Industrial Engineering Journal
ISSN: 0970-2555
Volume : 49, Issue 10, No. 1, October : 2020

MPPT Technology for DC Microgrid Power Flow Regulation

P. Lakshmi Priyanka
Assistant Professor
Dept.of Electrical and Electronics Engineering,
Anantha Lakshmi Institute of Technology and Sciences,
Ananthapuramu.

C.Revathi
Assistant Professor
Dept.of Electrical and Electronics Engineering,
Anantha Lakshmi Institute of Technology and Sciences,
Ananthapuramu.

Abstract:

Because of their low inertia, power converters are the primary components of a dc micro grid. The outcome is a high rate of change in DC voltage subject to power variations. To slow the pace at which the dc voltage is fluctuating, this research proposes a control technique based on monitoring the highest power point of the conductance. The proliferation of DC loads in recent years has made renewable energy DC micro grids a viable option for satisfying rising energy demands. Due to the fact that renewable and nonrenewable energy sources like solar panels, wind turbines, fuel cells, and diesel generators can all be connected to the DC grid, power management is an important consideration. This work presents a method for controlling the currents in a DC micro grid, which can be used to regulate the power generated by solar panels and wind turbines. Keeping the DC link voltage stable calls for voltage profile management in a standalone device, which can only be provided by a dedicated converter. The battery circuit controls the DC link voltage even if the maximum power is drawn from solar and wind to supply the loads linked to the DC bus. To regulate these three DC Micro grid sources, a custom Incremental Conductance Maximum PowerPoint Monitoring Algorithm has been created. This MATLABSIMULINK experiment examines the performance of the Incremental Conductance Maximum Power Point Monitoring Algorithm under varying loads and environmental variables, including those caused by the sun and the wind.

Index: ***DC micro grid; power flow, photovoltaics, systems for wind conversion***

1. INTRODUCTION:

With the decline of fossil fuels, the rising demand for energy urged people to shift towards renewable energy sources. The new trends in Semiconductor technology has made it possible to exploit Solar and wind energy for electricity.Because the majority of electronic loads require DC supply, The AC power is conventionally converted into DC inside the system to deliver loads.Also, most electronic loads are available. The direct supply of DCs to buildings and residences is possible. A micro grid is suitable for the direct current distribution system structure.A micro grid is a low voltage autonomous cluster created by a distributed generation, mainly from renewable energy sources, Solar, wind and hydro power, energy storage systems, and local storage systems. In distribution networks with the incorporation of renewable energy sources, DC micro grids are pointed out as a good option.Today, the latest technical developments and new directions in technology. Control on electricity stimulates a substantial increase Distributed generation (DG) capital worldwide. To effectively utilize the available renewable energy sources, it is necessary to always operate in MPPT mode.

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 49, Issue 10, No. 1, October : 2020

In standalone systems, maintaining the voltage profile is done by sacrificing the MPPT mode. In this paper, a battery charger discharger circuit used to regulate the DC link voltage while extracting the maximum from renewable energy sources. Depending on the availability of the solar and wind power while taking into account the load demand and battery voltage, the developed Management of power flow algorithm will determine the mode of operation to ensure reliable and uninterrupted power to the load. To monitor three sources in the DC Micro grid, an Incremental Conductance Maximum Power Point Tracking Algorithm is developed.

2. RELATED WORK:

The DC Micro grid consists of a solar PV array, a wind energy conversion system, a battery bank, and a DC bus interface power converter. The DC Micro grid block diagram considered for the analysis is shown in Fig.1.

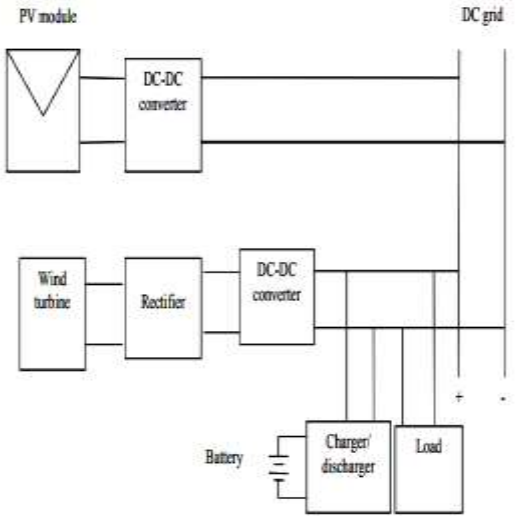


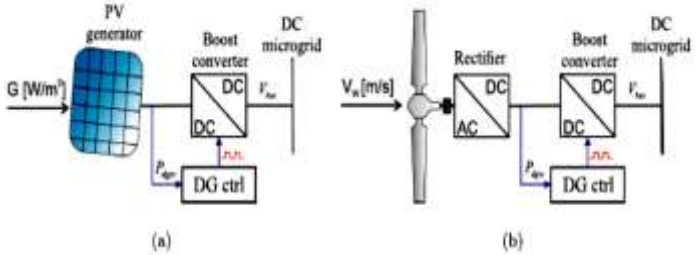
Fig. 1 Block diagram of the DC micro grid with Solar and wind energy sources

The wind turbine power is generated by the induction generator. The power generated from the induction generator is rectified to DC and through a power converter, fed into the DC bus. The MOSFET is used for the purpose of switching. The output is connected to the DC micro grid from the DC-DC boost converter where the loads are connected. The battery work is carried out by a DC-DC boost converter that also regulates the voltage of the DC connection.

2.1Distributed generator:

2.1.1 Model of Wind and Solar System

As distributed generators, a solar system and a wind system are introduced. The solar system is created by a boost converter connected to photovoltaic arrays. The radiance profile, G, is taken as the input to emulate the PV system, and the output power is calculated to be processed by the converter control in which the wind speed, Vw, is the input of the wind system. The created AC power is converted to DC by a rectifier, so the same control process applied to the PV system is applied to the wind structure. The output power is processed via the control of the converter.



Industrial Engineering Journal
ISSN: 0970-2555
Volume : 49, Issue 10, No. 1, October : 2020

Fig2. Distributed generation system (a) PV solar system. (b) Wind system

3. MPPT:

The Maximum Power Point Tracker (or MPPT) is a high-efficiency DC to DC converter that provides a solar panel or array with an ideal electrical load and generates a load-appropriate voltage. For a full array as a whole, conventional solar inverters perform MPPT. The same current, determined by the inverter, flows through all panels in the chain in such systems. But since different panels have distinct IV curves, i.e. different MPPs (due to production tolerance, partial shading, etc.), this architecture ensures that certain panels can perform below their MPP, resulting in energy loss.In the DC side, continuous power is avoided assistance in power flow algorithm management the battery regulates the DC link voltage. Hence maximum power is extracted from solar and wind energy systems.

3.1 INCREMENTAL CONDUCTANCE METHOD:

This approach consists of using the slope of the current derivative relative to the voltage to achieve the maximum power point. In the real world, what value MPPT offers depends on the collection, its environment, and its seasonal load pattern. Only when the Vpp is more than about 1V higher than the battery voltage does it give us an important current boost. This might not be the case in hot weather unless the batteries have a low charge. The Vpp will increase to 18V in cold weather, however. If the use of energy is highest in the winter (typical in most homes) and the winter weather is cold, when it is most needed, the energy will increase considerably.

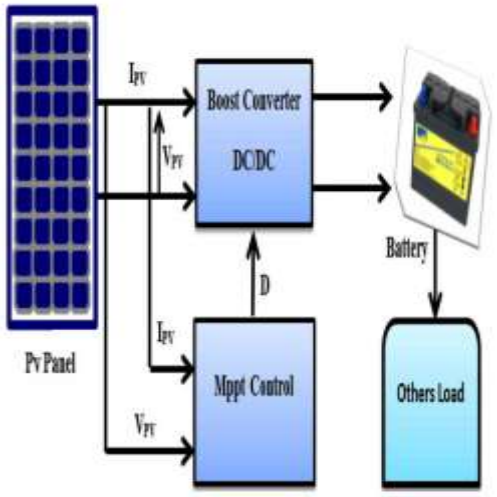


Fig.3: PV System with Power Converter and MPPT Control

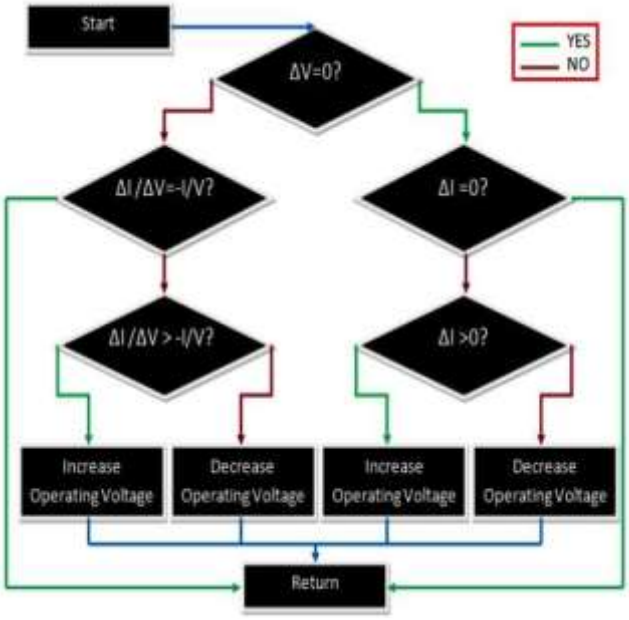


Fig 4: Organigram of incremental Inductance algorithm

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 49, Issue 10, No. 1, October : 2020

Where, $P = V \times I$

$$\begin{cases} \frac{\Delta I}{\Delta V} = -\frac{I}{V} & \text{at the MPP} \\ \frac{\Delta I}{\Delta V} > -\frac{I}{V} & \text{left of the MPP} \\ \frac{\Delta I}{\Delta V} < -\frac{I}{V} & \text{right of the MPP} \end{cases}$$

MPP can be monitored by comparing instant conductance with incremental conductance

The DC Micro grid consists of a wind generator with 700 W PV array and 500 W. A boost converter links the PV array to the 48V DC bus. A rectifier attaches the induction generator to the DC bus. The MPPT algorithm is used by Incremental Inductance. A 24V battery connects to the DC connection through a charger/discharger circuit. The charger circuit regulates the DC link voltage.

4.RESULTS AND DISCUSSION:

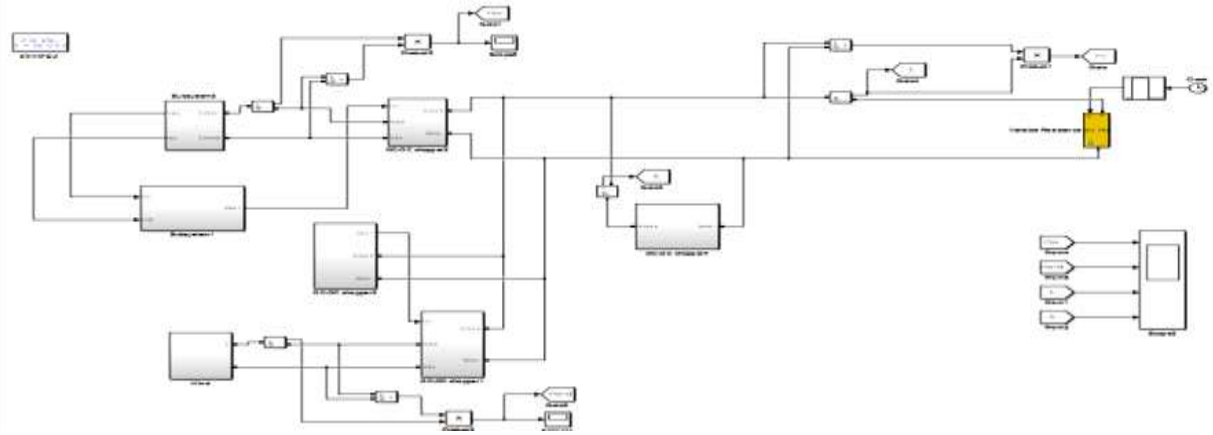
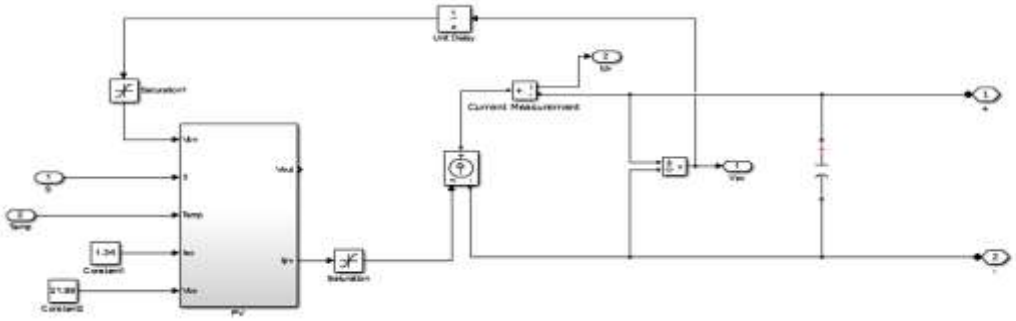


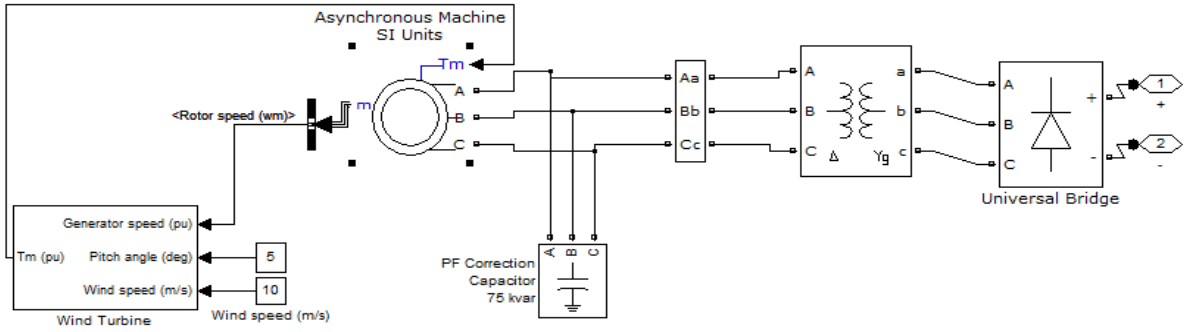
Fig 5 Simulink model of the developed DC Microgrid

SOLAR POWER GENERATION:

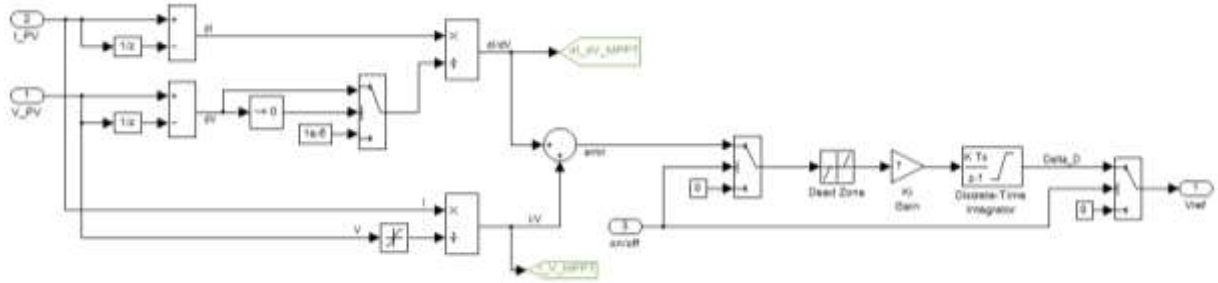


WIND POWER GENERATION:

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 49, Issue 10, No. 1, October : 2020



MPPT-INCREMENTAL CONDUCTANCE:



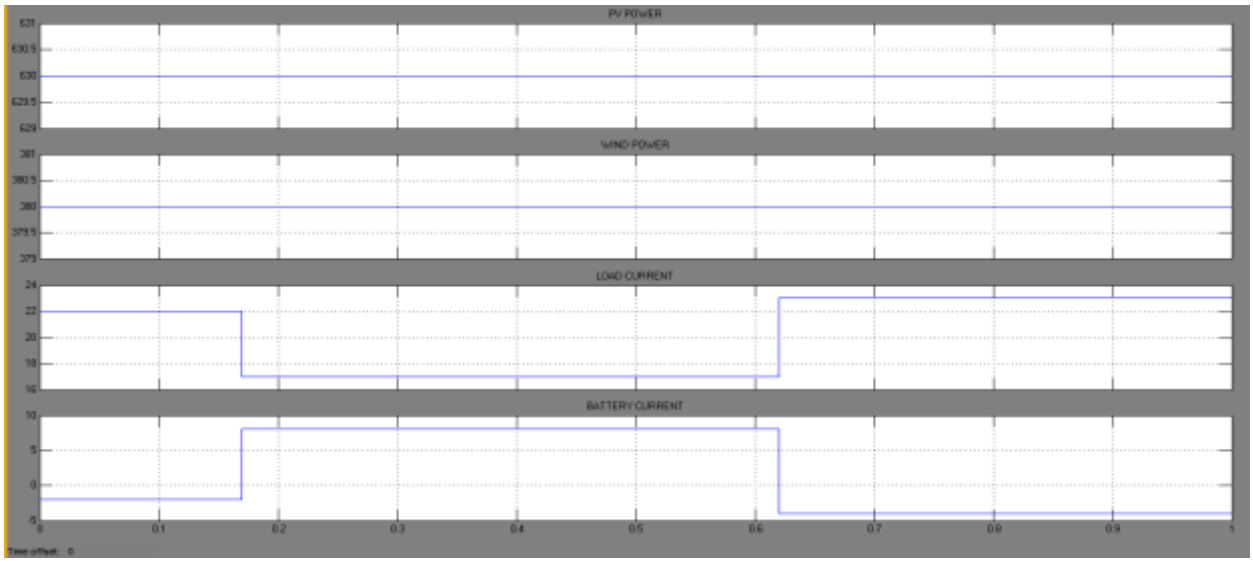


Fig 6: Response of the system for increase& decrease in load power

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 49, Issue 10, No. 1, October : 2020

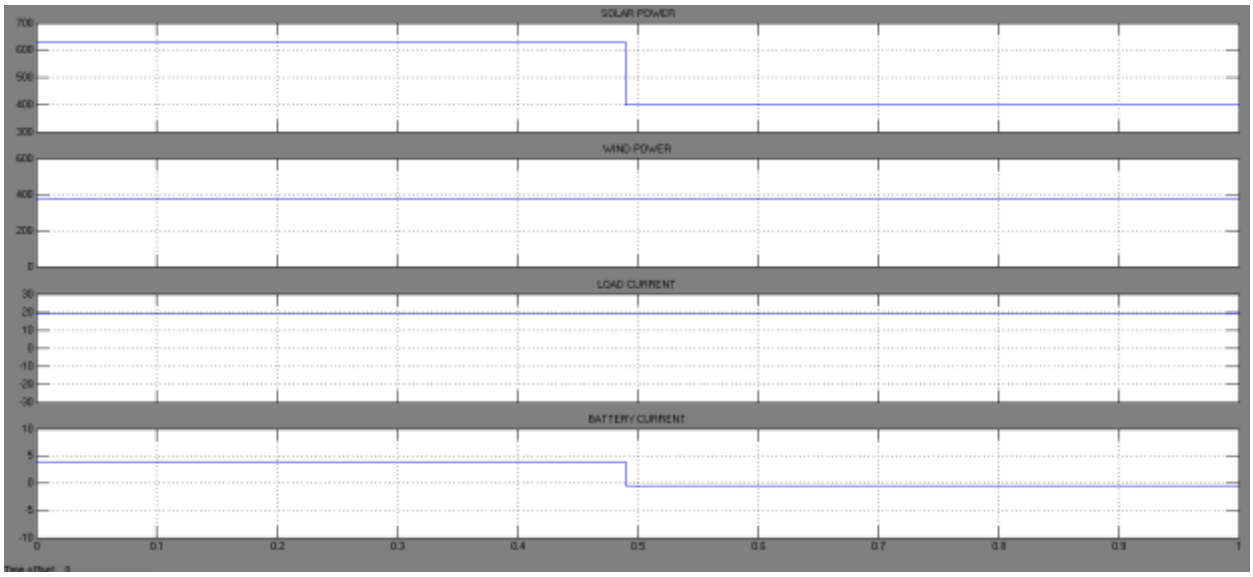


Fig 7: Response of the system during change in Ppv

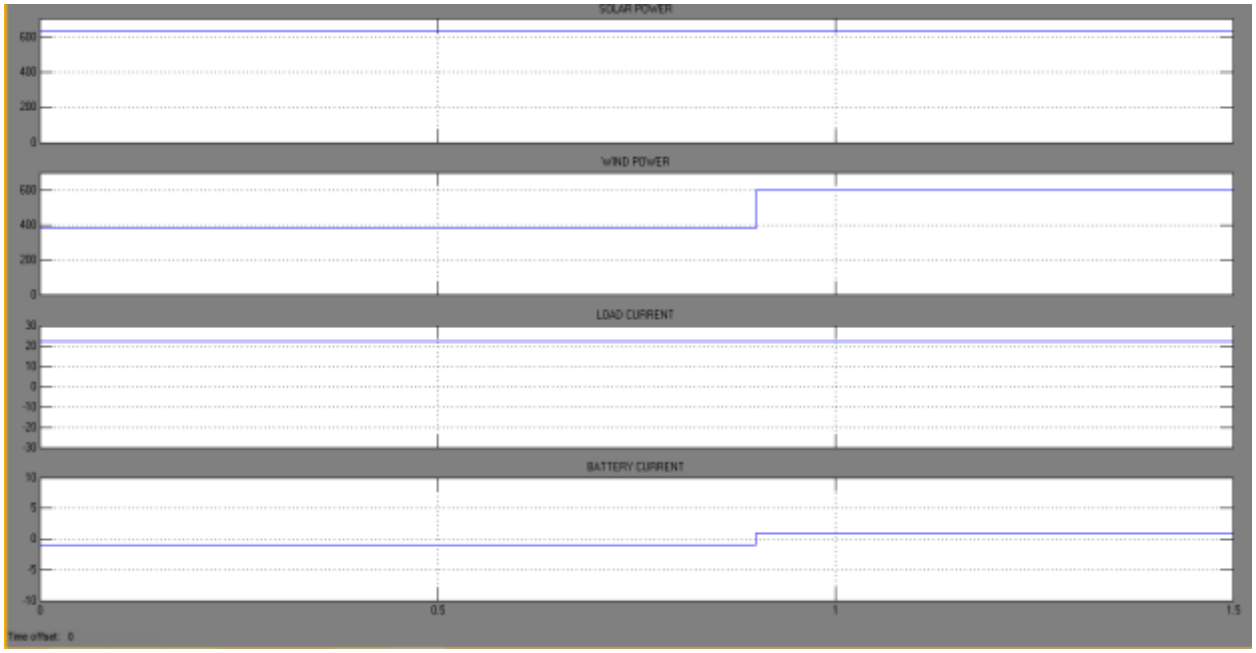


Fig 8: Response of the system during change in Pw

A. Change in load power:

The power from the solar panel (PPV) supplies 630W and the power (PW) from the wind turbine provides about 380W. If the load current (IL) decreases, i.e. the load demand decreases, then the excess energy is used to charge the battery in charging mode The power from the solar panel (PPV) supplies 630W power and the power (PW) from the wind turbine provides about 380W., when the load current (IL) rises, i.e. the demand for load increases, the

battery operates in discharge mode to supply the deficit power.

B. Change in PV power

The power generated from the solar panel (PPV) is reduced from 630W to 415W and the wind turbine produces the same power of 380W in order to research the response of the system to changes in input power. The battery works in the discharging mode to provide uninterrupted power to the load.

C. Change in Wind power

As the wind turbine (PW) generated power raises from 380W to 590W and the solar panel generates 630W of the same power, the additional power generated is used to charge the battery.

Conclusion:

For power flow management and incremental conductance, a maximum power point monitoring algorithm control algorithm for the DC micro grid with solar and wind power sources is presented. In this study, an incremental conductance maximum power point monitoring algorithm control is suggested to increase the inertia of the dc micro grid and decrease the change rate of the dc voltage. As the scheme involves different intermittent energy sources and loads that can vary in demand for power flow management and incremental conductance, a maximum power point monitoring control algorithm for the DC micro grid must be developed. In order to provide the loads with unceasing power supply and balance the power flow between the different sources at any time, a power flow algorithm management and incremental conductance maximum power point monitoring control algorithm for the DC micro grid is developed.

References:

[1] F. Katiraei, M. R. Iravani, A. L. Dimeas, and N. D. Hatziargyriou,"Micro grids management: control and operation aspects of micro grids,"IEEE Power Energy Mag., vol. 6, no. 3, pp. 54-65, MayJun. 2008.

[2] W. Jiang and B. Fahimi, “Active current sharing and sourcemanagement in fuel cell-battery hybrid power system,” IEEE Trans. Ind.Electron., vol. 57, no. 2, pp. 752–761, Jan. 2010.

[3] L. Xu and D. Chen, "Control and operation of a DC micro grid withvariable generation and energy storage," IEEE Trans. Power Del., vol.26, no. 4, pp. 25 I 3-2522, Oct. 2011.

[4] Jin C, Wang P, Xiao J, "Implementation of hierarchical control in DCmicrogrids,"IEEE Transaction of Industrial Electronics, vol.61 (8),pp.4032-4042, 2014.

[5] L. Xiaonan, J. M. Guerrero, S. Kai, and J. C. Vasquez, "AnImprovedDroop Control Method for DC Microgrids Based on Low Bandwidth Communication With DC Bus Voltage Restoration andEnhanced Current Sharing Accuracy," Power Electronics, IEEETransactionson, vol.29, pp.1800-1812, 2014.

[6] X. Liu, P. Wang and P. C. Loh, “Control of hybridbatteryultracapacitorenergy storage for stand-alone Photovoltaicsystem,” Proc.IEEE ECCE-10, Sep. 2010.

[7] B.Indu Rani, Saravana Ilango, and Nagamani, “Control Strategy ofManagement of power flow in the PV system supplies DC loads,”IEEE Trans. IndustrialElectronics, vol60, no.3, Aug.2013,pp. 3185-3194.

[8] Gao Chen, Qiang Yang, Ting Zhang, Zhejing Bao, and Wenjun Yan,"Realtime wind power stabilization approach based

onhybrid energystorage systems," 2013 Sixth International Conference ofComputational Intelligence, pp.124-129, October, 2013.
[9] T. Zhang, Z. J. Bao, G. Chen, Q. Yang, W. J. Yan, "Control Strategy fora Hybrid Energy Storage System to Mitigate Wind Power Fluctuations,"Sixth International Conference of Computational Intelligence, pp.27-32,October, 2013.
[10] Lalounia, Rekiouaa, Rekioua, Matagn. Fuzzy logic control instandalone pv system with battery storage. J Power Sources 2009; 193:
[11] Noroozian,Abedi,GharehpetianHosseini . Combined operation inDC isolated distribution and PV systems for supplying unbalanced ACloads.RenewableEnergy2009