CHAPTER 6

CONCLUSIONS AND FUTURE WORK

6.1 CONCLUSIONS

A novel cascaded single phase multilevel inverter with minimum number of power electronic devices and minimum number of isolated DC sources for renewable energy sources is proposed in this dissertation. The proposed inverter is compared with the other similar topologies available in the literature. Comparison with other topologies is based on a number of power electronic devices, isolated DC power supplies, switching losses and conduction losses.

The proposed multilevel inverter topology consists of two inverters connected to cascade. The upper inverter switches at high frequency and handles only 10% of the load power whereas the lower inverter switches at high frequency and handles 90% of the load power. Hence switching and conduction losses of the proposed inverter will be very less when compared to the other type of topologies.

Addition of each power electronic switch in the lower inverter increases the number of levels by four. Thus the proposed inverter topology is extendable to any required number of levels. A hybrid modulation switching strategy is proposed which is generalized to any number of levels. The proposed generalized hybrid modulation strategy is very simple to implement practically because the algorithm consists of simple arithmetic and logical
operations. The generalized hybrid modulation strategy when applied to the proposed multilevel inverter suffers from a capacitor voltage balancing problem. To overcome this issue a modified hybrid modulation strategy is proposed.

The proposed multilevel inverter topology is fed from PV arrays and is connected to the grid through boost converters. Since the power generated by PV array is dependent on climatic conditions, a maximum power point tracking is used to track the MPP. An Evolutionary Programming based MPPT algorithm is proposed. The EP based MPPT is found to be a good choice when the climatic conditions do not change continuously. Further EP based algorithm requires pyranometer to sense the irradiation, which is a costly solution.

So to avoid the above drawbacks of the EP based MPPT algorithm, sliding mode control based MPPT algorithm is proposed. The sliding mode control based MPPT algorithm is a better choice when the climatic conditions change continuously. Further sliding mode control based MPPT algorithm does not require pyranometer to measure the irradiance. Hence, among the two algorithms proposed sliding mode control based MPPT is the best choice. Both the algorithms are simulated using MATLAB/SIMULINK and the results are presented.

Control system used to control the grid connected multilevel inverter consists of two parts namely, the local controller and the master controller. The local controllers control the modulation index of the upper and lower inverters separately and the master controller controls both the local controllers so that it satisfies the grid requirement. Further, in order to control the DC link voltage of upper and lower inverters, separate $V_{DC}$ controllers are used. The prototype of the proposed inverter is built in the laboratory and the
entire hardware is controlled by using Xilinx FPGA SPATRAN 3A DSP. The results obtained from the prototype and simulations are presented.

6.2 FUTURE WORK

In this work both the upper and lower inverters are fed from PV arrays, but the investigations can be extended such that the upper inverter is fed from PV array and the lower inverter from any other renewable energy source (i.e. Wind or Fuel Cell).

Further selective harmonic eliminations methods can be used in the proposed modulation strategy which can improve the quality of power pumped into the grid. Investigations have to be made to extend the single phase inverter to a three-phase structure with further reduction in number of power electronic devices.