CHAPTER 6
CONCLUSION AND FUTURE SCOPE OF WORK

6.1 CONCLUSION

The demand of clean energy is supplied by wind, solar and other renewable energy sources strident towards a large diffusion of electric generators. This scenario has introduced several technical, economic, and political challenges due to its changing in nature for designing and managing the generation, transmission and distribution networks. To overcome this situation, the usage of electronic power converters introduces to resolve increased topological complexity, additional power losses, and Electro-Magnetic Interferences (EMIs) and thereby reducing the overall quality of service, efficiency, and network stability. The above cause motivates many researchers for addressing their efforts in proposing novel inverter topologies or modifying the existing topologies with a view to aim at improving the quality of the energy available at the inverter terminals. Most of the conventional and recent multilevel inverter topologies suffer from a higher number of switches such as power diode, DC-link capacitors, and gate driver circuits and voltage stress across the particular switches which will increase the system layout size and implementation cost along with reduction in system reliability.

The modulation techniques are more important in two level and multilevel inverter, which is considered to improve the high power quality. Among them, Pulse Width Modulation (PWM) and Multilevel Inverters (MLIs) are attaining both popularity and applications and becoming an effective substitute to recent inverter topologies. In order to meet sustained load demands, different energy sources and converters need to be integrated with each other for
improving their performances, establishing techniques for accurately predicting their outputs. The conventional carrier based modulation techniques widely used in industrial applications due to easy implementation and low THD but it increases the switching losses because switches are operated in high switching frequency. In addition, the switching pattern also becomes complex and in turn reduces the reliability. The above mentioned limitations motivated this research work to focus on novel multilevel inverter topology with reduced power switches with low blocking voltage and also concentrated on the development of carrier based pulse width modulation techniques suitable for voltage source inverter and multilevel inverter.

This research work presents the reviews and literature of modulation techniques for two level inverter, multilevel inverter and recent topologies in multilevel inverters. Furthermore, the important and advancements of recent topologies in multilevel inverter associated to conventional inverter are presented. The prime focus of the literature review has undergone to improve the performance characteristics of inverter, fundamental fortification, minimization of THD and reduce the switching losses. The growth and development of PWM techniques that have contributed to enhance the quality of power through effective reduction of THD were also discussed in this research.

This research presents an important aspect of designing a voltage source inverter, using modified carrier pulse width modulation techniques in hybrid energy conversion system with dynamic loading conditions. The new ‘un’shape carrier pulse width modulation (UNCPWM) technique is proposed, which uses the conventional sinusoidal reference signal and a semi-sinusoidal carrier for minimizing the Total Harmonic Distortion (THD) and to enhance the fundamental output voltage. The three existing carrier based PWM techniques such as SPWM, SSPWM and ISCPWM compared with proposed UNCPWM technique are also investigated and analyzed. The development of UNCPWM
technique for minimizing the total harmonic distortion and enhances the fundamental output voltage in hybrid wind/PV system is also presented. The simulation has been carried out in MATLAB Simulink to analyze the performance of the proposed technique by means of comparing the fundamental component of Root Mean Square output voltage and THD for different values of modulation index.

This research work focuses on the design of new hybrid multilevel inverter with reduced blocking voltage of switches and minimizing the number of switch count. The new hybrid topologies Type I and Type II are proposed and it can be used in both symmetric and asymmetric configuration. The design of multilevel inverter topology was realized in terms of number of required power electronic switches, gate driver circuits and maximum blocking voltage against required voltage levels. The result obtained has proved that the maximum blocking voltage and total peak inverse voltage is also reduced with Type I topology configuration. But the number of redundant states is higher in a symmetric configuration, which will provide more reliability and modularity than asymmetric configurations. The proposed topology analyzed for controllable power source with dynamic loading conditions. The advantages of proposed multilevel inverter with these topologies were elaborated with comparison of conventional and recent new multilevel inverter topologies.

Finally, 13-level inverter is designed with symmetric topology for reducing THD in this research. The proposed type I topology is simulated using MATLAB / Simulink software. From the result, it is evident that the number of switches in proposed topology is half of the CHB topology switches which further reduces the switching and conduction losses. Furthermore, a new modulation technique UNCPWM is also implemented to enhance the performance of proposed topology. This modulation technique produces minimum voltage THD (5.27%) with improved RMS output voltage (86.52V) at
the load side. In order to validate the performance of proposed topology, the 13-level inverter has been tested in laboratory environment and it has good agreement with simulation results.

6.2 SUGGESTIONS AND FUTURE WORK

The following points to be suggested and considered as future works:

i. The proposed modulation technique and hybrid multilevel inverter topology can be applied to three-phase system. The performance of the system can be experimentally evaluated.

ii. The proposed modulation technique and the multilevel inverter topology can be extended for various applications such as industrial drives, HVDC back to back converters, FACTS devices and etc.

iii. The proposed hybrid MLI can be adopted for AC micro grid applications with grid-connected system.