Pic Controller Based Load Response For Wind And Solar Integration To Improve Power System Reliability

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Abstract- *Sunlight-based vitality and wind vitality are the two sustainable power sources most basic being used. Wind vitality has turned into the slightest costly sustainable power source innovation in the presence and has created the enthusiasm of researchers and teachers over the world. Photovoltaic cells change over the vitality from daylight into DC electricity. PVs offer included focal points over other sustainable power sources in that they radiate no commotion and require no support. Hybridizing sunlight-based and wind control sources give a reasonable type of intensity power generation. The wind and sunlight-based vitality frameworks are exceptionally questionable because of their unusual nature. The solution reported in this dissertation primarily investigates the reliability constrained planning and operations of electric power systems including renewable sources of energy by accounting for uncertainty.*

Keywords- Hybridization, Photovoltaic cell, Wind turbine, Power sustainable.

I. INTRODUCTION

Electrical power is transmitted and supplied through connection points with specified and quoted capacities. In some cases, especially in Gaza, the electrical demand is more than the supply limit, this obliges the distribution companies to schedule the power supply over different periods varying from four to ten hours a day. This status represents a real problem for residents and all other sectors. This problem is available for over ten years, and no indications for its end during the next years are available due to the continuously unchanged political situation. However, installing PV systems on residential houses and other private or common utilities with relatively low daily energy consumption represents an effective solution for a wide range of such consumers which represents a considerable part of the total electric power consumption in Gaza. The PV power system can provide a continuous power supply during grid blackouts, and it can inject the excess produced power into the electrical grid during the day periods. However, grid-connected PV systems cannot continue supplying electrical power during grid blackout hours due to the islanding mode of the inverter which is an essential main feature for each grid-connected inverter to satisfy the safety issues. Therefore, the electrical power generated from the PV system during blackout hours will be lost if no storage battery is available in the PV system. This leads to a considerable energy loss and will result in increasing the payback period of the PV systems. This paper aims to present a solution for such a problem by introducing an unconventional PV system that includes storage batteries, charge regulator, grid-connected inverter, bidirectional AC/DC converter, and control system to secure for continuous power supply. This system is designed to enable exploiting fully the hours of grid availability not only in supplying the load but also in charging the battery. On the other hand, it will exploit fully the PV-generated power in charging the battery, supplying the load, and injecting the excess energy into the grid. The novelty of the proposed PV system, in comparison with other conventional PV systems, is that it can operate in stand-alone and grid-connected modes without reducing the safety measures required for the islanding mode. The proposed system has been until now not built-in Palestine, and publications on such a system were not found due to its particularity in operating in stand-alone and grid-connected modes in a city of time-wise irregular daily grid interruptions for several hours. On the other hand, unlike the conventional grid-connected PV systems, which operate mostly at a DC voltage in the range of 400-600 V, the proposed system operates at a much lower DC voltage amounting to 48 V which is safer and facilitates reducing the number of necessary battery cells to only 24 cells.

II. RELATED WORKS

Increasing the pool of responsive resources is beneficial for wind and solar since they add variability and uncertainty to the power system at the same time that they displace generation that itself can respond [1]. Unbalanced loads with different types including constant power, constant current, and constant impedance are modeled at the system buses [2].The presented method has been tested and compared with different IEEE test feeders ‘results.

A review of the drawbacks of renewable energy as a promising energy source of the future[3]. In solar cell fabrication and converter technology, solar PV has emerged as one of the most promising renewable sources for bulk power generation[4].

The main goal of this is[5] to transform the behavior of the current uncontrollable RES into stable predictable generation, converting it from variable and unpredictable generation into dispatchable generation.[6] discusses feasibility analysis, optimum sizing, modeling, control aspects, and reliability issues. The fuzzy interval-based model for the microgrid testbed will help to formulate the energy management problem with more accuracy and robustness[7].

III. PROPOSED METHODOLOGY

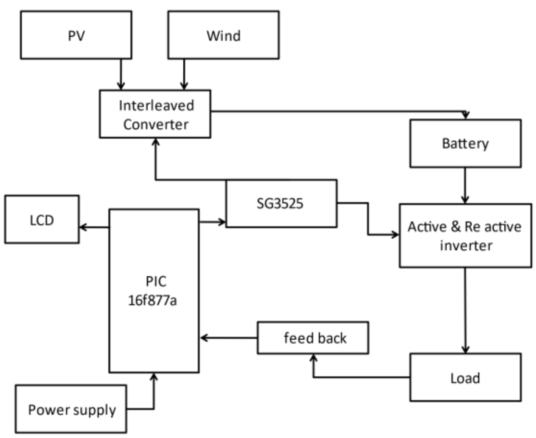

Figure 1 Block Diagram

Solar and are connected with Interleaved converter to maintain the output voltage as constant.For the Interleaved converter,the signal is obtained from the PIC controller as shown in fig 1, the signal is given to the converter with the help of gate drivers.Batteries are monitored and controlled by a Microcontroller.

IV. SYSTEM DESIGN

In this, we are going to improve renewable energy stability. The power fed from PV and wind varies from time to time. Here we are going to stabilize the power and give it to the battery. For stabilizing weuse an interleaved converter and then we store the stabilized power in the battery. The wind energy produces AC and a converter is here used to convert the AC into DC and then given to the interleaved capacitor. The PV produces DC and it's directly given to the interleaved capacitor as shown in figure1. The output depends on the pulse generated. Then the power is given to the active and reactive inverter. The active inverter gives the supply to the load. A feedback circuit was connected to the load and given to the controller. The feedback gives the signal and the process that has been carried out on the utilizing side. The controller was programmed with an AI algorithm. The output stability was fixed due to the pulse generated by the PWM. The PWM helps to fix the value at the output like 12v or 24v. The average value of current and voltage fed to the load is controlled by the supply and load. Along with the MPPT is used to reduce the output of the solar panel which can be utilized by the battery.

PHOTOVOLTAIC CELL

The photovoltaic cell (often shortened as PV) in figure 2 gets its name from the process of converting light (photons) to electricity (voltage), which is called the photovoltaic effect. This phenomenon was first exploited in 1954 by scientists at Bell Laboratories who created a working solar cell made from silicon that generated an electric current when exposed to sunlight**.**

Figure 2PHOTOVOLTAIC CELL

WIND TURBINE

A Wind turbinein fig 3 is a device that converts the wind's kinetic energy into electrical energy. Wind turbines are manufactured in a wide range of sizes. Smaller wind turbines are used for applications such as battery charging for auxiliary power for boats or caravans, and to power traffic warning signs. Larger wind turbines can contribute to a domestic power supply while selling unused power packs to the utility supplier via the electrical grid. Wind turbines work on a simple principle: instead of using electricity to make wind like a fan -wind turbines use the wind to make electricity. The wind turns the propeller-like blades of a turbine around a rotor, which spins a generator and creates electricity.

Figure 3 Wind Turbine

ULTRACAPACITOR

An ultracapacitorshown in fig 4, also known as a supercapacitor or electrochemical capacitor, is a device for storing electrical energy which is growing rapidly in popularity. Because no physical or chemical changes occur when the charge is stored, ultracapacitors can also be used many times over with degradation. During charging, ions from the electrolyte accumulate on the surface of each carbon-coated plate. Like capacitors, ultracapacitors store energy in an electric field, which is created between two oppositely charged particles when they are separated. This then causes each electrode to attractions of the opposite charge.

Figure 4Ultracapacitor

PIC MICROCONTROLLER

PIC is a family of modified Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division shown in figure 5. The name PIC initially referred to "Peripheral Interface Controller" now it is "PIC" only.The PIC architecture is characterized by its multiple attributes, Separate code, and data spaces (Harvard architecture). A small number of fixed-length instructions.PIN Diagram of PIC. Most instructions are single cycle execution (2 clock cycles, or 4 clock cycles in 8-bit models), with one delay cycle on branches and skip One accumulator (W0), the use of which (as source operand) is implied (i.e., is not encoded in the opcode).

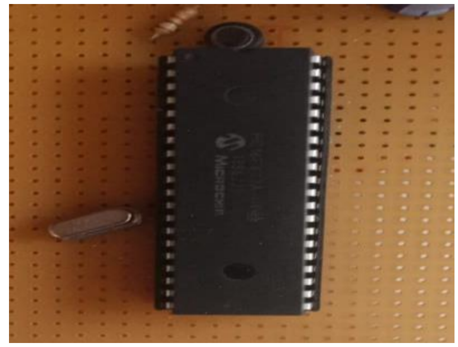

Figure 5PIC Microcontroller

INVERTER

Inverters shown in 6 are used as an emergency backup when there is a power outage. It turns on the electrical appliances when the main supply is off. The function of an inverter is to convert Direct Current (DC) into Alternating Current (AC). DC is the current produced from the battery or solar panel. Inverter technologies have advanced significantly, such that in addition to converting DC to AC, they provide several other capabilities and services to ensure that the inverter can operate at an optimal performance level, such as data monitoring, advanced utility controls, applications, and system design engineering. Inverter manufacturers also provide post-installation services that are integral to maintaining energy production and a high level of performance for the project, including preventative maintenance, O&M services, and a quick mean time to repair (MTTR).

Figure 6Inverter

BATTERY

The batteryshown in figure 7 is a source of electric power consisting of one or more electrochemical cells with external connections for powering electrical devices such as flashlights, mobile phones, and electric cars. Batteries are needed because of the fluctuating nature of the output being delivered by the PV panels or array. They also convert the electrical energy into stored chemical energy for use when the solar array is not producing power. During the hours of sunshine, the PV system is directly fed to the load, with excess electrical energy being stored in the batteries for later use. During the night, or during a period of low solar irradiance, such as a cloudy, rainy day, energy is supplied to the load from the battery.

Figure7 BATTERY

V. SIMULATION RESULTS

The simulation results of Load response for wind and solar integration are shown below. Figures 8 and 9 displaythe output of Windpower.

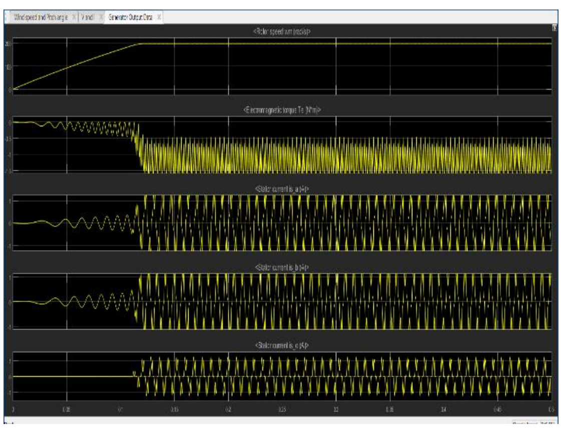

Figure 8 Generator Output Data

Figure 8 shows Rotor speed Electromagnetictorque and Stator Current.

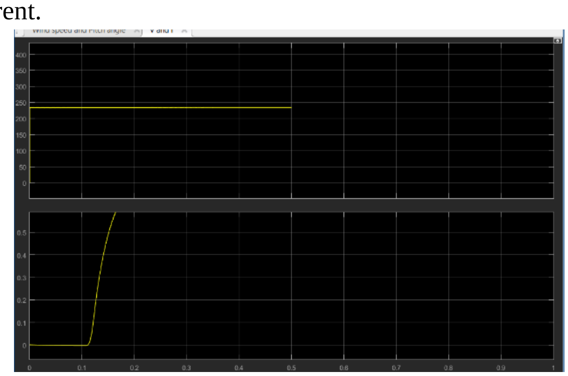

Figure 9 Output Voltage and Current of Wind

Figure9 shows wind generates constant voltage and increasing current.

Voltage

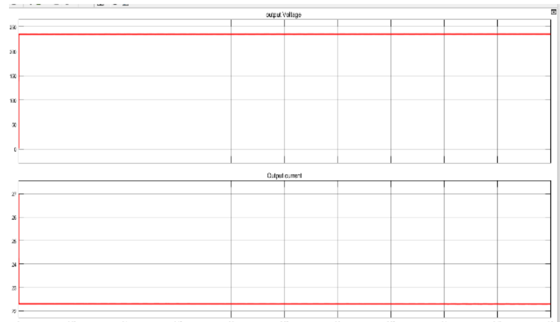

Figure 10 Input and Output Voltage of Solar

Load Measurement

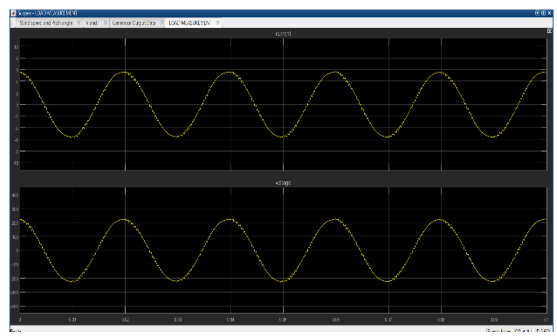

Figure 11 Current and Voltage of Load

Figure 11 Displays Current and Voltage Waveforms of load.

VI. RESULT & DISCUSSION

An integratedpower converter as the interface for the PV/Wind hybrid distributed power generation system is proposed. Compared with the conventional system topology containing an independent DC-DC conversion stage, the proposed system has advantages in terms of higher power density and reliability. The phase shift angle of the full-bridge and the switch duty cycle are adopted as two control variables to obtain the required DC bus voltage and realize the power balance and frequency stabilization. Different operating scenarios of the system under various power conditions are discussed in detail and a comprehensive energy management and control strategy is proposed accordingly. The PIC controller can enable one of the control loops in different scenarios to optimize the whole system performance, taking both the MPPT benefit and the battery charging/discharging management requirements into consideration. The simulation results verify the performance of the proposed PV/battery hybrid distributed power generation system and the feasibility of the control algorithm.

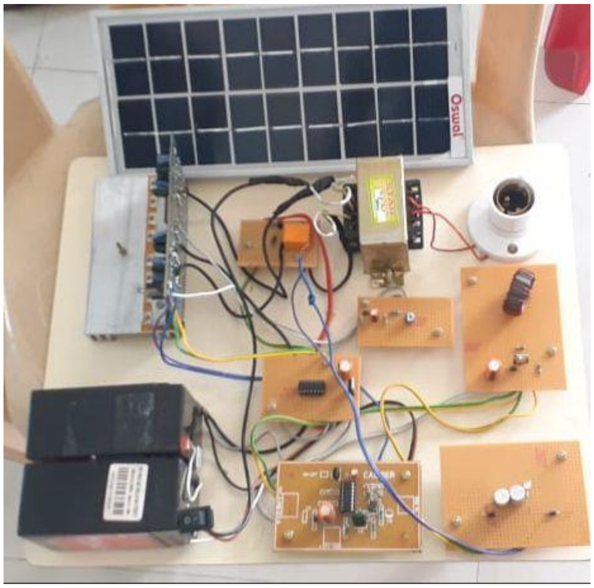

Figure12 Snapshot of proposed Hardware Kit

S.NO	PARAMETERS	EXISTING PROJECT	PROPOSED PROJECT
1	Efficiency	70%	85%
2	Cost	More expensive	Low cost
3	Losses	High	Low
4	Battery	Nil	Available to store
5	Alternative option charger for EB	Not Available	Available

VII. CONCLUSION

We discussed the performance of the dual power generation solar and windmill generator. This dual renewable power generation system was designed and developed. The proposed system comprises four main ingredients which are a solar PV module, horizontally rotating WT, an energy storage system, and a microcontroller to control the charging power from the PV-WT system to the ESS system. The wind and PV power generation is their unstable power output, which can impact negatively utility and microgrid operations. The power control strategies for large-scale renewable hybrid power systems taking into account the optimum capacity of SES and battery aging will be discussed. The proposed system is going to demonstrate that the control strategy can manage Segmented Energy Storage power and load response inverter control within a specified target region. The presented system shown in figure 12 was able to generate an average output power of 61.729W per day. Therefore, the system can generate an annual output power of about 207.4 kWh. Furthermore, these results show that this system demonstrates superior performance compared with the solar modules and wind systems when they work dividually. During the conducted experiments, the solar panels worked as the main source of the generated energy while the wind system acted as a secondary source of energy during the solar absent time. Moreover, the safety factor was calculated to be within the limits of two which shows the proposed system can meet industrial safety.

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