PV based DSM Technique for Power Saving in Residential Loads

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Abstract— Demand Side Management (DSM) is associated to means of adapting the electricity demand to the electricity production, transmission, and distribution in the grid. Smart Grids and Demand Side Management hold potential increase share of energy sources to distribute energy, reduce the need for the energy, and reduce the cost of the power for customers. The core objective of DSM is to attend the load over time by saving the peaks and to transfer as much of the flexible demand as possible way from peak time into periods of lower activity. The aim of my paper is to design a conceptual model, which designs the Domains included Applications and Actors related to Demand Side Management and smart metering. This paper focuses on demand side management (DSM) of households. The paper proposes power grid enhancement DSM techniques to form a system. The two techniques are: a) advanced metering infrastructure (AMI) and b) solar photovoltaic (PV) systems installed on households. The aim of the AMI is to provide communication between the energy consumers. It brings energy awareness to households by providing them with more detailed energy consumption information which helps them manage their energy better. Integration of standalone solar PV supplements energy that households draw from the system. It reduces load catered by the grid. It can also save peak demand and hence delay need for large investment into new power stations.

Key words: PV Array, DC-DC Boost Converter, PWM Inverter & Demand Side Smart Meters

I. Introduction

The essence of this dissertation is to investigate demand site management (DSM) for domestic households. This thesis presents a set of studies carried-out to determine how to achieve DSM through advanced metering infrastructure (AMI) and solar photovoltaic (PV) integration on domestic power distribution systems. The first part of this thesis is therefore finding a more efficient design for AMI. The second part investigates design factors associated with integrating solar PVs on a distribution network. The AMI section studies alternative communication network technologies and simulation of the proposed design techniques that can be used for networking the components of the modern metering infrastructure that supports DSM. The Standalone solar PV system studies feasibility of the approach. The economic feasibility studies concentrate more on cost-benefit trade-offs of domestic PV integration in terms of DSM and peak demand saving (PDS). The technical feasibility study investigates power quality disturbances and how these can be detected and mitigated. In addition, the thesis presents case studies on real-life implementation issues of AMI and solar PV systems. These case studies also resolve into power management for implementation of the proposed DSM solutions.

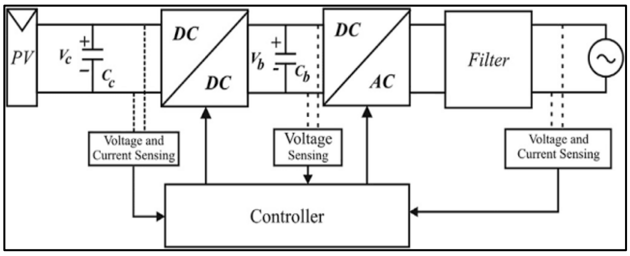

Fig. 1: Block Diagram of Standalone PV system

A. Objectives

- The basic objective of this paper is to extract maximum power and to maintain power quality to as at is factory level from the varying condition the Photovoltaic array with different solar irradiation.
- To capture the maximum power from the PV system, maximum power point tracking is applied.

B. Modeling of a Solar Cell

PV array are formed by combine no of solar cell in series and in parallel. A simple solar cell equivalent circuit model is shown in figure. To enhance the performance orating no of cell are combine. Solar cell are connected in series to provide greater output voltage and combined in parallel to increase the current. Hence a particular PV array is the combination of several PV module connected in series and parallel. A module is the combination of no of solar cells connected in series and parallel.

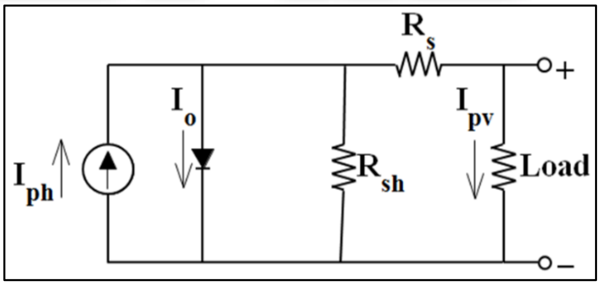

Fig. 2: Circuit Diagram of a Single PV Cell

C. Incremental Conductance Method

This algorithm, shown below, compares the incremental conductance to the instantaneous conductance in a PV system. Depending on the result, it increases or decreases the voltage until the maximum power point (MPP) is reached. Unlike with the P&O algorithm, the voltage remains constant once MPP is reached.

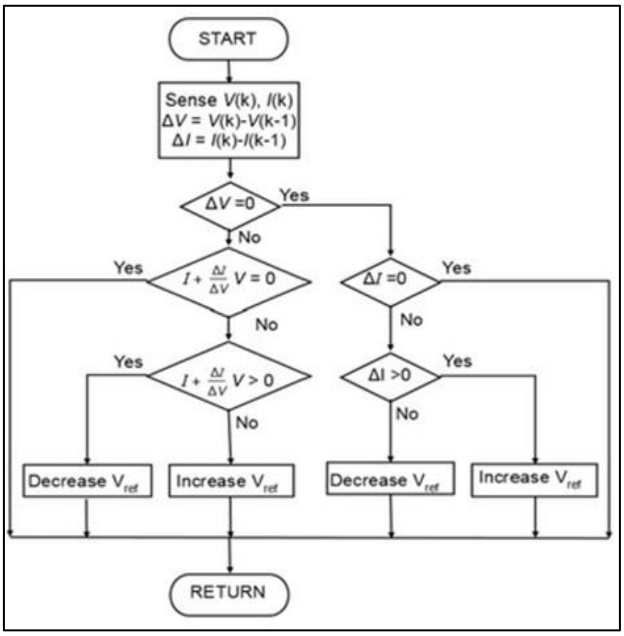

Fig. 3: Incremental Conductance Algorithm Flow Chart

With this algorithm the operating voltage V is perturbed with every MPPT cycle. As soon as the MPP is reached, V will oscillate around the ideal operating voltage. This causes a power loss which depends on the step width of as in gleperturbationi. E. the larger the step is, the larger the oscillations around voltage of maximum power is and vice versa. If the step width is large, the MPPT algorithm m will be responding quickly to sudden changes in operating conditions with the tradeoff of increased losses under stable or slowly changing conditions. If the step width is very small the losses under stable or slowly changing conditions will be reduced, but the system will be only able to respond very slowly to rapid changes in temperature and so larirradiance. The value of ideal step width is system dependent and needs to be experimentally determined.

II. EXPERIMENTAL WORK

A microgrid is defined as a system consisting of generation sources, storage equipment, and electrically connected loads, to meet a determined energy demand. It can operate connected to the main grid in medium voltage or low voltage, or isolated from the same. Energy sources in a microgrid can be renewable (e.g. photovoltaic, wind, thermal and geothermal generation, biomass, tidal and cogeneration, etc.), conventional in situ (e.g. diesel thermal plants) or the same electric grid.

The current trend focuses on the use of renewable energies in the majority of cases, leaving conventional generation for exceptional cases, such as details.

Fig 4 shows the general structure of a microgrid, formed by different energy generation systems (conventional and unconventional), energy storage system, and power management units (e.g. converter, grid-tied inverter, pure inverter, and regulator) for the system operation and the possible connection to the grid.

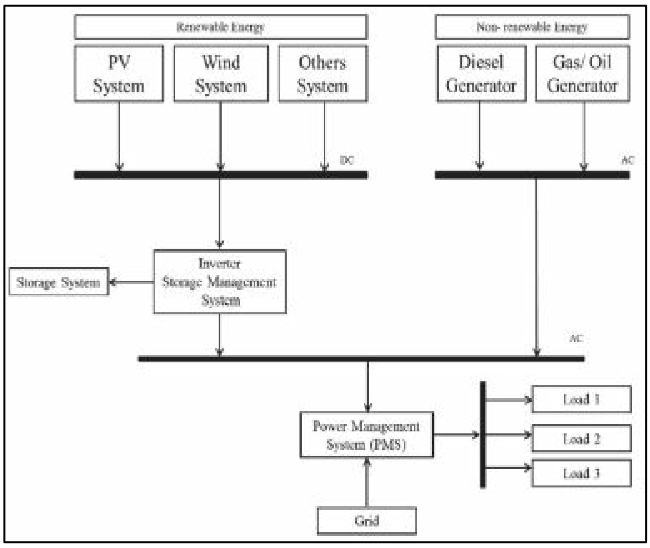

Fig. 4: Proposed Structure of Microgrid

The most advanced micro grids have a power management strategy (PMS) and an energy management strategy (EMS), which are described in the information flow diagram (Fig.5). These management functions require a communication infrastructure consisting of smart metering equipment.

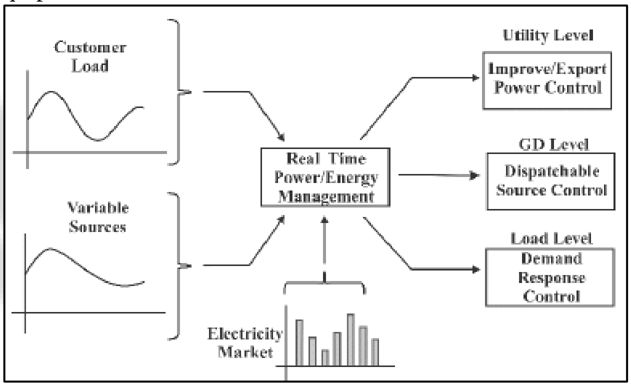

Fig. 5: Information Flow & Function of a real time EMS for microgrid

The configuration of the hybrid system is shown in Figure 6 where various AC and DC sources and loads are connected to the corresponding AC and DC networks. The AC and DC links are linked together through three- phase converters. The AC bus of the hybrid grid is tied to the utility grid.

In the proposed system, PV arrays are connected to the DC bus through boost converter to simulate DC sources. A battery with bidirectional DC/DC converter is connected to DC bus as energy storage. A variable DC and AC load are connected to their DC and AC buses to simulate various loads through EMS.

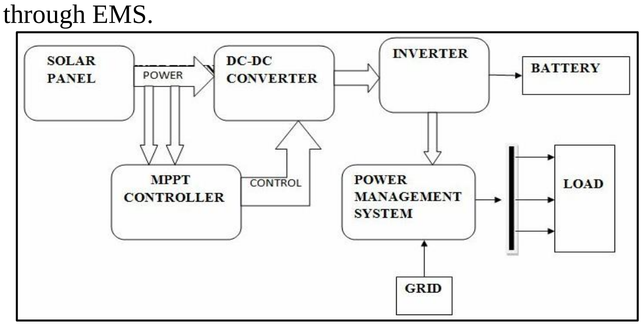

Fig. 6: Proposed Model Block Diagram

A. Modeling of 3-Level Bridge Inverter

IndistributionpowergenerationsystemthreephaseVSIareusedt ointerferebetween DC& AC system. For the control of active and reactive power along with constant DC link voltage different control technique are used to the three phase grid connected voltage source Inverter. Nowadays power electronics converter are widely employed in all the application due to the switches non linearity occur in the system so the power stage must be line a raised.

III. SIMULATION RESULTS

A micro grid whose parameters is simulated using MATLAB/SIMULINK environment. The operation is carried out for the grid connected mode. Along with the micro grid, the performance of the photo voltaic system and battery is analyzed. The solar irradiation is also taken in to consideration for the study of micro grid. The performance analysis is done using simulated results which are found using MATLAB. Smarts meters and time-of-use pricing DSM can help us to manage our electricity costs. In our project we introduced time-of-use pricing to reflect the costs of producing electricity at different times of the day. There are three time-of-use periods:

A. Consideration

Load1	Fan	90W
Load2	AC	1000W
Load3	Pump	800W
Load4	Heater	900W
Load5	Fridge	100W

Load switching curve can be simulated by using MATLAB/SIMULINK for different hours in a day and time of use pricing can be analysed by using smart meters so as to reduce the electricity bill as well as power consumption can be reduced by using the whole system and demand side management can be verified by switching of loads at on load and off load whose timing will be fixed as per DSM techniques. The different load switching can be viewed in graph by switching on and off manually. This can be verified by the graph and the simulation results of has been described.

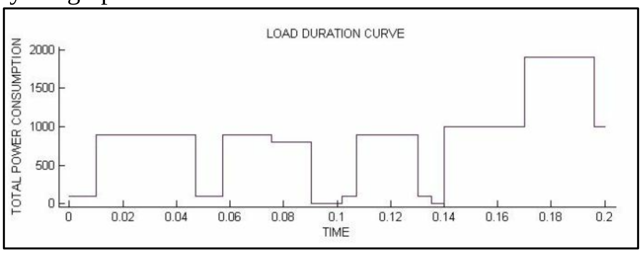

Fig. 7: Total Power Consumption during a Day

IV. CONCLUSION

The modeling of micro grid for power system configuration is done in MATLAB/SIMULINK for energy and power management system. The present work mainly in cludes the grid tied mode of operation. The models are developed for all the converters to maintain table system under various loads and resource conditions and also the control mechanism are studied. MPPT algorithm is used to harness maximum power from DC sources and to coordinate the power exchange between DC and AC grid. Although the system can diminish the processes of DC/AC and AC/DC conversion Sinan individual AC or DC grid, there are many practical problems for the implementation of the system based on the current AC dominated infrastructure. The efficiency of the total system depends on the diminution of conversion losses and the increase for an extra DC link. The micro grid can provide are liable, high quality and more efficient power to consumer. The system may be feasible for small isolated in dustrial plants with both PV systems and battery.

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