CHAPTER 6
CONCLUSION & FUTURE SCOPE

Renewable energy technologies such as photovoltaic (PV) are becoming more commonly accepted as a means of sustaining and enhancing living standards while minimizing environmental damage.

6.1 Conclusion

This thesis has validated the multipurpose use of conventional PV systems by modifying the control approach to manage the active and reactive power at the utility grid and load side with unity power factor at grid during PCC voltage within an acceptable range. However, the Conventional-PV is only injected with active power, has no reactive power support to the utility grid, and is also useless at night. During a day time, the objective of the presented multipurpose PV system is to inject active power according to solar irradiance and exchange reactive power at PCC to manage either PCC voltage or unity power factor at grid side if and only if PCC voltage is within an acceptable range. The mode of operation of a multipurpose PV system is validated through simulation results and experimental results. The grid synchronization needed for the control approach of a multipurpose PV system is deployed by combining the MDSOGI-FLL and tan-arc angle method to detect the frequency of the grid and phase angle under non-ideal grid conditions. Simulation results and experimental results also validate the synchronization approach. The control approach is implemented on a single-stage PV system to eliminate the DC-DC converter efficiency improvement with a cost-effective solution. The simulation results and experimental results confirm that multipurpose single-stage PV stem can provide fast, reactive power supports when needed, either voltage regulation support or power factor correction, and also validated the effectiveness and performance evaluation of control approach in different operative modes during the day as well as night. The switching between different modes of operation approves that the control approach of a multipurpose single-stage grid-tied PV system has adaptability scalability and can accommodate a wide range of atmospheric conditions and dynamic PV system operation.

Based on the research objective and the summary of the work provided in the thesis regarding the proposed control techniques, the following conclusions are made:

[1] The modified dual-SOGI-FLL and tan-arc method are validated to extract the phase angle of PCC voltage for the control system during non-ideal grid conditions.

[2] The multi-purpose PV inverter can manage smartly active power injection and fulfill the need for reactive power at PCC and grid without an oversizing inverter. Besides, it also provides reactive power exchange to either regulate PCC voltage or unity power factor at grid side if PCC voltage is within an acceptable range. It can handle a reactive power current through quadrature–axis (q-axis) current control during load variation 1-2 cycles.

[3] The multi-purpose PV inverter can inject active power into the grid, controlled through a linearized DC bus voltage controller with a modified DC current sensor less MPPT algorithm.

6.2 Future scope

The multipurpose single-stage PV system presented in the thesis still has scope to work. The future scopes are listed below:

[1] The grid-tied PV system typically operates in a current-controlled mode to supply a predetermined amount of electricity to the primary grid. As scope of work, the multipurpose single-stage PV system must identify an islanding condition and as action control shift from current-controlled mode to voltage-controlled mode and disconnect from the utility grid. It will maintain a constant voltage for the local load, including non-linear load during this mode.

[2] PR controller and model predictive controller maybe apply for the seamless transition from the grid-tied PV system to standalone PV system or islanding PV system to accommodate the local load.

[3] From the implementation point of view, parallel processors may reduce the computation burden on a single processor. It will increase the speed as well as the performance of the system.