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Review Analysis of Modeling And Control Of Photovoltaic And Fuel Cell Based Alternative Power Systems

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Abstract – In this paper we present a modeling and control study of two power generators; photovoltaic array and fuel cell based systems. To improve the performance of PV system a MPPT method is proposed. The PV system consists of a PV array connected to a DC-DC buck converter and a resistive load. A maximum power point tracker controller is required to extract the maximum generated power. The flexible step is calculated according to the value of the PV power-voltage typical slope. The second working system comprises a controlled DC-DC converter fed by a proton exchange membrane fuel cell (PEMFC) and supplies a DC bus.

Keywords–Photovoltaic Fuel, Fuel Cell, Alternative Energy, Hybrid Power System

1 Introduction

The consistently expanding energy consumption, the taking off expense and the expendable idea of non-renewable energy source, and the declining worldwide condition have made expanded enthusiasm for green [renewable and additionally power module (FC)- based vitality sources] control age frameworks.. Also the fossil fuel, uranium, gas are in limited quantity. Also, they cause global problems such as the greenhouse effect and pollution which are posing great danger for our environment and eventually for the entire life on our planet.

Photovoltaic and fuel cell are the renewable energy source widely use in low power application. Indeed, Fuel Cells (FCs) are considered as important power sources that provide reliable and continuous supply Solar energy represents one among the most promising sustainable energy sources as being clean and freely available everywhere. It is considered as an appropriate choice adopted for various applications, such as irrigation and electrification, thanks to its ability to be directly converted into electrical energy using solar cells Photovoltaic generator converts solar radiation directly into electricity. Photovoltaic generators have a lot of advantages such as being inexhaustible and pollution. Free, silent, no rotating parts etc. They are replacing electricity generators by other polluting ways.FCs also show great potential to be green power sources of the future because of many merits they have (such as great efficiency, zero or low emission of pollutant gases, and flexible modular structure) and the quick progress in FC technologies. However, each of the aforementioned technologies has its own drawbacks. For instance, wind and solar power are highly dependent on climate while FCs needs hydrogen-rich fuel. However, because different alternative energy sources can match each other to some extent, multisource hybrid other energy systems (with proper control) have abundant prospective to provide higher

quality and more consistent power to consumers than a system based on a particular resource. The worldwide research attention has been fixed by the energy hybrid system because of this entire feature.

It is evident from literature on renewable energy that majority of the studies were focused on areas like cost reduction of generation, efficiency improvement and alternative sources of renewable energy. However, many studies also attempted on solving issues surrounding the enhancement of distribution of renewable energy to meet the increasing demand (Ersan Kabalci, 2013).

The purpose of this paper because the renewable energy show nonlinear characteristics in comparison with nuclear and thermal energy sources, they do not cause any environmental pollution. Solar energy, wind energy, fuel cell, hydel power and tidal sources are the most extensively used renewable energy resource for electricity generation. Research on renewable energy has been going for a long time in order to identify the energy alternatives and increase the efficiency of the current sources. In this paper, an improved method for PV system is firstly proposed based on INC algorithm and using fuzzy logic concept in order to reduce the drawbacks of using a fixed step. The proposed controller generates a variable step size. It allows the step size selection with respect to the slope computation value which ensures finding the maximum power point quickly. Fuzzy logic concept has proven its effectiveness as demonstrated since it handles the system nonlinearity and it does not need an accurate mathematical model. Then, the second FC power system is proposed and studied in terms of gases utilization, stack consumption and efficiency.

2 Literature

T. Markvart et al. [1] “Sizing of hybrid photovoltaic wind energy system” author proposed the sizes of the PV array and wind turbine in a PV/wind vitality half and half framework. Utilizing the deliberate estimations of sun oriented and wind vitality at a given area, the strategy utilizes a straightforward graphical development to decide the ideal arrangement of the two generators that fulfills the vitality request of the client consistently.

R. Ramakumar et al. [2]“A knowledge based approach to the design of integrated renewable energy system” author proposed integrated renewable systems utilize two or more renewable energy resource and end-use advances to supply an assortment of vitality needs, regularly in an independent mode. An information based plan approach that limits the absolute capital expense at a preselected unwavering quality level is introduced. The unwavering quality level is measured by the loss of intensity supply likelihood. The methodology incorporates some asset need coordinating dependent on financial matters, the nature of vitality required, and the attributes of the asset

Kaushik Rajashekara, et al. [3]”Hybrid fuel cell strategies for clean power generation” author proposed hybrid power system consists of a combination of two or more power age advances to utilize their working attributes and to acquire efficiencies higher than that could be gotten from a solitary power source. Since power modules straightforwardly convert fuel and an oxidant into power through an electrochemical procedure, they produce low outflows and have higher working efficiencies. Henceforth, joining energy units with different sources, the productivity of the consolidated framework can be additionally expanded or broaden the span of the accessible capacity to the heap as a reinforcement control. In this paper, various kinds of energy unit half breed frameworks and their applications are introduced. An examination of the joined cycle activity of a strong oxide power device (SOFC)- small scale turbine is exhibited. A technique for joining the thermo photovoltaic power age unit and SOFC to acquire the cross breed control framework that would have higher effectiveness is proposed. The half and half activity of wind power and sun based power framework with proton trade layer energy component is likewise displayed.

O. C. Onar et al. [4],"Dynamic modeling, design and stimulation of a wind fuel/cell ultra-capacitor based hybrid power generation system” author research and development of alternative energy sources have shown excellent potential as a type of commitment to regular power age frameworks. So as to satisfy supported burden needs during shifting characteristic conditions, diverse vitality sources and converters

should be coordinated with one another for expanded utilization of elective vitality. The paper centers around the mix of wind, energy component (FC) and ultra-capacitor (UC) frameworks for continued power age. As the breeze turbine yield power shifts with the breeze speed: a FC framework with a UC bank can be incorporated with the breeze turbine to guarantee that the framework performs under all conditions. We propose in this a unique model, structure and reenactment of a breeze/FC/UC half breed control age framework with power stream controllers. In the proposed framework, when the breeze speed is adequate, the breeze turbine can fulfill the heap need while encouraging the electrolyze. On the off chance that the accessible power from the breeze turbine can't fulfill the heap request, the FC framework can satisfy the abundance power need, while the UC can satisfy the heap need over the most extreme power accessible from the FC framework for short durations. Furthermore, this system can tolerate the rapid changes in wind speed and suppress the effects of these fluctuations on the equipment side voltage in a novel topology.

H. De Battista et al. [5]“power conditioning for a wind hydrogen system” author proposed the efforts to reduce the costs of renewable energy advances and electrolyzes, the improvement of reasonable controllers are required for cost-aggressive power creation by sustainable hydrogen power plants. In this paper, a novel control is proposed for a breeze electrolysis framework, which match the breeze power yield to the electrolyze control necessities, hence picking up in framework execution. It fundamentally comprises in constantly molding the power reference of a traditional greatest power point following calculation. In this manner, high streamlined power change productivity is accomplished satisfying simultaneously the electrolyze determinations. This control methodology is created utilizing ideas of the reference molding strategy and of the sliding mode control hypothesis.

B. Delfino et al. [6]“modeling and control of an integrated fuel cell wind turbine system” author proposed an increasing role in the electric power system of the near future. It incorporates an assortment of advancements, for example, energy units, miniaturized scale turbines, wind turbines, photovoltaic and capacity frameworks, in the power extend between 10 kW and 100 MW. In this paper, a control framework for the coordination of an energy unit and a breeze turbine producing framework has been proposed, and the consequences of the demonstrating in the PSCAD-EMTDC recreation condition have been accounted for.

E.S. Abdin, et al. [7] “control design and dynamic permofance analysis of a wind turbine generation system” author proposed modeling and control design for a wind energy conversion scheme using acceptance generators. The plan comprises of a three-stage enlistment generator driven by a level pivot wind turbine and interfaced to the utility through a twofold overhead transmission line. A static VAr compensator was associated at the acceptance generator terminals to direct its voltage. The mechanical power info was controlled utilizing the sharp edge pitch-edge. Both state and yield criticism controllers are planned utilizing MATLAB programming to direct the generator yield. From the recreation results, the reaction of shut circle framework displayed a good damping and fast recovery under different type of large disturbances.

E. Muljadi, et al. [8]"Pitch-controlled variable-speed wind turbine generation” author proposed operation of variable-speed wind turbines with pitch control. The system the authors considered is controlled to generate most extreme vitality while limiting burdens. The augmentation of vitality was just done on a static premise and just drive train burdens were considered as a requirement. In low to medium breeze speeds, the generator and the power converter control the breeze turbine to catch most extreme vitality from the breeze. In the high-wind-speed areas, the breeze turbine is controlled to keep up the streamlined power delivered by the breeze turbine. Two techniques to change the streamlined power were explored: pitch control and generator burden control, the two of which are utilized to regulate the operation of the wind turbine.

M.J. Khan, et al. [9]"Analysis & Development of a Proto-type Hybrid Fuel Cell Distributed Generation Power System for Stand-alone Applications, "author proposed dynamic modeling and simulation results of a small wind–fuel cell hybrid energy framework. The

framework comprises of a 400 W wind turbine, a proton trade layer energy unit (PEMFC), ultra capacitors, an electrolyze, and a power converter. The yield change of the breeze turbine because of wind speed variety is diminished utilizing an energy unit stack. The heap is provided from the breeze turbine with a power module working in parallel. Abundance wind vitality when accessible is changed over to hydrogen utilizing an electrolyze for later use in the power device. Ultra capacitors and a power converter unit are proposed to limit voltage variances in the framework and create AC voltage. Dynamic displaying of different parts of this little separated framework is exhibited. Dynamic parts of temperature variety and twofold layer capacitance of the energy unit are additionally included. PID type controllers are utilized to control the power module framework. SIMULINKTM is utilized for the recreation of this exceptionally nonlinear half breed vitality framework. Framework elements are concentrated to decide the voltage variety all through the framework. Transient reactions of the framework to step changes in the heap current and wind speed in various potential circumstances are exhibited. Examination of reproduction results and impediments of the breeze power module cross breed vitality framework are talked about. The voltage variety at the yield was observed to be inside the adequate range. The proposed framework does not require conventional battery storage. It may be used for off-grid power generation in remote communities.

D. B. Nelson et al. [10]"Unit Sizing and cost Analysis of standalone hybrid wind/PV/fuel cell power generation systems, "author proposed an economic evaluation of a hybrid wind/photovoltaic/fuel cell (FC) age framework for a run of the mill home in the Pacific Northwest is performed. In this design the blend of a FC stack, an electrolyser, and hydrogen stockpiling tanks is utilized as the vitality stockpiling framework. This framework is contrasted with a customary cross breed vitality framework with battery stockpiling. A PC program has been created to estimate framework parts so as to coordinate the heap of the site in the most practical manner. An expense of power, a general framework cost, and a make back the initial investment separation examination is additionally determined for every arrangement.

3 Method

Modeling and Simulation of Photovoltaic Full Cell Hybrid System

1 BLOCK DIAGRAM OF PVFC HYBRID SYSTEM

The block diagram of the PVFC Hybrid system is shown in figure 1 consists of a photovoltaic cell, a fuel cell, an inverter and a DC-DC converter. In this system a photovoltaic cell feeds power into grid through the DC-DC converter and inverter, which step up the voltage level and invert the DC of the photovoltaic cell into AC for the grid. In the absence of solar radiation the fuel cell is the other alternative which continuous the powers supply to the grid.

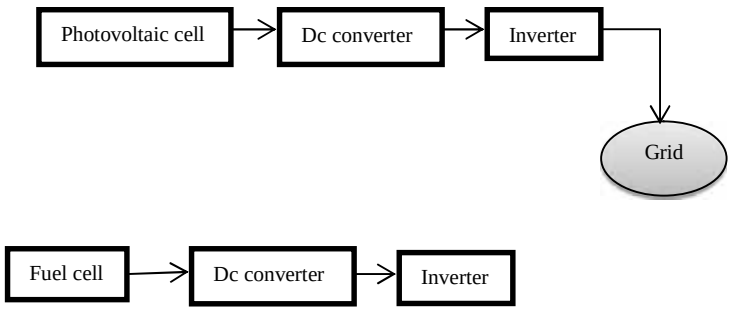

Fig 1 Block Diagram of PVFC Cell

A. Modeling of Photovoltaic Cell

A general mathematical description of I-V output characteristics for a PV cell has been studied for over the past four decades. Such an equivalent circuit-based model is mainly used for the MPPT technologies. The equivalent circuit of the general model which consists of a photo current, a diode, a parallel resistor expressing a leakage current, and a series resistor describing an internal resistance to the current flow, is shown in Figure 2

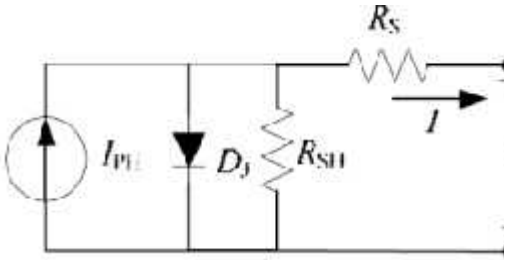

Figure 2. "Electrical model of PV cell

The voltage-current characteristic equation of a solar cell is given as

$$I = I_{ph} - I_{se^{\frac{q(v+IRS)}{KTcA-1(v+IRS)RSH}}} \quad \text{Eq 1}$$

Where PH I is a light-generated current or photocurrent, S I is the cell saturation of dark current, q C 19 1.6 10−=× is an electron charge, k 1.38 10 J / K −23 =× is a Boltzmann's constant, TC is the cell's working temperature, A is an ideal factor, RSH is a shunt resistance, and RS is a series resistance. The photocurrent mainly depends on the solar insulation and cell's working temperature, which is described as [1],

$$I_{PH} = [(I_{SC} + K_I(T_C + T_{ref})]\lambda \quad \text{Eq 2}$$

Where SC I is the cells short-circuit current at a C 0 25 and 2 1kW /m, KI is the cells short-circuit current temperature coefficient, Tref is the cell's reference temperature, and λ is the solar insulation in 2 kW /m [2] .

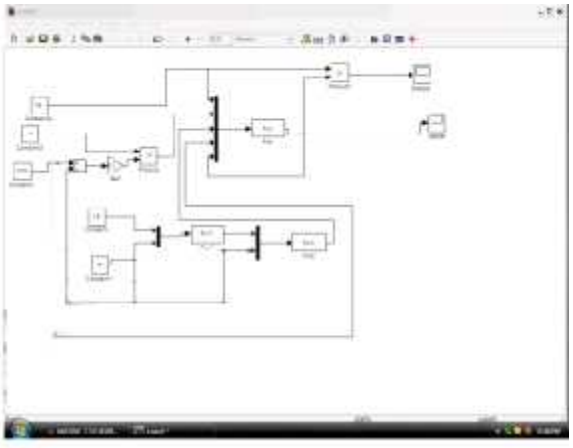

Fig 3 Model of Solar Cell"

Determination of Model Parameters

All of the model parameters can be determined by examining the manufacturer's specifications of PV products. The most important parameters widely used for describing the cell electrical performance are the open-circuit voltage VOC and the short circuit current ISC. The aforementioned equations are implicit and nonlinear; therefore, it is difficult to arrive at an analytical solution for a set of model parameters at a specific temperature and irradiance [3]. Since normally PH S I >> I and ignoring the small diode and ground-leakage currents under zero-terminal voltage, the short-circuit current SC I is approximately equal to the photocurrent PH I IPH [1], i.

$$I_{PH} = I_S \quad \text{Eq 3}$$

Table 1 specifications of variables used in the model of

Characteristics	SPEC
Typical peak power(P_p)	60W
Voltage at peak power(V_{VV})	17.1V
Current at peak power(I_{pp})	3.5A
Short circuit current(I_{SC})	3.8A
Open circuit voltage(V_{OC})	21.1V
Temperature coefficient of open circuit voltage	-73mV/ °C
Temperature coefficient of short circuit current(K_I)	3mA /°C
Approximate effect of temperature on power	-0.38W/°C
Nominal operating cell temperature	49°C

B. Modeling of PEM Fuel Cell

This model is embedded into the Simper Systems of MATLAB as a controlled voltage source. The relationship between the molar flow of any gas (hydrogen) through the valve and its partial pressure inside the channel can be expressed as [3]

$$\frac{Q_{h2}}{p_{h2}} = k_{an}/\sqrt{m_{h2}} \quad \text{Eq 4.}$$

For hydrogen molar flow, there are three significant factors: hydrogen input flow, hydrogen output flow and hydrogen flow during the reaction

4 conclusions

In this paper analysis different method of hybrid system. Here is get idea how to connect different source called hybrid system and get best quality output. Here different author work with several idea.

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