Modified Photovoltaic Burp Charge System on Energy-Saving Configuration for PVSystems

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Abstract:A smart charging management (CM) introduces three sorts of charge statuses, a burp pulse (BP) charge and two pulse charges, which charges three batteries, Bum, B1, and B2 simultaneously and separately by using interleaved fly back converter module. Two pulse charges aregoing with the BP charge so as to keep the PV- Wind energy supply ceaseless and esteem the remaining vitality for furtherstoring. The BP charge for Bum is made out of a positive pulse (PP) charge in a positive burp pulse (PBP) period and negativepulse (NP) charge in non-PBP period. The other two batteries B1 and B2 are dependably with PP charge in the non-PBP period,in which B1 charges the remaining PV-Wind vitality to keep the PV-Wind vitality supply ceaseless, understanding the vitality; B2charges the release sum from Bm by critically releasing, which to be sure is identical to the NP charge, accomplishing the vitalityrecuperation idea. Analysis of PV-WIND burp Charge system can be solved out by MATLAB/Simulink.

Keywords: Interleaved Flyback Converter, PV Array, Wind Energy Module

I. INTRODUCTION

Electrification of remote and rural isolated areas with the national grid is not always possible due to the prohibitive costs. Therefore, many off-the-grid communities have been using diesel engines as the main power source. To meet the energy needs, governments have opted for the installation of independent renewable energy systems with battery energy storage systems (BESS) [1]. However, energy storage is one of the greatest challenges for renewable energy systems, especially in stand-alone solar photovoltaic system and wind farms, where the application of electrochemical energy storage demonstrates high response times and round-trip efficiencies [2]. Moreover, from an economical point of view, in a solar photovoltaic system, the energy storage system (ESS) represents 40% of the total cost [3 – 4]. Storage technologies are usually categorized based on time scale of applications such as instantaneous (less than a few seconds), short term (less than a few minutes), mid-term (less than a few hours), and long-term (days) [5]. Moreover of the BESS there are different types of energy storage technologies [5 – 12]: pumped hydro energy storage (PHES), compressed air energy storage (CAES), flywheel energy storage (FES), hydrogen-based Energy Storage System (HES), flow battery energy storage (FBES), superconducting magnetic energy storage (SME), and super capacitor energy storage (SES). However, because of their localization flexibility, efficiency, scalability, and other appealing features [13], the BESS is the preferred technology [14],

II. BACKGROUND WORKS

Many algorithms are formulated for PV system. The mainaim is to find the point in the V-I characteristics of the solarpanel, at which the product of Voltage and current ismaximum. It is found that there is only one point in the curveat particular temperature and irradiation condition.As the solar energy is a promising form of energy to meetour power demand, technology improvement is required tokeep the power generated from PV panels to be maximum atall weather conditions. Many algorithms are being developedto find the maximum point of power obtained from a cell,module and hence a panel. Efficiency of a module:

Perturb and observe method:

This is the basic hill climbing algorithm used. First the PVvoltage and current are measured and the correspondingpower is calculated. A small perturbation of voltage or dutycycle of the dc/dc converter, in one direction is considered and corresponding power is calculated. The two power values are then compared. If power calculated after perturbation is more than first, then the perturbation is in the correct direction; otherwise it should be reversed. In this way, the peak power point is recognized and hence the corresponding voltage can be calculated. P&O/hill-climbing show occasional deviation from the maximum operating point in case of rapidly changing atmospheric conditions. The perturbation size is important in providing good performance in both dynamic and steady-state response. To achieve better result an adaptive hill climbing technique, with a variable perturbation step size can be formulated, where an automatic tuning controller varies the perturbation step size according to the environmental condition.

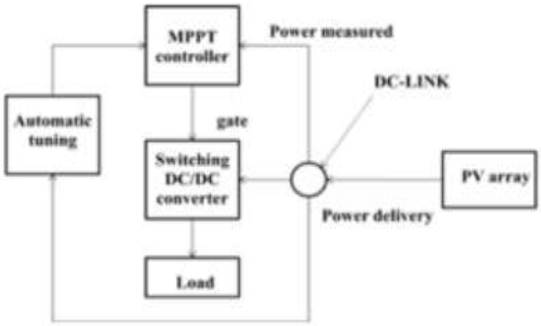

Fig1.Schematic representation of Adaptive Perturband Observe method.

Ripple Co-relation Control technique:

The switching action of the converter imposes voltage andcurrent ripple on the generated power of PV system when it isconnected to a power converter. This ripple can be utilized bythe system to perform MPPT. No artificial perturbation isrequired as the ripple is naturally available by using aswitching converter.

Intelligent MPPT techniques:

Fuzzy Logic (FL)-Based MPPT Technique: The softcomputing techniques achieved very good performances, fastresponses with no overshoot, and less fluctuations in thesteady state for rapid temperature and irradiance variations.

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III. SYSTEM CONFIGURATION

Smart charging management: Three dynamic charging states in one BP charging period are

- Executing the PP Charge to the Main Battery B m in PBP Period, t0 < t < t1 : As shown in Fig.2, the main Bm first receives PP iB 1 split from current source is via power switch QT 1 in the interval tp 1 (PBP period, from t0 to t1) while B 1 and B 2 are in relaxation. In this situation, the B m undergoes the PP charging. Executing (a) the Intense Discharge from the B m to B2 and (b) the PP Charge to the B 1 , t1 < t < t 2 :
- In Fig. 2(b), QT1 turns OFF and QT 3 turns ON, in the interval tp3 (NP period, from t 1 to t 2), the IFC-2 intensely discharges the B m and transfers its discharging amount to charge B2 , which performs energy recovery concept. In this situation, the Bm equivalently undergoes the NP charging.
- In this period, which is a part interval of the non-PBP period T2 , QT2 turns ON and QT 1 turns OFF, B1 first executes part of the remaining PP charging from PV module through QT2. This charging actiontion ensures the energy pump from PV module continuous and keeps MPPT optimum, attainingenergy treasuring concept.

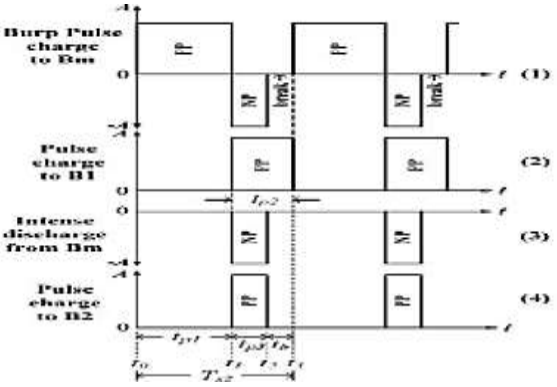

Fig. 2. PV burp charging scenarios: (1) burp pulse (BP) toB m , (2) PP charge to B1, (3) NP intense-discharging fromB m to B 2 with PP, and (4) PPto B 2 ; where PP: positivepulse, NP: negative pulse, and Ts2 : BP period.

The pulse width modulation (PWM) concept is borrowedfrom communication systems, wherever an indication ismodulated before its transmission, and so demodulated at thereceiving terminal to recover the initial signal. Constant ideamay be applied to an influence convertor. in an exceedinglypower convertor, the switch network has associate on/offnonlinear nature. The desired continuous wave form ismodulated and reborn to digitized signals to management theswitch network. All the PWM schemes may be evaluatedunder a certain switching frequency and the reference signalfrequency ratio, and the input and output voltage ratio, whichis also named as the modulation index M.

The performance of a modulation scheme can be evaluated based on the following five aspects:

- Distortion of the output voltage or current;
- Power losses;
- Harmonic spectrum and EMI;
- Dynamic range; and
- Complexity. It is always desirable to minimize the

distortion of the output voltage or current. It maychange with the modulation index in a nonlinear curve.The power losses are related to the total number of switching actions in one switching cycle, and the current level at switching. Therefore, different modulation schemes may result in different efficiencies. A PWM scheme with minimized switching losses is desirable especially for highpower applications. Harmonic spectrum of the output voltageor current is related to the EMI issue and acoustic noise. It is desirable to minimize the EMIand acoustic noise. Dynamic range refers to the maximum possible control level in steadystate or during transient. It can also be interpreted as the ratio between the maximum possible output and the input. It is desirable to have a higher ratio. It means a better DC link voltage utilization, which is crucial for high voltage applications. It is preferable to have a PWM scheme that canbe implemented easily, by either an analog means or digital means as shown in Fig.3.

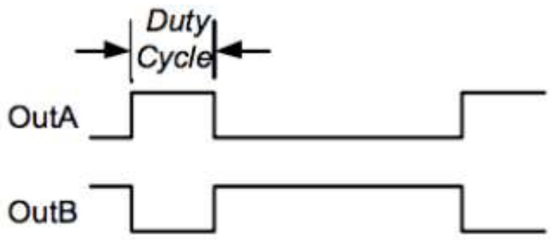

Fig.3. PWM waveforms.

IV. SIMULATION RESULTS

The below figs.4to 15 shows the simulation circuit diagram of a proposed system and following shows thewaveforms getting from the simulation diagram.

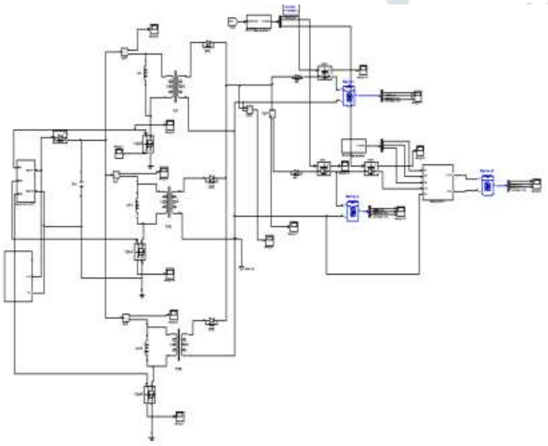

Fig.4 Simulation circuit diagram of proposed converter.

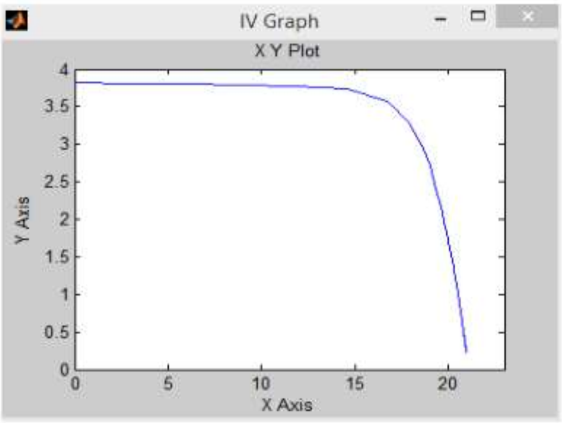

Fig.5. I-V characteristics.

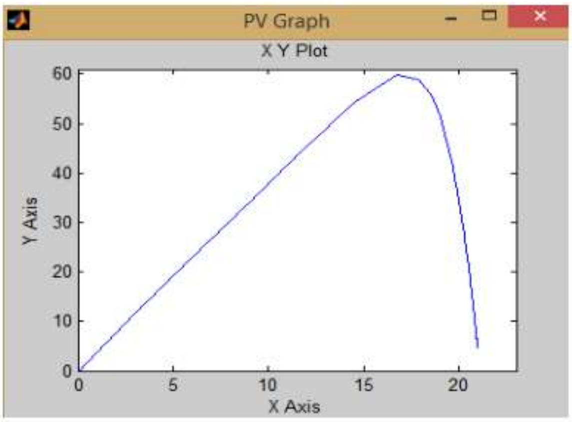

Fig.6. Solar PV characteristics.

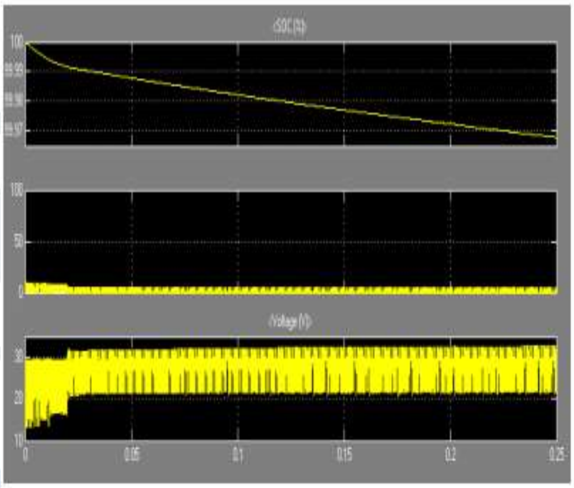

Fig.7. Waveforms of Battery Bm SOC, Current, Voltage.

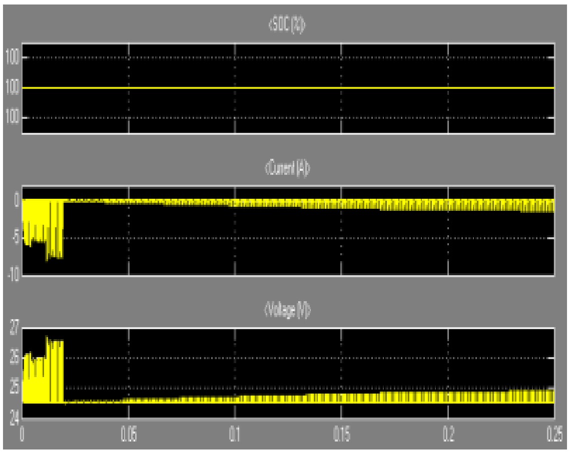

Fig.8.Waveforms of Battery B1 SOC, Current, Voltage

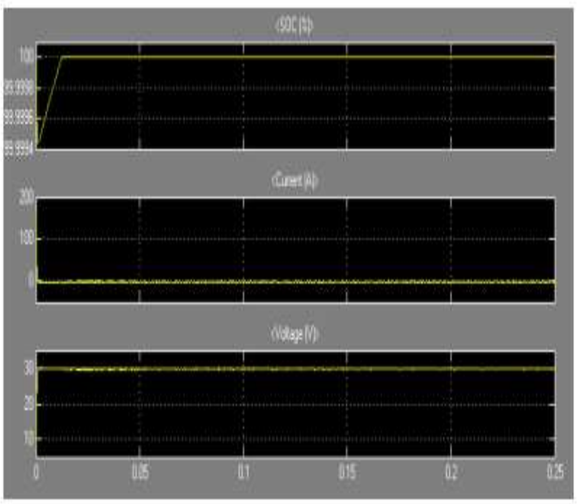

Fig.9. Waveforms of BatteryB2 SOC, Current, Voltage.

V. CONCLUSION

The idea of concurrently charging three batteries by utilizing direc trenewable source creates a new theme, which makes it come true to achieve the energy treasuring and recovery concept.Excluding for a large-scale energy management to the batterycharge, even in a remote area, the PV-Wind BCS can also bea hybrid charger for renewable energy application if additional renewable energy is mixed with the PV energy.Mainly different from a general hybrid charging mode, which always requires a dc bus as an energy buffer, the proposedPV-BCS emphasizes directly using PV energy supplywithout dc bus. In spite of the benefit of low-frequency pulsebreak aided for prolonging the battery life, the tiny brief break between the adjacent high-frequency pulses also benefits the dissolve of sulfating crystallization. Simulation results done with MATLAB/simulink.

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