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Title **MODELLING AND SIMULATION OF GIRD CONNECTED HYBRID POWER SYSTEM INTEGRATED WITH SOLAR PV/WIND AND CONTROLLED BY VOLTAGE REGULATOR**

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Modelling and Simulation of gird connected hybrid power system integrated with solar PV/Wind and controlled by Voltage Regulator

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Abstract-As energy prices continue to rise, attention has shifted toward non-conventional sources of energy. One promising solution is a hybrid solar-wind energy system that are connected to the grid. This system combines solar and wind energy sources and is designed to power AC loads.

The solar system uses a boost converter to raise the DC output, and the maximum power point tracking (MPPT) technique is employed to optimize the solar system's output. Meanwhile, the wind subsystem consists of a PMSG and Ac to Dc converter, as well as a boost converter for maximum output. A voltage regulator controls the hybrid solar-wind system.

To increase reliability and lessen reliance on one energy source, the authors have connected these two systems to create a robust hybrid energy system. They have also provided a model for the hybrid PV and wind turbine system that is controlled by the voltage regulator.

Overall, this hybrid solar-wind energy system is a promising solution to the energy challenges of the 21st century. It is more reliable energy supply is provided by combining two non conventional energy sources. and good source of power than a single-source system.

Keywords: Photovoltaic Cell, Maximum Power Point Tracking, Wind Model, regulation of voltage.

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I.INTRODUCTION

In recent times, the increasing cost of fossil fuels for electricity production, coupled with the depletion of non-renewable energy sources and growing environmental concerns, has led to a growing focus on non-conventional sources of energy .Solar, wind, and hydro power have become essential globally, providing a means to reduce reliance on traditional electricity sources and mitigate the negative impacts of pollution.

Hybrid power systems combine two or more renewable energy sources, such as PhotoVoltaic-fuel cell, PV-biomass, or wind-PV systems, to create cost-effective and environmentally-friendly energy solutions, particularly suited for rural areas. A combination of An efficient energy option with high power and reliability qualities is the PV-wind power system. The present study aims to model a hybrid solar PV-wind power system, with a focus on improving essential parameters to enhance the system's performance.

The model includes a PV array, wind conversion system, DC/DC converter, battery, and voltage regulator. The voltage regulator is used to control the hybrid system, and the simulation model is developed using Matlab/Simulink.

II. METHODOLOGY

A. Photovoltaic Cell

The Photovoltaic cell is an essential component of a Photovoltaic system, which requires multiple cells to be connected in series and parallel to achieve the necessary voltage and current. A semiconductor diode is a photovoltaic cell that consists of a p-n junction that reacts to light. To show the voltage, current, and power performance under various operating situations, a mathematical model of the PhotoVoltaic cell is simulated. The parallel junction of the photocurrent source (Iph), the diode (D), and the shunt resistance (Rsh) of a photovoltaic cell is connected in series with the series resistance (Rs). The matching PV cell circuit is shown in the Fig. 1, which displays the current source of the solar cell, the current of the diode, and the current shunted diode as Iphs, Ids, and Ishd, respectively.

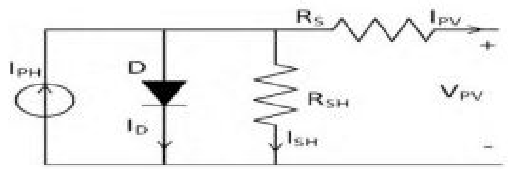

Fig 1

$$Ipvs = Iph - Ids\left(e^{q(Vphs+Ipvs*Rs)/nKT} - 1\right) - \frac{Vphs + Ipvs * Rs}{Rs} \quad (1)$$

Where

Iph = solar current

Ids= saturated diode current

qs= Charge of electron

ks =Boltzmann’s constant

ns= ideality factor

Ts= tempk

We can alter the value of the induced solar current /1000 by altering the

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working temperature and sun irradiation level.

Ishc= cell short circuit current

Iphs= Ishc+kj(Tct-Trt)*Irs/1000

Kj= temperature coefficient

Tct, Trt = reference and working temperature.

B. MPPT

To optimize the o/p power of PhotoVoltaic modules despite environmental fluctuations, a control technique is required.

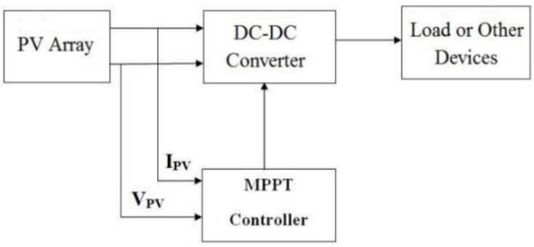

Fig 2

The PV cell's nonlinear relationship with atmospheric conditions such as temperature and irradiance makes it necessary to identify the MPPT. In the paper it is proposed that the use of the perturb and observed technique to track the maximum power point as conditions vary. The P&O method continuously monitors the terminal voltage and current of the Photovoltaic array, introduces small perturbations to the voltage, and observes the resulting changes in power to determine the control signal. The P&O algorithm adjusts the duty cycle of the DC-DC boost converter by adjusting the switching duty cycle.

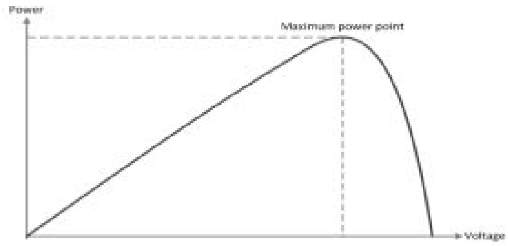

Fig 3

When the duty cycle is changed to maintain a constant converter output voltage, the power-voltage relationship is depicted by the MPPT graph in Fig. 3.

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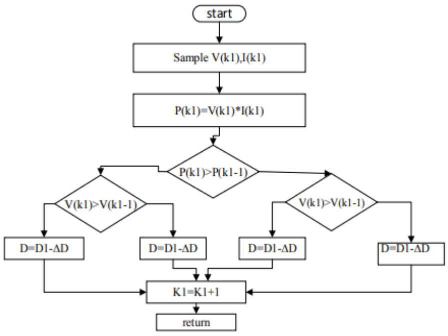

Fig 4

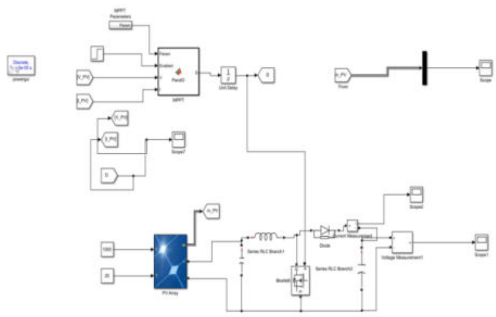

Fig.5

C. Wind Turbine Modelling

An apparatus that transforms wind energy into mechanical energy is a wind turbine. The power captured by a wind turbine can be represented by a mathematical equation. A wind turbine system model that produces three-phase AC power is shown in Fig. 6. A ac to dc convereter is then used to convert the power. In order to couple the wind and solar systems, the AC power must be converted to DC power with the same magnitude. In this system, a PMSG synchronous machine is used because it improves the reliability of the wind turbine.

A PMSG is a machine that uses permanent magnets for field excitation, eliminating the need for reactive magnetizing current. Advantages of a synchronous generator include low burden, compact design, and increased capability.

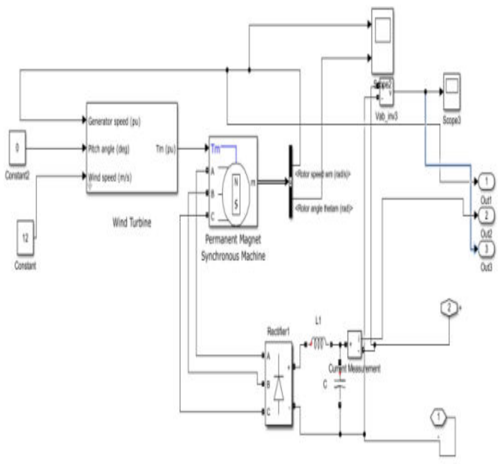

Fig 6

D. Battery Modelling

From the fig 7 it is displayed that a MATLAB model of a battery system that consists of a three-phase dc to ac converter which is connected to the supply. The system charges the battery when running normally and uses the stored energy during abnormal conditions.

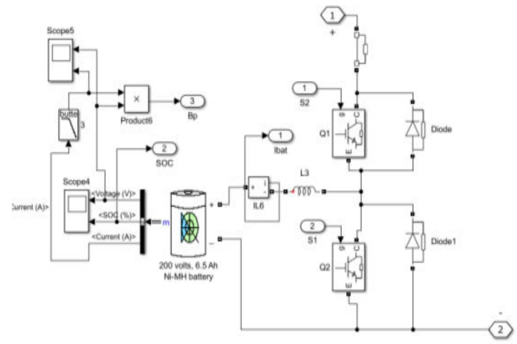

Fig 7

E. Voltage Regulator

Figure 8 shows an inverter that uses a voltage regulator to convert DC power to AC power at a desired frequency. The voltage regulator converts the generated DC voltage into three-phase AC voltage using pulse width modulation signals. In order to generate the necessary pulses for operation, the pulse width modulation signals which are made up of three phase signals with a 120-degree phase shift are compared to vector control signals with a high-frequency carrier signal. The 120-degree phase to neutral voltage Vph at the fundamental frequency is expressed as:

$$V_{ph} = V_{dc} / \sqrt{3}$$

Vph=phase voltage

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Vdc= i/p voltage

The proportional-integral-derivative control Pulse Width Modulation technique is used to generate the desired pulses for the dc to ac converter.

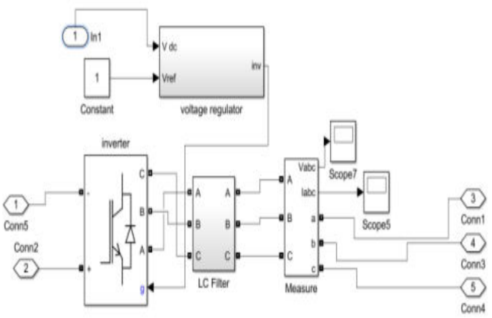

Fig.8

III. RESULTS AND SIMULATION

In the figure 9 it is shown that combined photovoltaic-wind system and their Simulink model . The simulation was carried out using solar irradiance and wind speed. The figure displays the o/p of the solar pv and wind generation systems. The simulation of the hybrid system was conducted for 0.3 seconds using MATLAB software.

The DC voltage after employing a boost converter to raise the PV array voltage to a high-level DC voltage with MPPT approach is shown in Figures 10 and 11, respectively, as is the wind turbine output. A PMSG wind turbine produces AC voltage in the wind turbine output, which is subsequently converted into DC voltage by the rectifier. Fig. 12 shows the DC boost voltage after coupling both the PV and wind subsystems.

In Figure. 13, the three-phase AC voltage is without any fluctuation is shown after connecting the system to the grid.

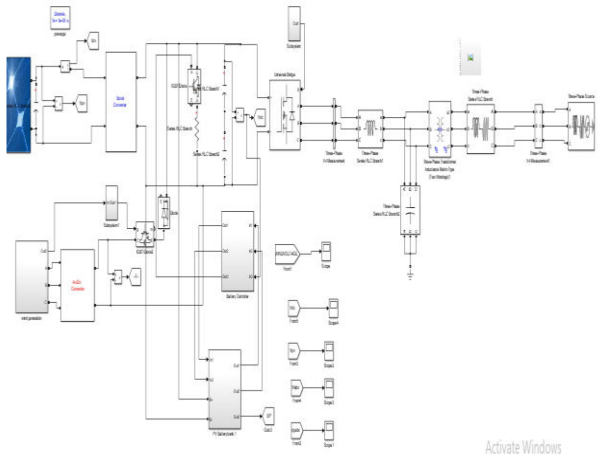

Fig.9

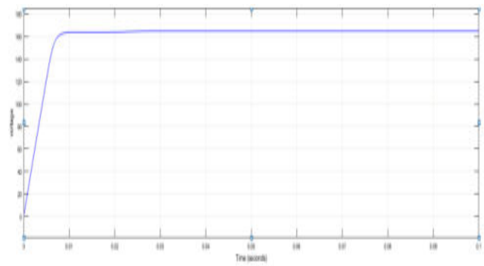

Fig 10

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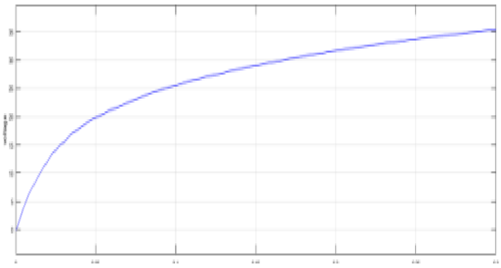

Fig 11

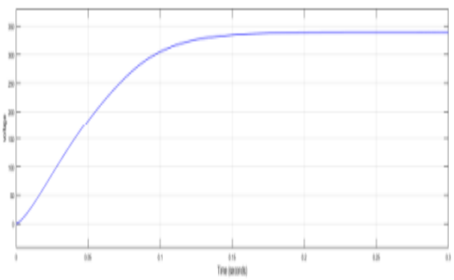

Fig 12

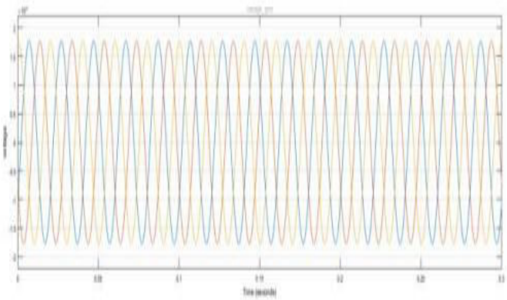

Fig 13

IV. CONCLUSION & FUTURE SCOPE

The design and evaluation of a hybrid system that combines solar and wind generation systems under the direction of a voltage regulator are covered in this study. To simulate how the system will operate at various wind speeds and levels of irradiance, MATLAB software was employed. The aim of this hybrid system is to provide a cost-effective and reliable electricity solution for remote areas.

To evaluate the performance of the system, the study conducted tests using a wind speed of 12m/s, and solar PV panel irradiance of 1000w/m2 and temperature of 250, from t=0 to t=0.3sec. After coupling the DC voltage from both sources to the DC link, the voltage regulator is used to control the system's performance, and improvements were made accordingly.

The simulation model of the hybrid system was developed using MATLAB/Simulink software, and the results of the study were presented. In addition to using PV/wind energy sources, the study suggested that other non conventional energy sources could be used in the hybrid system to improve reliability and obtain better results. To improve the inverter's control, various control techniques were employed instead of the voltage regulator.

REFERENCES

[1] J.Godson,M.Karthick,"Solar PV-Wind hybrid power generations system" Vol. 2, Issue 11, November 2013

[2] Dr. Swapnil B. Mohod, Vikramsingh R. Parihar," Hybrid Power System with Integration of Wind Battery and Solar PV

System" 978-1-5386-0814-2/17/2017 IEEE.

[3] Anjali Rana, Mohammand Ilyas" Implementation of WIND/PV Hybrid system using matlab"IJAREEIE Vol. 4, 10-15662 Issue 7, july 2015.

[4] Mubashar Yaqoob Zargar,Mairaj-ud-din Mufti,"Modelling and control of wind solar hybrid system using energy storage" 978-1-5090-1666-2/16/2016 IEEE.

[5]Prachi P.Chintawar,M.R.Bachwad,"Power quality imrovement Wind/PV hybrid system.