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Hybrid Renewable Energy Based Grid Connected Load Management Scheme via Coupled DC-DC Converter

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ABSTRACT: In today's environment, renewable energy sources are the major needs to provide the supplementation for the power industry, the renewable energy sources are categorized into several categories such as Windmill, Photovoltaic array, Battery and so on. In this approach, a photovoltaic-Wind-battery based power management system is designed to provide support to power flow control of grid-connected hybrid household devices. The main objective of the proposed system is to satisfy the load control via power flow problems, which is inputted via multiple renewable power sources as well as manage or stores the surplus power into the grid as well as charging the battery from that grid as and when it is needed. In this system, a bidirectional buck-boost converter is used to manage the power flow as well as maintaining the battery charging and discharging needs. The buck converter is used to reduce the input voltage and provide supply to the required household devices or else reduce the power from the input flow and store that into the small charging devices such as battery. The boost converter is used to increase the power flow from the input source and provide necessary supply to the household devices to operate gently without any power problems. The proposed converter architecture has reduced number of power conversion stages with less component count, and reduced losses compared to existing grid-connected hybrid systems. For all this entire system improves the efficiency and performance of the power flow management scenario as well as improve its reliability over renewable architecture.

KEYWORDS: Renewable Energy Source, PV, Windmill, Battery, Hybrid Systems, Buck Converter, Boost Converter, MPPT, Bidirectional Converter.

I. INTRODUCTION

Quick exhaustion of non-renewable energy source holds, regularly expanding vitality request and worries over environmental change rouse control era from sustainable power sources. Photovoltaic (PV) and the wind have developed as well known vitality sources due to their eco-accommodating nature and cost adequacy. Be that as it may, these sources are discontinuous in nature. Consequently, it is a test to supply steady and persistent power utilizing these sources. This can be tended to by proficiently coordinating with vitality stockpiling components. The intriguing correlative conduct of PV based insulation and wind speed design combined with the previously mentioned preferences, has prompted the examination on their coordination
bringing about the half and half PV-wind frameworks.

For accomplishing the mix of various inexhaustible sources, the customary approach includes utilizing committed single-input converters one for each source, which is associated with a typical dc-transport [1][2][3][4][5]. In any case, these converters are not successfully used, because of the irregular idea of the sustainable sources. What's more, there are numerous power change stages which decrease the effectiveness of the framework. A huge measure of writing exists on the mix of PV oriented and wind vitality as a crossbred vitality era framework which concentrates chiefly on its estimation and improvement [7][8]. In prior methodologies the estimating of generators in a half and half framework is explored. In this framework, the sources and capacity are interfaced at the DC-Link, through their committed converters.

Different commitments are made on their displaying angles and control methods for a stand-alone hybrid energy system in [9][10][11][12]. Dynamic execution of a remain solitary half and half PV-wind framework with

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battery stockpiling is examined in [9]. In past frameworks, a detachment/sliding mode control is exhibited which controls the operation of wind vitality framework to supplement the PV-Light based vitality producing the framework. Very few endeavors are made to streamline the circuit arrangement of these frameworks that could diminish the cost and increment the proficiency and dependability.

In prior methodologies, incorporated converters for PV and wind vitality frameworks are displayed. PV-wind half breed framework, proposed by Daniel et al. [16], has a basic power topology yet it is reasonable for remaining solitary applications. An incorporated four-port topology in light of half-breed PV-wind framework is proposed in [18]. Be that as it may, regardless of straight-forward topology the control conspires utilized is intricate. In past examination, to sustain the dc stacks a low limit multi-port converter for a half-breed framework is introduced. Half Bridge and PV-wind based era of power and its interface with the power lattice are the imperative research regions. Chen et al. in [20][21] have proposed a multi-input half breed PV-wind control era framework which has a buck/buck-boost melded multi-input dc-dc converter and a full-connect DC-AC inverter. This framework is mostly centered on enhancing the dc-connect voltage control. In the six-arm converter topology proposed by H. C. Chiang et al. [22], the yields of a PV exhibit and wind generators are sustained to a lift converter to coordinate the dc-transport voltage.

The enduring state execution of a grid-connected mixture PV and wind framework with battery stockpiling is broke down in [4]. This framework concentrates on framework
designing, for example, vitality generation, framework dependability, unit estimating, and cost investigation. In past frameworks, a half and half PV-wind framework alongside a battery is introduced, in which the two sources are associated with a typical dc-transport through individual power converters. Furthermore, the dc-transport is associated with the utility framework through an inverter. The utilization of Multi-Input Converter (MIC) for hybrid power frameworks is pulling in expanding consideration due to decreased part tally, improved power thickness, smallness and brought together control. Because of these points of interest, numerous topologies are proposed and they can be characterized into three gatherings, non-disconnected, completely secluded and halfway detached multi-port topologies.

All the power ports in non-disengaged multi-port topologies share a shared belief. To infer the multi-port dc-dc converters, an arrangement or parallel design is utilized in the information side [23][24][25][26][27]. A few parts can be shared by each information port. Be that as it may, a period sharing control conspire couples each info port, and the adaptability of the vitality conveyance is constrained. The arrangement or parallel design can be reached out at the yield to determine multi-port dc-dc converters [28]. Be that as it may, the power parts can't be shared.

Every one of the topologies in non-disconnected multi-port is for the most part mixes of essential topology units, for example, the buck, the lift, the buck-help or the bi-directional buck/support topology unit. These timesharing based multi-port topologies guarantee ease and simple usage. Notwithstanding, a typical restriction is that power from numerous sources of info can't be exchanged all the while to the heap. Further, coordinating wide voltage reaches will be troublesome in these circuits. This made the scientists to incline toward disengaged multi-port converters contrasted with non-disconnected multi-port DC-DC converters.

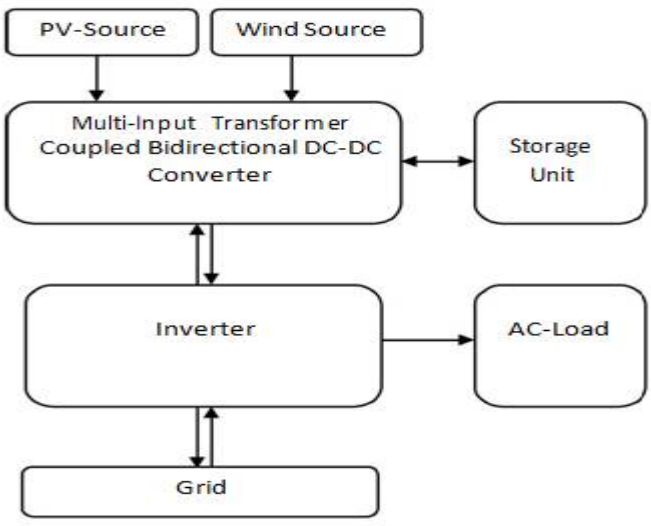

Fig.1 Grid-connected hybrid PV-wind-battery based system Model

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II. PROPOSED CONVERTER CONFIGURATION

The proposed converter comprises of a transformer coupled lift double half-connect bidirectional converter intertwined with bidirectional buck-support converter and a solitary stage full-connect inverter. The proposed converter has lessened number of energy change stages with less part check and high effectiveness contrasted with the current network associated plans. The topology is straightforward and needs just six power switches. The schematic outline of the converter is portrayed in the following figure. The lift double half-connect converter has two dc-interfaces on the two sides of the high recurrence transformer. Controlling the voltage of one of the dc-joins, guarantees controlling the voltage of the other. This makes the control technique straightforward. Also, extra converters can be incorporated with any of the two dc-joins. A bidirectional buck-support dc-dc converter is incorporated with the essential side dc-connection and a single-stage full-bridge bidirectional converter is associated with the dc-connection of the optional side. The contribution of the half-connect converter is framed by associating the PV cluster in arrangement with the battery, subsequently consolidating an inalienable boosting stage for the plan. The boosting ability is additionally upgraded by a high recurrence venture up transformer.

The transformer likewise guarantees galvanic disconnection to the heap from the sources and the battery. The bidirectional buck-boost converter is utilized to saddle control from PV alongside battery charging/releasing control. The extraordinary component of this converter is that MPP following, battery charge control and voltage boosting are expert through a solitary converter. Transformer coupled lift half-connect converter is utilized for tackling power from the wind and a solitary stage full-connect bidirectional converter is utilized for encouraging air conditioning burdens and association with lattice. The proposed converter has lessened a number of energy transformation stages with less part check and high proficiency contrasted with the current network associated converters. The power spill out of wind source is controlled through a unidirectional lift half-connect converter.

For getting MPP successfully, smooth variety in source current is required which can be gotten utilizing an inductor. In the proposed topology, an inductor is put in arrangement with the breeze source which guarantees persistent current and hence this inductor current can be utilized for keeping up MPP current. At the point when switch T 3 is ON, the present coursing through the source inductor increments. The capacitor C1 releases through the transformer essential and switch T 3 as appeared in the following figure.

In optional side capacitor C3 charges through transformer auxiliary and hostile to parallel diode of switch T 5. At the point when switch T 3 is killed and T 4 is turned ON, at first the inductor current courses through anti-parallel diode of switch T 4 and through the capacitor bank. The way of current appears in the following figure. Amid this interim, the present moving through diode diminishes and that coursing through transformer essential increments. At the point when current moving through the inductor ends up plainly equivalent to that moving through transformer essential, the diode kills. Since, T 4 is gated ON amid this time, the capacitor C2 now releases through switch T 4 and transformer essential. Amid the ON time of T 4, hostile to parallel diode of switch T 6 behaviors to charge the capacitor C4. The way of current stream appears in the following figure. Amid the ON time of T 3, the essential voltage VP = −VC1. The optional voltage VS = nVp = −nVC1 = −VC3, or VC3 = nVC1 and voltage crosswise over essential inductor Lw is Vw. At the point when T 3 is killed and T 4 turned ON, the essential voltage VP = VC2. Auxiliary voltage VS = nVP = nVC2 = VC4 and voltage crosswise over essential inductor Lw is Vw −(VC1 +VC2). It can be demonstrated that (VC1 + VC2) = Vw (1−Dw) . The capacitor voltages are viewed as consistent with relentless state and they settle at VC3 = nVC1, VC4 = nVC2.

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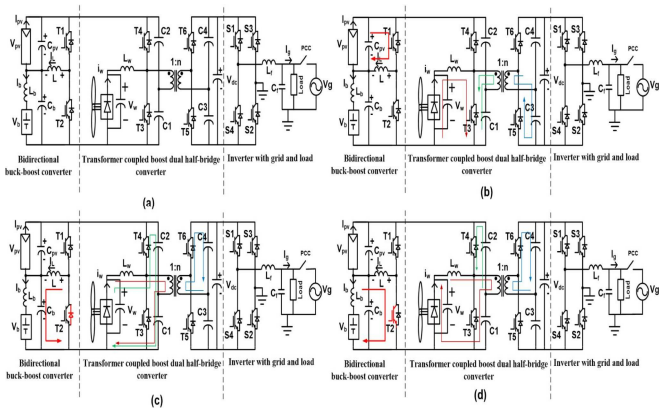

Fig.2 Operating modes of proposed multi-input transformer coupled bidirectional dc-dc converter. (a) Proposed converter configuration. (b) Operation when switch T3 is turned ON. (c) Operation when switch T4 ON, charging the capacitor bank. (d) Operation when switch T4 ON, capacitor C2 discharging.

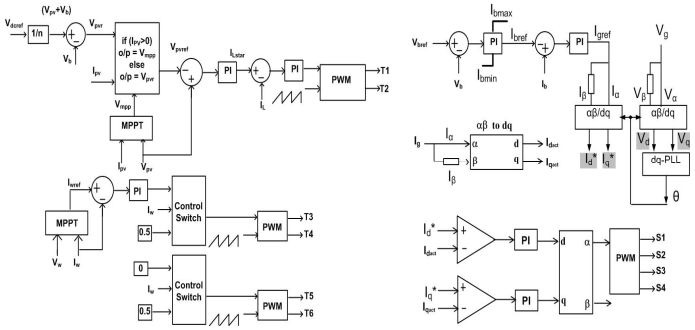

Fig.3. Proposed control scheme for power flow management of a grid-connected hybrid PV-wind-battery based system.

III. LITERATURE SURVEY

In the year of 2011 the authors "W. Qi, J. Liu, X. Chen, and P. D. Christofides" proposed a paper titled "Supervisory predictive control of standalone wind/solar energy generation systems" in that they described such as this work focuses on the development of a supervisory model predictive control method for the optimal management and operation of hybrid standalone wind-solar energy generation systems. We design the supervisory control system via model predictive control which computes the power references for the wind and solar subsystems at each sampling time while minimizing a suitable cost function. The power references are sent to two local controllers which drive the two subsystems to the requested power references. We discuss how to incorporate practical considerations, for example, how to extend the lifetime of the equipment by reducing the peak values of inrush or surge currents, into the formulation of the model predictive control optimization problem. We present several simulation case studies that demonstrate the applicability and effectiveness of the proposed supervisory predictive control architecture.

In the year of 2010 the authors "C. Liu, K. T. Chau and X. Zhang" proposed a paper titled "An efficient wind-photovoltaic hybrid generation system using doubly excited permanent-magnet brushless machine" in that they described such as: with ever-increasing concerns on energy issues, the development of renewable energy sources is becoming more and more attractive. This paper first reviews both the wind power and photovoltaic (PV) power generation techniques and their maximum-power-point tracking (MPPT) methods. Then, a new stand-alone wind-PV hybrid generation system is proposed for application to remote and isolated areas. For the wind power generation branch, a new doubly excited permanent-magnet brushless machine is used to capture the maximum wind power by

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using online flux control. For the PV power generation branch, a single-ended primary inductance converter is adopted to harness the maximum solar power by tuning the duty cycle. The experimental results confirm that the proposed hybrid generation system can provide high efficiency with the use of MPPT.

IV. CONCLUSION

A grid-enabled hybrid Photovoltaic wind and battery based power evacuation conspire for household application is designed over here. The proposed hybrid framework gives a rich incorporation of PV furthermore, Wind Source to extricate most extreme vitality from the two sources. It is acknowledged by a novel multi-input transformer coupled bidirectional dc-dc converter took after by an ordinary full-bridge inverter. An adaptable control procedure which accomplishes better usage of PV, wind control, battery limits without affecting the existence of battery and power stream administration in a lattice associated crossover PV-wind-battery based framework nourishing air conditioning loads is displayed. Definite reenactment considered are conveyed out to find out the feasibility of the plan. The test comes about acquired are in close concurrence with reproductions and are steady in exhibiting the capacity of the framework to work either in framework sustaining or remain solitary mode. The proposed design is equipped for providing un-interruptible energy to air conditioning loads and guarantees departure of surplus PV and wind control into the grid.

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BIOGRAPHY

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