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Designing of Dual power generation Solar plus Wind Energy Hybrid System using MPPT

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Abstract- Renewable energy is another energy efficiency solution within the modern day of life. The production of energy contributes significantly to the environment and thus human health to the environment. In India, wind and solar energy are available at no cost throughout the year.In India there is a power shortage and load restrictions. Due to power shortages and problems in many regions, to bridge the gap between electricity demand and supply, we must use a hybrid system.The paper aims to improve the power demand using Wind and Solar energy within the MATLAB software. The hybrid model has Solar panels Maximum power point tracking, power converter, turbine and PMSG generator.

Keywords: Renewable Energy, MPP, Converter, Inverter, Hybrid System

I. INTRODUCTION

Energy is an important factor in human growth and a factor that contributes to global prosperity. It supports economic growth, human well-being and the standard of living of the nation. Energy from a common source has major barriers to current and future measurements of environmental and environmental safety around the world. It is a well-known fact that sources such as coal, gasoline, oil and other energy products have led to significant reductions in these resources and major impacts on environmental conditions such as greenhouse gas emissions causing environmental imbalances. At the same time the standard energy resources available the needs cannot be met. Therefore, the world's major energy sources will be depleted in another form of energy from extraordinary energy for a few years. Therefore, in today's energy-intensive world, renewable, clean, friendly energy sources are the best option as they are continuous source of energy and contributes significantly to satisfying the world's requirements. These R.E.S are clean, friendly and reliable in energy production. Natural sources of renewable energy include sunshine, wind, rain, waves, sun, wind, hydro, and biomass, to highlight a few. These help heat the earth and the waves. Energy produced from natural resources is carbon-free without minimal pollution and is sufficient to compensate for the energy produced by coal and other fossil fuels that keep these resources for future generations.

II. THE NEED FOR RENEWABLE ENERGY

In today's world, demand for electricity is growing exponentially. The most common overuse of the environment. The only downside to these renewable energy sources is the variability of seasonal and environmental climates. During the summer, solar energy is able to produce energy while in winters and springs the production of solar energy is low. Similarly, Wind energy varies due to changes in wind speed and cannot provide a consatnt effect. Therefore, for continuous power supply hybrid system generation using renewable energy works better for such situations. A hybrid energy system is described as a system that incorporates two or more renewable energy sources in an efficient way to produce continuous energy to meet the demand and this system is reliable and works well for being environmentally friendly at low cost. The type of

renewable energy is used to generate electricity is solar and wind power. There are several advantages to combining solar energy with high energy that is greatly reduced, relying on a single energy source in many cases is greatly minimized and thus the quality of the energy produced is enhanced.

III. PROPOSED HYBRID SYSTEM OF WIND AND SOLAR ENGERGY

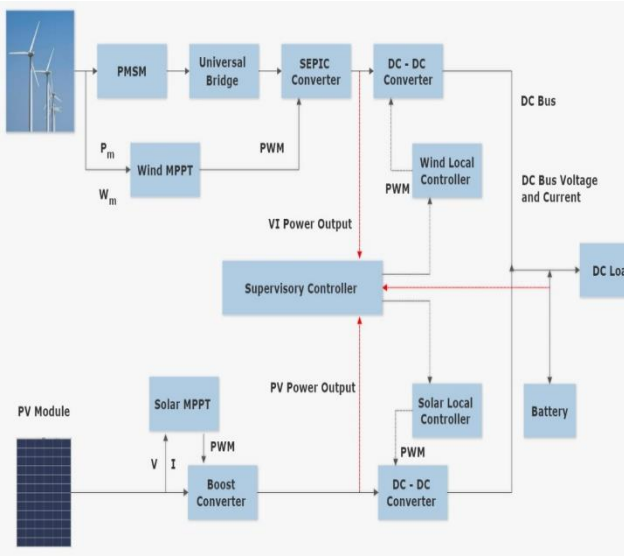


Fig.1 Hybrid System Of System Of Solar And Wind Energy

The implementation work in paper is done using the MATLAB software. With the help of Simulink library, the hybrid system was designed with the help of mathematical equations and analyzed for the design of solar and wind power generation system. In many off-grid scenarios, a hybrid system has been shown to reduce the total cost of standalone power supply. Feature of proposed topology are:

1. Each renewable energy source can be operated in a step-up/step-down mode.
2. MPPT is possible for each source.
3. individual and concurrent operation

IV. SOLAR ENERGY PARAMETERS AND EQUIVALENT CIRCUIT

Solar energy is captured and converted into electrical energy by solar electric systems. This conversion occurs in solar modules, which are also known as solar panels. Solar cells make up a solar module. The sc current density I_{SC}, the open circuit voltage V_{OC}, and the fill factor, as well as the peak power Pmax, are the major characteristics used to characterize the solar cell performance.

Eq gives the I-V characteristic of a solar cell that functions like an ideal diode.

$I(Va) = Irec(Va) - Igen(Va) - Iph$

$= I0[\exp(eVa/kT) - 1] - Iph.$

$I = I0[\exp(e(V - A\,JRs)\,kT) - 1] + V - A\,IRs\,Rp - Iph,$

With the help of above mathematically equations of solar module we designed simulink model of solar in the MATLAB software one by one and then combine the simulink to get the solar module. The simulation is shown in the experimental setup.

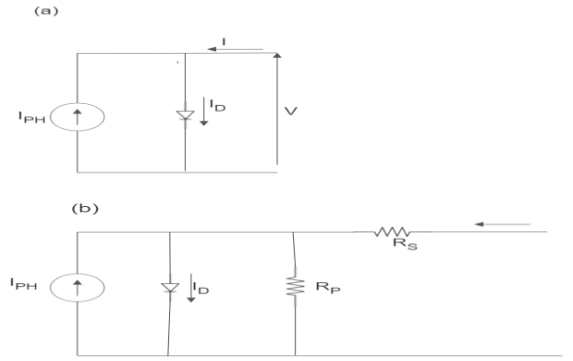


Figure 2: A solar cell's comparable circuit with a Series Resistance (Rs) and a Shunt Resistance (Shunt) (Rp)

WIND ENERGY SYSTEM

The wind turbine catches the kinetic energy of the wind and converts it to mechanical energy, which is then transformed to electrical energy by generators such permanent magnet synchronous generators and induction generators. The horizontal and vertical axis are the two types of turbine designs available. To improve energy capture, the turbine is installed on a tall tower.

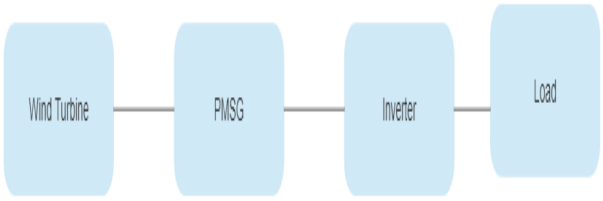
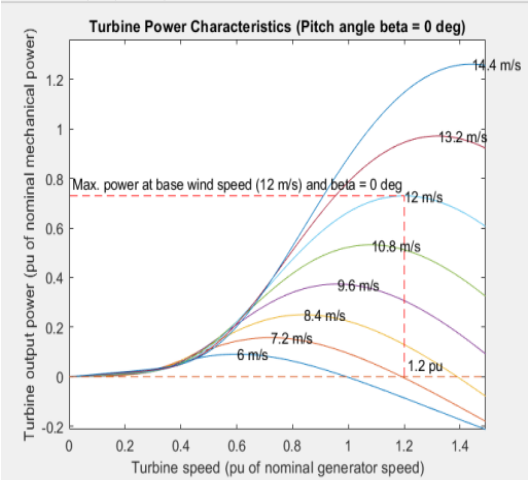


Fig3: Block diagram of wind energy

Wind Turbine parameters

Parameter	Value
Mechanical Power of wind turbine	20kw
Electrical Generator Base Power	20e3

Base wind Speed	12m/s
Base rotational speed	0
Maximum power	0.8



MPPT

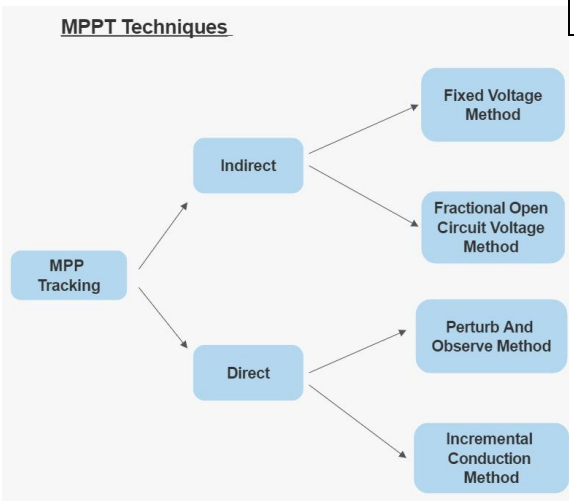


Fig4. MPPT Technique

Mppt stands for maximum power point tracking, and it is an algorithm used in photovoltaic (PV) inverters to modify the impedance perceived by the solar array in order to keep the PV system functioning at its peak output under various conditions such as changing solar irradiation, temperature, and load.

The process of doing this is known as maximum power point tracking, and it involves constantly attempting to keep the point of the PV panels at maximum power.

A standard solar panel converts only 30 to 40% of incident sun irradiation into electrical energy. To increase the efficiency of solar panels, maximum power point tracking technology is applied.Mppt works best in cold weather, on overcast or hazy days, and when the battery is fully charged.

Only 30 to 40% of incident solar irradiation is converted into electrical energy by a conventional solar panel. The maximum power point tracking method is used to boost the solar panels' efficiency.Mppt performs best in cold weather, on overcast or hazy days, and with a fully charged battery.

MPPT technique	Convergence speed	Implementation complexity	Periodic tuning	Sensed parameters
Perturb & observe	Varies	Low	No	Voltage
Incremental conductance	Varies	Medium	No	Voltage,current
Frictional V_{OC}	Medium	Low	Yes	Voltage
Frictional I_{SC}	Medium	Medium	Yes	Current
Fuzzy logic control	Fast	High	Yes	Varies
Neural network	Fast	High	Yes	Varies

Table; characteristics of different MPPT Techniques

Below is an example of a basic P&O MPPT algorithm.

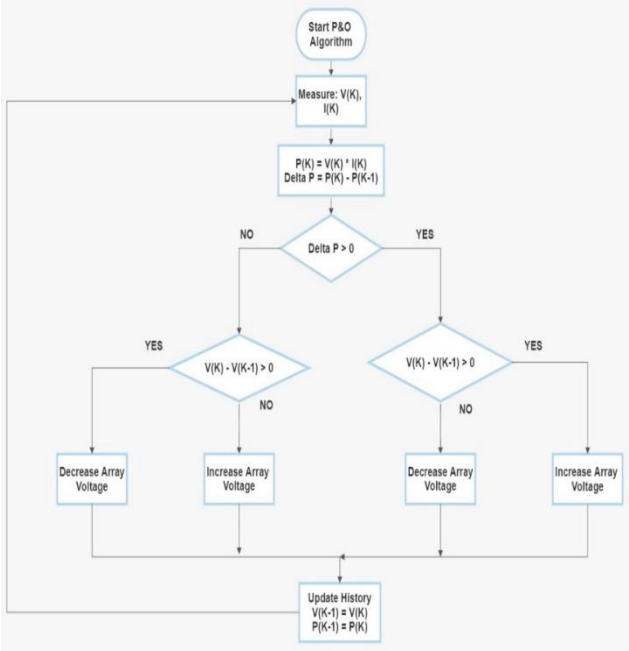


Fig 5.flow chart of Perturb & Observe (P&O)

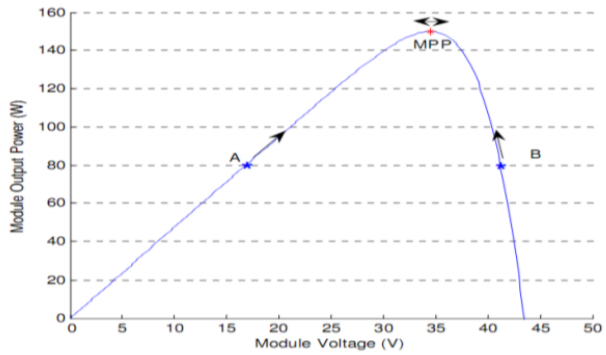


Figure6: MPP and operating points A and B in the solar panel characteristics.

V. SIMULATION CIRCUIT

1.Solar Simulation Model

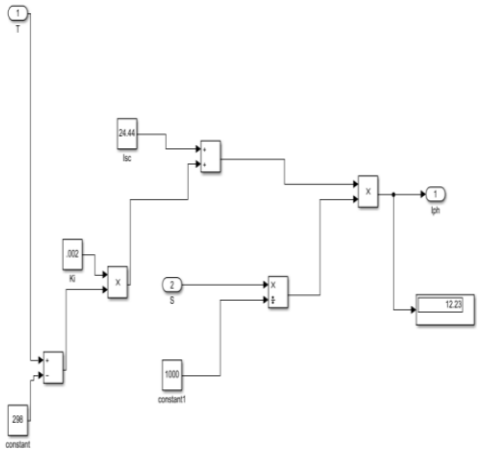


Fig7.1.1: simulink of Iph

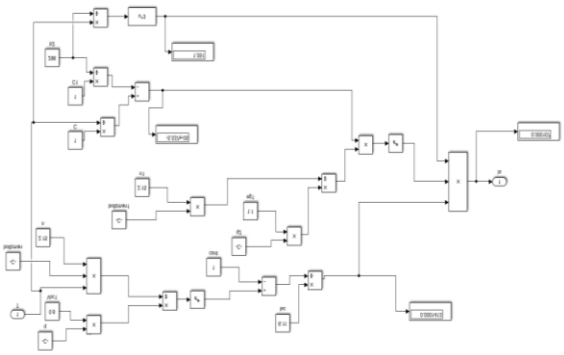


Fig: 7.1.2:simulink of Io

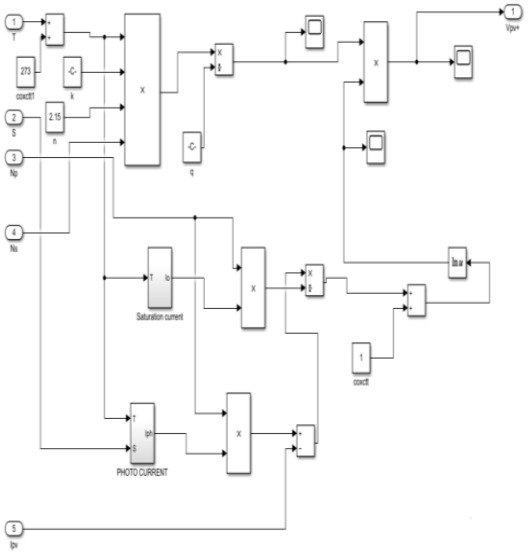


Fig.7.1.3 simulink of Ipv

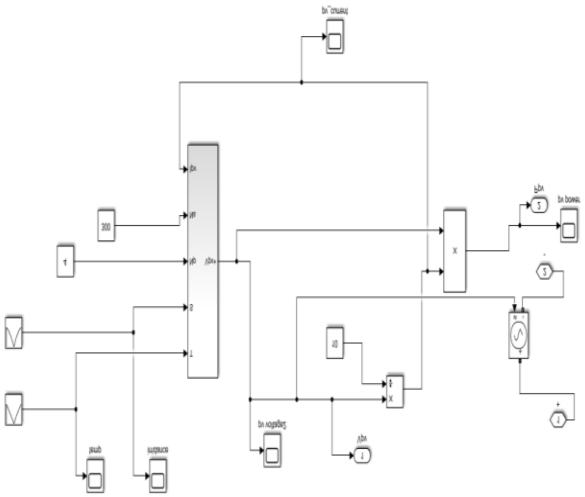


Fig.7.1.4:pv array

2.MPPT Model

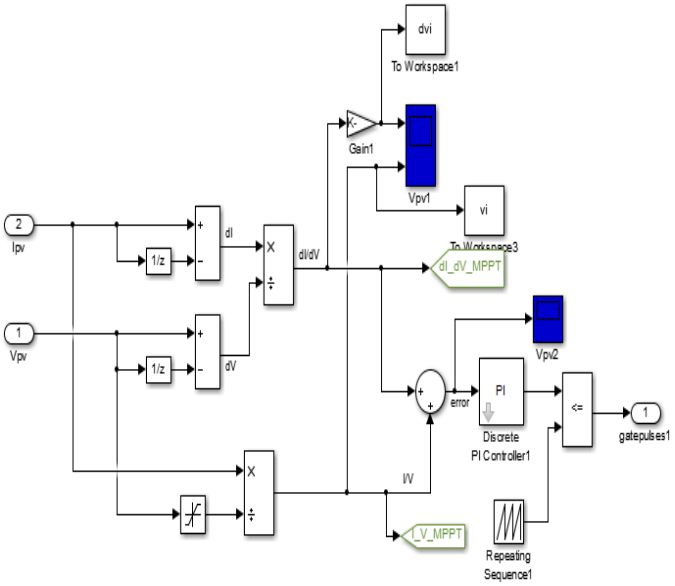


Fig8:Simulink Model of (P&O) MPPT

3.WIND ENERGY SIMULATION

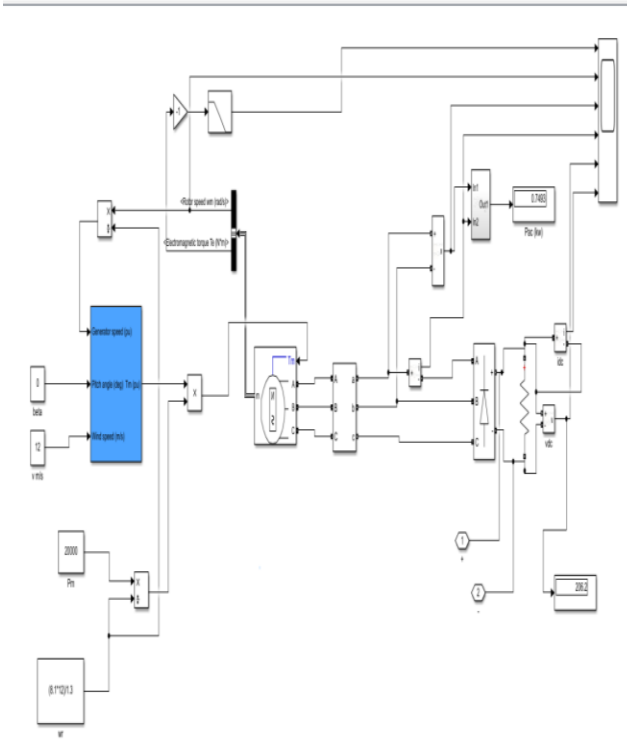


Fig 9:Simulink Model of Wind Energy

4.CUK SPIC CONVERTER

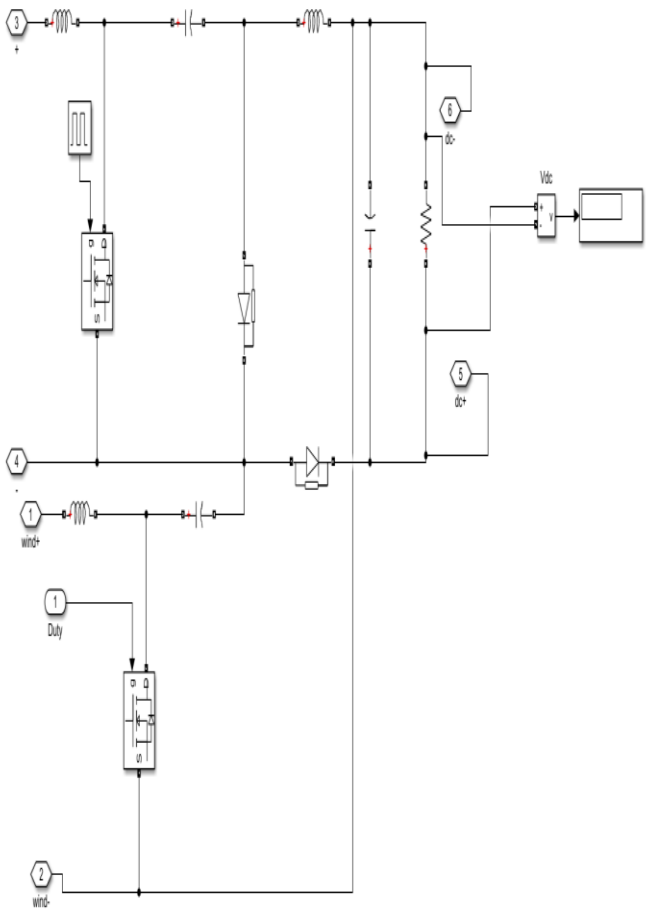


Fig:10 simulation of cuk converter

HYBRID MODEL

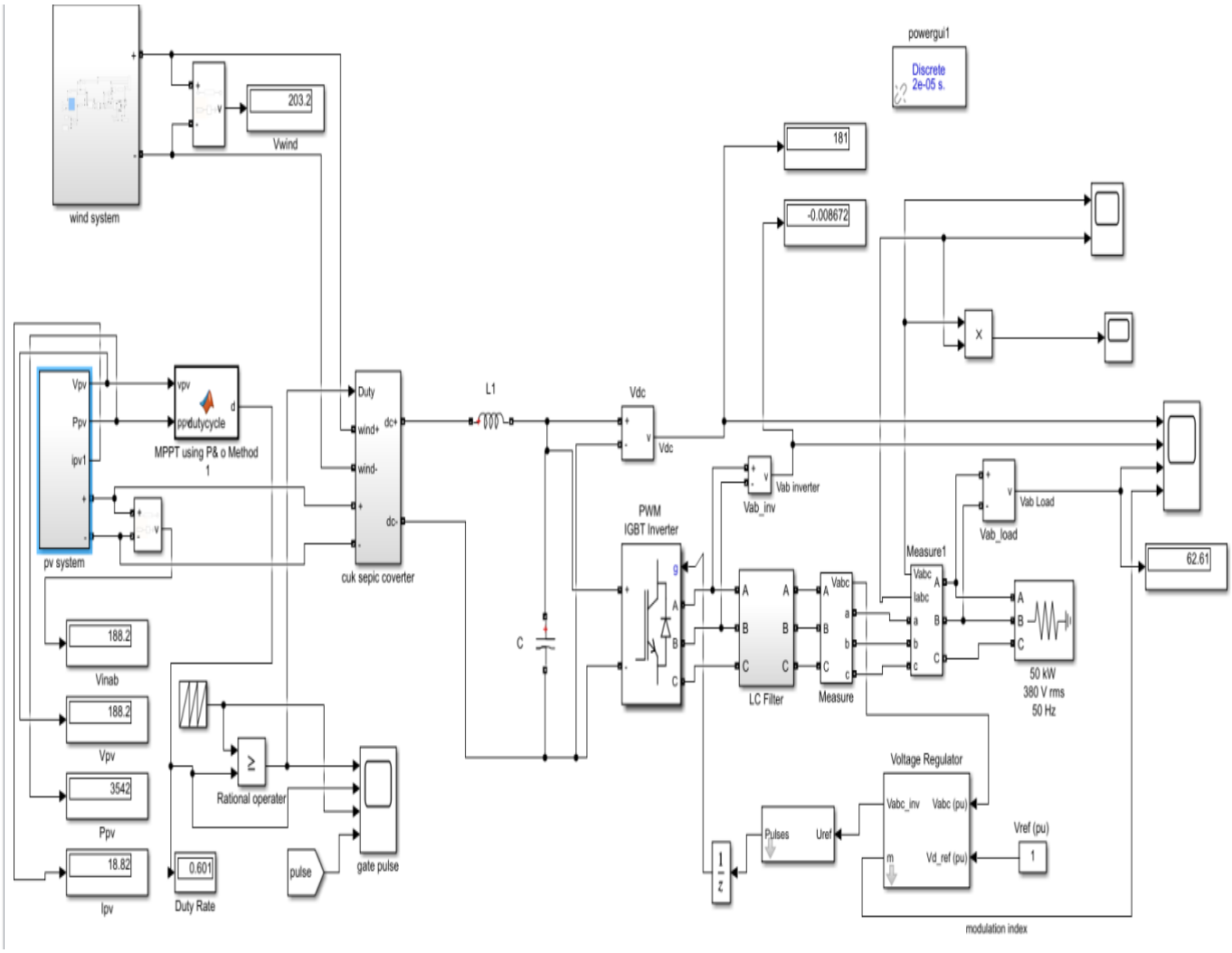


Fig11: Wind and solar energy hybrid system simulation

VI. EXPERIMENTAL VALIDATION

In the following paper we will take you through the modelling and testing of the wind- solar Hybrid Model both with their individual testing that is of solar and wind setup and components separately as well as the Hybrid model attained by combining these two.

Obtained Results:

These are the simulation results obtained.

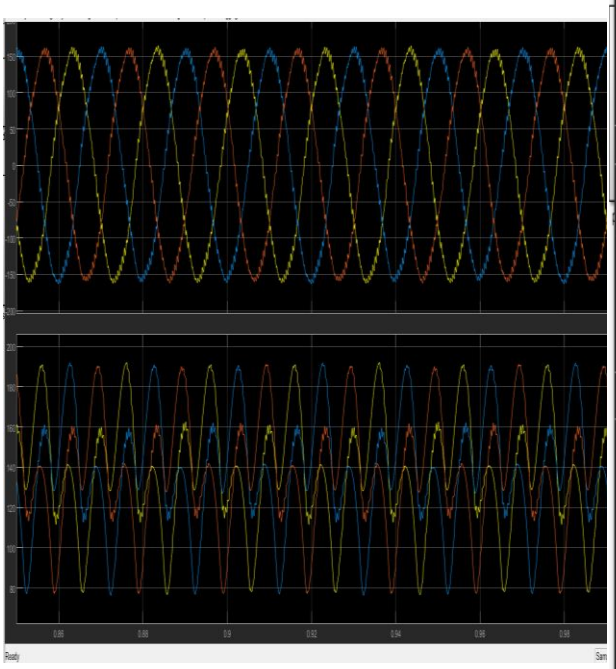


Figure. 12:Output Voltage and current of hybrid System(solar and wind)

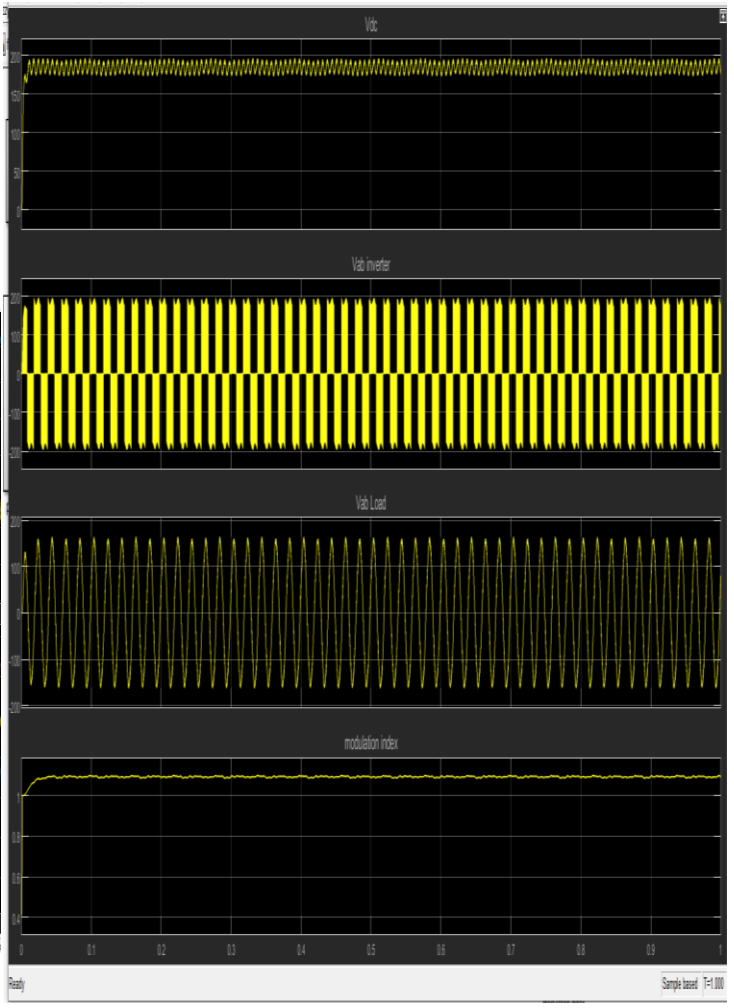


Fig. 13: Three Phase 45 Volts 50 Hz Alternating Voltage Waveform

Above is the Output from the combination of both the sources.
This Voltage is then passed through an Inverter to Convert it into Alternating Voltage of 50Hz.
The output obtained from the inverter is alternating.

The hybrid power generation system shown here is a dynamic power generation system. in which the generated power is dependent on various conditions, so this model generates a time varying output that is plotted in the graph shown in fig 14:

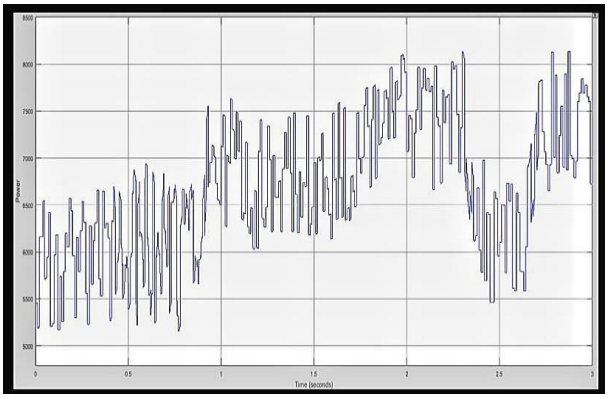


Fig. 14: Time Varying Real Power produced by the Hybrid Model

VII. CONCLUSION

A hybrid solar and wind energy system can be studied and simulated using this programme.
The wind model, solar model, mppt and control methodologies, the load, as well as the simulation findings, are implemented and confirmed.In MATLAB, individual modelling and simulation of wind and PV systems were carried out. And hybrid model has been simulated by combining wind and solar energy resources together with the help of converter and voltage regulator.
Their Output produced were varied according to the variations in the Input conditions.
DC-DC booster used across the PV and Wind Generators helps to provide a Controlled Voltage source.

The generated output voltages that can be delivered to the load are depicted in the developed hybrid system's simulation result. This hybrid system is more reliable as compared to single energy system.
Working with both renewable energy at their rated capacity. This system is capable of providing minimum load strength under the worst climatic conditions and during peak times it also helps reducing the load from the grid.

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