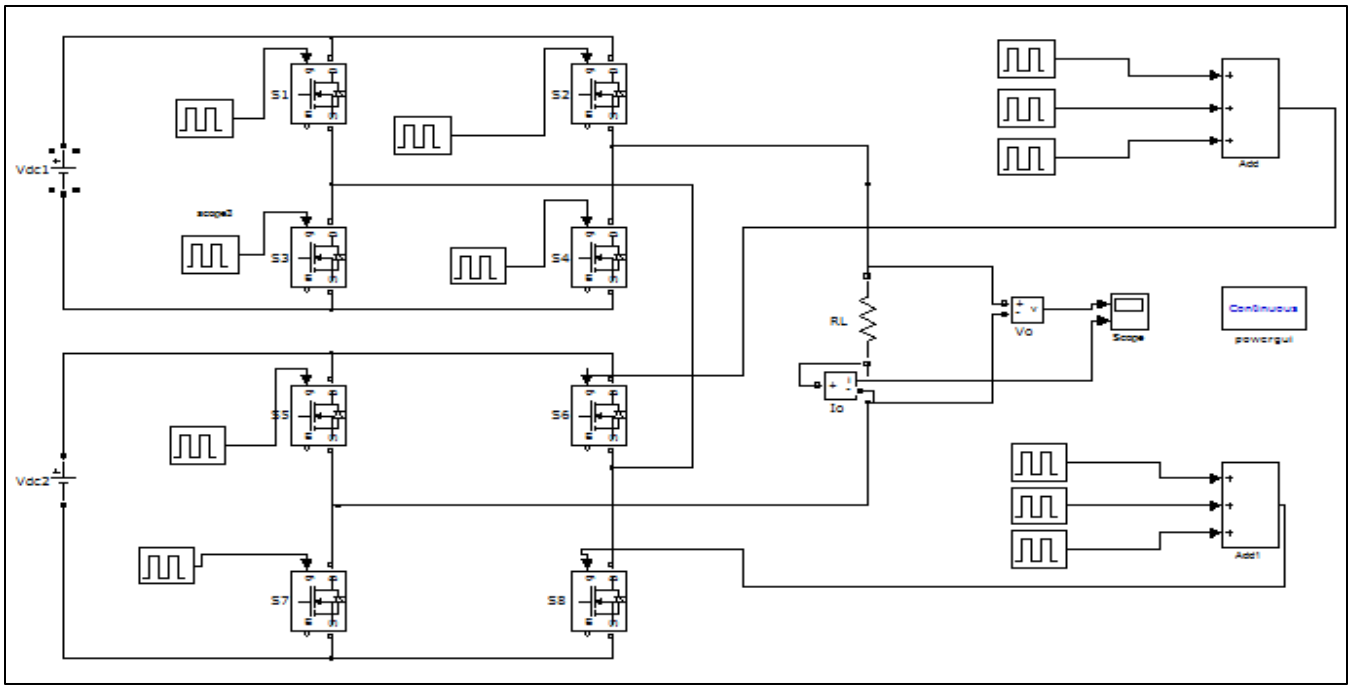

Fig. 3.1: Circuit diagram of H-bridge multilevel Inverter

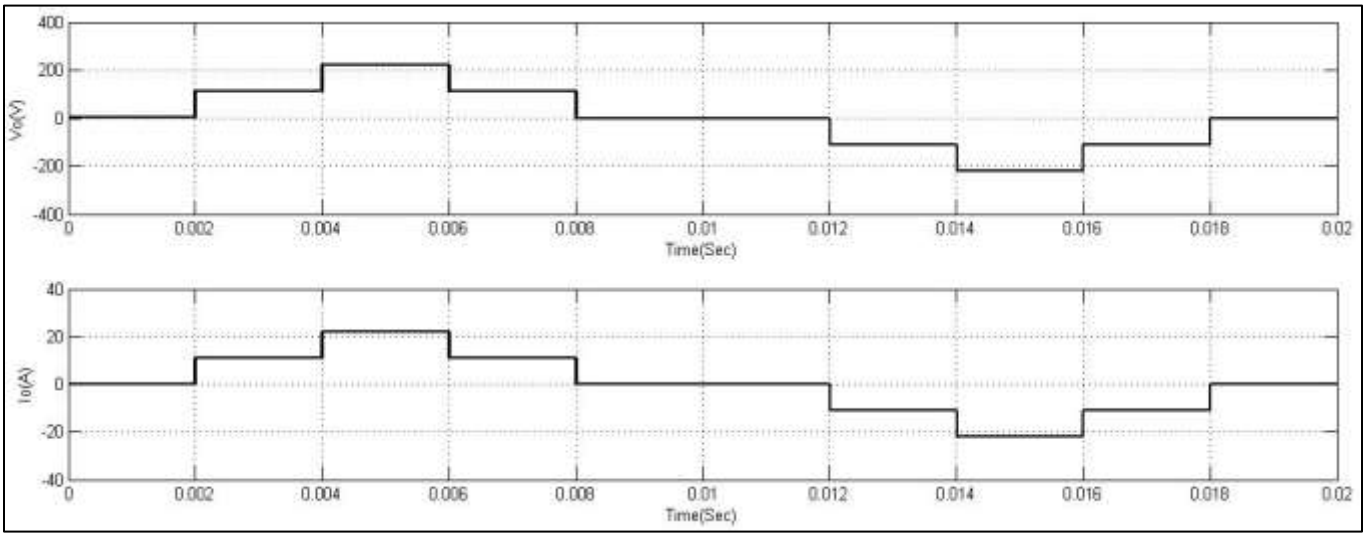

Fig. 3.2: Output Voltage and Current waveform

VI. CONCLUSION

- H-bridge inverter is best among these three multi-level inverters because of these following reasons:
- Less number of components is used.
- Voltage unbalancing is very small.
- Wide applications.
- Batter output voltage.

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