A STUDY ON RECENT APPROACHES IN SOLAR PHOTOVOLTAIC SYSTEMS WITH GRID CONNECTIVITY

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ABSTRACT:

Energy is the key component for the conservative improvement of a nation. With the expanding worry about the worldwide request for Renewable Energy (RE) vitality, it is particularly imperative to diminish the cost of the entire sunlight based photovoltaic (PV) framework. Still now a large portion of the sun based photovoltaic (PV) system is exceedingly costly. In this paper we have demonstrated that lattice tied close planetary system can be produced by precluding the energy storage device like huge limit battery bank. It won't just lessen the inside misfortunes for charging and releasing of battery bank yet in addition in the meantime a lot of cost of the battery will be decreased. In this way, the framework support cost will be decreased too. We have proposed another way to deal with plan a photovoltaic (PV) sun oriented power framework which can be worked by bolstering the sun oriented energy to the national network alongside the private load. Once more on the off chance that there is an additional power interest for private load alongside the sun based power then this framework can likewise give an open door to devour the power from the national network. The aggregate framework is controlled with the assistance of some the sensors and a microcontroller. In general a huge decrease in the framework costs and productive framework execution can be figured it out.

Keywords: Smart control, Grid connected PV system, PV system without storage, Net metering, Grid-tie inverter.

INTRODUCTION:

PV systems can be installed without being connected with the conventional grid line are off grid system and most of this systems make use of the large capacitive battery as energy storage device. They store the energy in day time and use it at night time. One the other hand there is a very little use of on grid or grid tied system.

Conventional Off Grid System

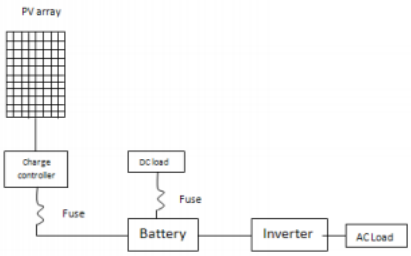

Fig. 1 Schematic diagram of a off-grid PV system with AC and DC loads

Typical configuration of a off-grid PV system is depicted above in Fig 1. This system is consists of a PV array with a charge controller, battery and DC load. This can be operated to drive an AC load by using an Inverter.

Conventional Grid Tied PV System

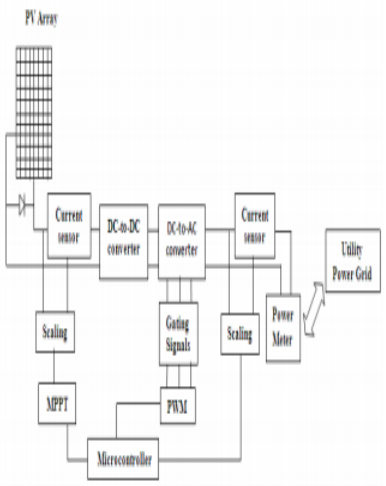

Fig. 2 Block diagram of a grid-tied PV system

Still grid tied PV system is not a popular PV installation system in the world. Some of the grid tied system has been designed earlier which was not so efficient at all. But to reach the goal of having more energy from renewable sources, we need to grab every opportunity of scaling up. Configuration of a typical grid-tied PV system is given above in Fig2.

System Layout

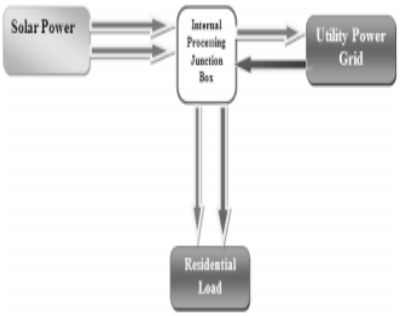

Fig.3 Layout diagram of the planned grid-tied PV system

A newly designed grid-tied PV system is shown in Fig.3. Here the grid-tied PV system is consists of an internal processing junction box with its three end point. These are solar power, utility power grid and Residential load. Here this system always tries to feed the solar power to the utility power grid. At the same time the residential load will consume the power from the utility power grid. But if the grid power is unavailable then the residential load demand will be supplied by the solar power.

Schematic Diagram and the Relay Position

The power flow from the PV array and the utility power grid is controlled by three relay. The positions of the relays are also shown in Fig.4. During normal operation relay 3 always at Normally Close (NC) position. At day time when sunlight and grid power is available relay 1 and relay 2 both will be at NC position. So that the solar power will feed to the grid through relay 1 and at the same time residential load will consume power from utility power grid through relay 2. But if grid power is unavailable relay 2 will be off and relay 3 will be at Normally Open (NO) position. So that, the solar power can flows to the residential load. Again if there is any overloading situation due to the residential load the relay 3 will be operating to disconnect the connection and ensure the safety of the system. At the same time it will generate a signal to the consumer for reducing the load. This is how the system will operate with a most efficient manner.

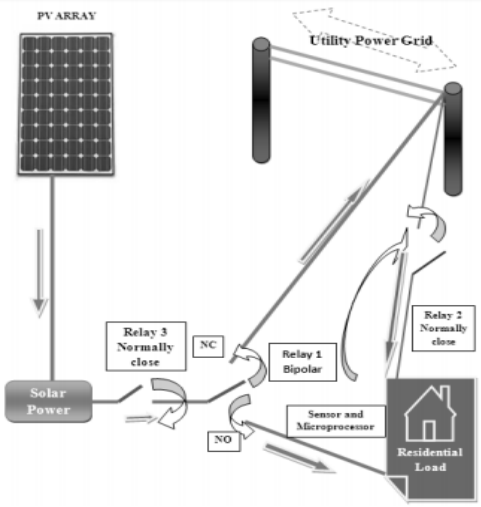

Fig. 4 Schematic diagram of the planed grid-tied PV system

Grid-Tied PV System Block Diagram

Fig.5 shows the block diagram of the control scheme. The system block diagram consists of solar PV array, MPPT charge controller, DC to DC converter, High efficient Grid Tie inverter, AC three phase synchronizer, Microcontroller, DC power measuring device, CT, PT, ADC (Analogue to Digital converter), Relays and Metering device. We can describe all those elements in three parts:

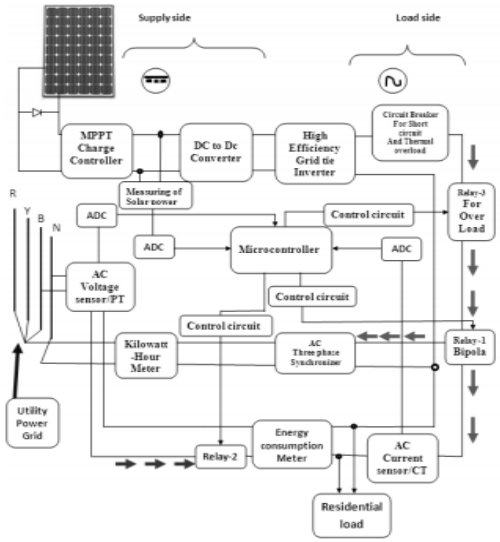

Fig. 5 Grid-Tied PV system block diagram

Voltage Control of Solar PV Array

The power output of a PV array depends on the voltage level where it operates under a given condition of irradiance and cell surface temperature. For efficient operation, a PV array should operate near at the peak point of the V-I curve. Various Maximum Power Tracking (MPPT) techniques have been proposed.

Flow Chart Of The Control Scheme

Fig. 7 shows the flow chart of the control scheme. According to the flow chart we develop a program in Micro-c and also in assembly code to check the system performance. Here, after initialization of the system parameter the microcontroller always check the availability of grid power and solar power and take decision to control the relay 1 and relay 2. The microcontroller also compares the solar power with the residential load to control the relay1 and relay 3. According to the technical requirement in IEEE 1547, to prevent islanding situation the microcontroller always monitor the voltage and frequency of the grid and disconnect the grid tie inverter from the grid for any worse situation by controlling relay 1.

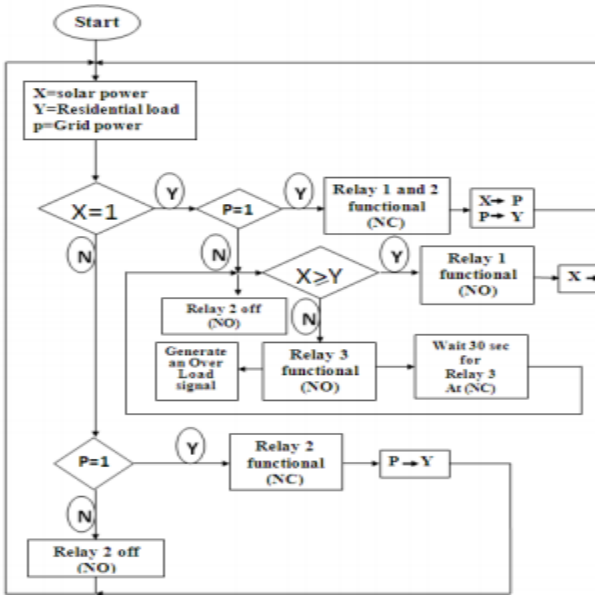

Fig 6: Flow chart of the control scheme

Cost Analysis of The PV System

PV array Wp of a PV system with and without storage device. Here for a typical system we assume the relative cost components as: PV array $ 1.207 per Wp, Battery $1.207 per AH, Inverter $ 0.6030 per Watt, Charge controller $1.207 per Amp. This graph shows that the system cost will be cheap for a same Wp PV array installation without storage device (Battery). Fig.7 shows the graph of installation cost vs.

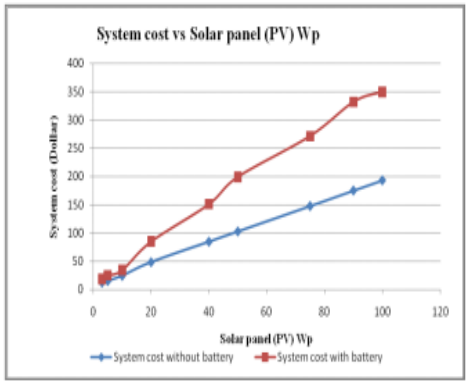

Fig. 7. System cost vs. solar panel (PV) Wp

Performance of a Typical System With Storage

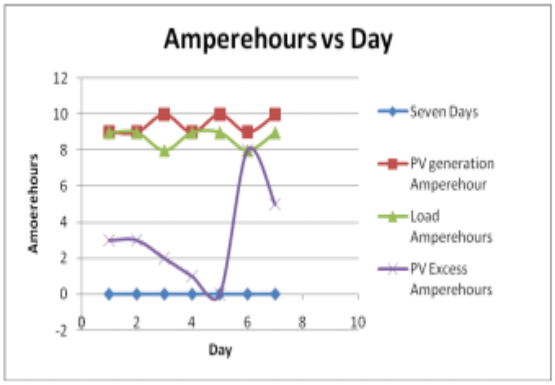

Fig. 8, Ampere-hour vs days of a typical PV system

Fig.8 shows the graph of Ampere-hour vs days. Here for this system we use a solar panel of Pmax 87W, Vpmax 17.4V, Ipmax 5.02A, Voc 21.7V and Isc 5.34 A at temperature 25oC. We have measured this data from our experimental set up.

Advantages of The Designed System

A typical solar system would require a large battery bank to storage the solar energy. By removing this expensive storage device the system installation cost can be maintained within an acceptable limit. Grid tied system is more power efficient than a conventional solar system. It ensures full utilization of solar energy whereas battery discharge rate is 60% to 65% in conventional off-grid solar system in Bangladesh. As energy storage capacity of these batteries degrade with time and need replacement which required extra cost for the system owner. This grid-tied system also represents the consumer as an energy provider to the utility power grid.

Net metering allows system owners to get credit for any electricity from the system sends to the national grid. If the grid power is unavailable, still the system will continue to supply critical on-site loads.

Limitation of The Designed System

In this paper we have come within the reach of a new PV system design. But in our design we have also some limitations. This grid-tied system without storage can't supply power during night or rainy day when sunlight is not sufficient. Again power output from certain renewable energy sources, like wind and solar, can be intermittent. Fluctuation in output can negatively affect power grid frequency, voltage, component performance, causing instability in the power generation system and interrupted service to the customers.

Conclusion

This system has been designed with a concept of micro photovoltaic power station. Still the solar PV system installation cost is not within an acceptable limit. Proper step should be taken to reduce the solar PV system cost. So that, the general electricity consumer can concentrates their attention in grid-tied PV system. We hope there will be occur a lot of activity regarding grid-tied PV system and then our work may help to decide an optimized way. So, in this paper we have shown an advanced grid-tied PV system which is suitable for Bangladesh as well as for other countries to produce more energy from renewable energy sources. Thus every photovoltaic system which is installed in any where can be treated as a micro PV power station, no matter what ever the generation capacity of the plant.

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