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WIND AND SOLAR MPPT IN HYBRID MICROGRID

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ABSTRACT

This paper presents a detailed analysis of the perturb and observe (P&O) maximum power point tracking algorithm (MPPT) in solar generation and wind power generator. This paper presents the optimum utilization of renewable energy sources. In renewable energy sources wind mill and photovoltaic cell plays an important role. The available wind velocity and solar radiation and climate plays important role in Indian power sector. Increasing demand of electricity it is very important to develop micro-grids to diversify the generation. So to solve this problem and optimization of wind and solar power are necessary. To optimize power in wind mill we have to track the maximum wind velocity to produce more power by extracting power from the wind and maximum power point tracking (MPPT) technique is utilized to extract more power from PV cells.PID controller and dq axis theory is used in wind mill and MPPT technique is used to form DC Micro-grid and implemented in MATLAB. Results show the better operating performance of micro-Grid in stability issue, increase in efficiency and optimum power extraction from the wind mill and solar cell.

KEYWORDS: wind mill, PV cell, Hybrid Micro grid, MPPT.

INTRODUCTION

Solar energy is one of the most important renewable energy resources that have been gaining increased attention now a day. Solar energy is plentiful it has the greatest availability compared to other energy sources. Now in India government announces the up to 2020 India will be the largest solar energy producer in world. So accordingly it is necessary to focuses on this renewable energy source. Recently, research and development of low cost flat-panel solar panels, thin-film devices, concentrator systems, and many innovative concepts have increased. In the near future, the costs of small solar-power modular units and solar-power plants will be economically feasible for large-scale production and use of solar energy. The amount of power generated from a photovoltaic (PV) system mainly depends on the factors such as temperatures and solar irradiances. According to the high cost and low efficiency of a

PV system, it is necessary to operate at the maximum power point (MPP) which changes with solar irradiances or load variations.

Normally in PV applications, a number of solar cells or an array of solar panels connected to a load without a MPPT controller will often result in less power extracted as well as wastage of power, which ultimately results in the need to install more panels for the same power requirement. For smaller / cheaper devices that have the battery connected directly to the panel, this will also, result in premature battery failure or capacity loss, due to the lack of a proper end-of-charge procedure and higher voltage. In the short term, not using an MPPT controller will result in a higher installation cost and, in time, the costs will escalatedue to eventual equipment failure. Even with a proper charge controller, the prospect of having to pay 30-50% more up front for additional solar panels makes the MPPT controller very attractive. Therefore, most feasible way to increase the efficiency of a solar panel is to use a Maximum Power point Tracker (MPPT), a power electronic device that significantly increases the system efficiency.

There are many published works on this topic, but only a tiny portion of them show how to actually implement the algorithms in hardware, as well as state common problems and pitfalls. Even when using the simplest MPPT algorithm with a well-designed synchronous switching power supply, it can expected that at least 90% of the panels available power will end up in the battery, so the benefits are obvious. Various topologies presenting but the techniques used where can applied to DC-DC converters. The buck converter is a special case, since it has a linear voltage transfer function when operating in Continuous Conduction Mode (CCM). This simplifies things a lot, and the MPPT controller can be implementing by operating directly on the converter duty cycle. In this case, the algorithm modifies the solar panel operating voltage by using efficient algorithm.

The main problem solved by the MPPT algorithms is to search the available maximum power all the time. In a larger system, connecting a single MPPT controller to multiple panels will yield good results. For obtaining maximum power from solar panel, it utilizes different types of control circuit or logic to search maximum point and thus to allow the converter circuit to extract the maximum power available from a cell. By using it, the system operates at the Maximum Power Point (MPP) and produces its maximum power output. Thus, an MPPT maximizes the array efficiency, thereby reducing the overall system cost. In this paper, we have proposed the photovoltaic solar panels operation. The foremost way to increase the efficiency of a solar panel is to use a Maximum Power point Tracker

This paper investigates its PID controller and dq theory used in controller of turbines for the use of wind power generation. The interest for this grew from the ever increasing demand for energy. After investigating the nature of the three bladed wind turbines, it became apparent that the machines were not very efficient, expensive and have a limited fatigue life. The speed control and analysis of each phase of turbine is difficult and complex so dq theory is used to study wind power generator is proposed in this paper and a comparison in performance has been carried out. The speed control according to change in velocity of air and power extracting of turbine to extract more power has been carried out. The ability to accelerate the air flow through a converging intake thereby increasing the power that can be extracted from the air flow. As the wind passes through a converging duct the velocity increases while the pressure decreases. The power extracted has a cubic relationship to wind velocity whereas the relation to pressure is linear**.**

By connecting these two renewable energy sources we can track maximum power produced by the wind mill as well as solar system and micro grid is formed.

LITERATURE SURVEY:

A detailed literature review today would lead to the conclusion that although the *INC* is slightly more complicated to implement, it provides better performance than *P&O* under both static and dynamic conditions. The two main problems of the *P&O*thatarefrequentlymentionedintheliteraturearetheoscillationsaroundtheMPPundersteady-state conditions and the poor tracking (possibly in the wrong direction, away from MPP) under changing irradiance [3]–[14].Methods to improve the dynamic behavior of the *P&O*, including variable step size and perturbation frequency, have been reported in the literature [4],[5],[6],[7]–[8].On the other hand, it is often state din the literature that the *INC* can determine the position of the actual operating point relative to the MPP, and it can find the distance to it; it can also stopper tubing when the MPP has been reached, thus offering as up error performance to the *P&O*. It is also often stated that the *INC* cant rack fast changing irradiance better than the *P&O,* e.g., [9],[10],[11],[12].
"The disadvantage of the *P&O* method can be improved by comparing the instant anions panel conduct acne with the incremental panel conductance"[11].
In ducted wind turbine it will get greater velocity than actual velocity of wind. So we will get continuously power by ducted wind mill. Compared to the normal wind mill we can extract more power [13].PID controller and direct axis and quadrature axis is used for the study of wind mill to extract more power. So for continuous supply it is necessary to form the hybrid micro grid because at night time the air velocity is more so we can utilize wind mill and in day time we require solar system to produce more power. Accordingly hybrid micro grid is requiring to design.

PROBLEM OVERVIEW

Our project seeks to prove the concept of a "micro grid," while also analyzing the maximum power tracking produced by the wind mill and solar system to increase the efficiency of the system. In normal installation of the solar system the energy produced was not tracking continuously so it will effect on the efficiency of the solar plant and it will produce low power. In wind mill when air flows with less velocity then anemometer sense the velocity and win mill will stop from rotating. So change in weather effects on both renewable energy sources. To accomplish this we will have to design our system so that it is able to provide power irrespective of whether condition i.e continuous supply of power., maintain operation under islanded conditions, fully integrate renewable energy sources that help to reduce carbon emission, and comply with specific regulations.

MPPT IN SOLAR SYSTEM BY PERTURB AND OBSERVE (P&O) ALGORITHM

Maximum power point tracking (MPPT) is one of the key functions that every grid-connected PV inverter should have. There is a large amount of publications that deals with MPPT, and trackers in the majority of the commercial PV inverters are able to extracta round 99% of the

available power from the PV plan to Vera wider radiance and temperature range, at least in steady state [1]. An extensive over view of modern MPPT techniques has been presented in [2]. The two most frequently discussed MPPT algorithms are the perturb –and -observe (*P&O)*and the incremental conductance (*INC)*. These methods are based on the fact that ,on the voltage– power characteristic, the variation of the power w.r.t. voltage is positive (*dP/dV>0*) on the left-hand side of the maximum power point(MPP), while it is negative (*dP/dV <0*) on the right- hand side of the MPP. The main advantages of these methods are that they are generic, e.g., suitable for any PV array, they require eno in- formation about the PV array, they worker as on ably well under most conditions, and they are simple to implement on a digital controller.

A. Operating Principle of Perturb-and-Observe

The *P&O* is probably the most often used MPPT algorithm today, due to its simplicity and generic nature as shown in fig2. It is based on the fact that the derivative of power in function of voltage is zero at MPP. At an operating point on the *P–V* curve, if the operating voltage of the PV array is perturbed in a given direction and *dP*>0, it is known that the per duration moved the array's operating point toward the MPP. The *P&O* algorithm would then continue to perturb the PV array voltage in the same direction. If *dP<0*, then the change in operating point moved the PV array away from the MPP, and the *P&O* algorithm reverses the direction of the perturbation.

To improve the efficiency of the solar panel MPPT is used. According to maximum power point theorem, output power of any circuit can be maximize by adjusting source impedance equal to the load impedance, so the MPPT algorithm is equivalent to the problem of impedance matching. In present work, the buck-bust Converter is used as impedance matching device between input and output by changing the duty cycle of the converter circuit. A major advantage of buck-bust converter is that high or low voltage obtained from the available voltage according to the application. Output voltage of the converter is depend on the duty cycle, so MPPT is used to calculate the duty cycle for obtain the maximum output voltage because if output voltage increases than power also increases. In this paper Perturb and Observe (P&O) and constant duty cycle techniques are used.

B. Perturb & Observe MPPT Algorithm

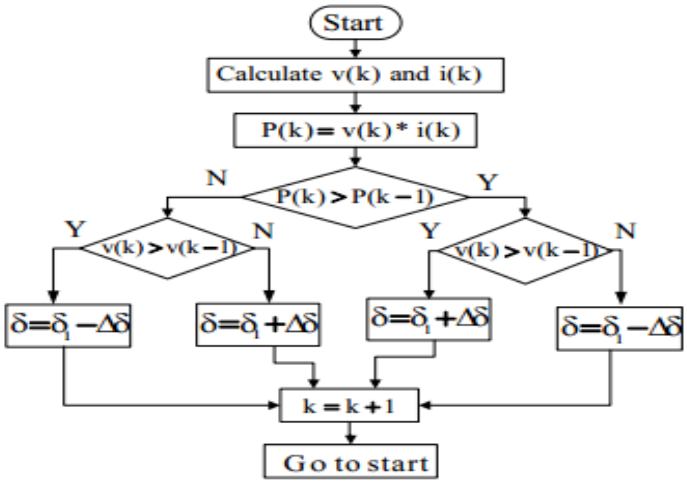

Fig.1 Flowchart of P&O MPPT

It is the simplest method of MPPT to implement. In this method only voltage is sensed, so it is easy to implement. In this method power output of system is checked by varying the supplied voltage. If on increasing the voltage, power is also increases then further 'δ' is increased otherwise start decreasing the 'δ'. Similarly, while decreasing voltage if power increases the duty cycle is decreased. These steps continue till maximum power point is reached. The corresponding voltage at which MPP is reached is known as reference point (V ref). The entire process P&O algorithm is shown in Fig.1.

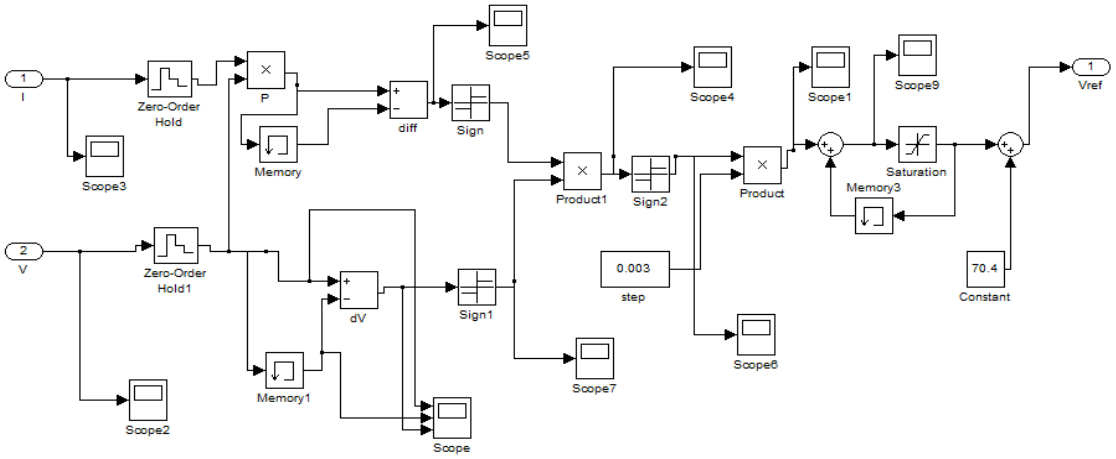

Fig2. P&O technique used in MPPT

MATLAB/SIMULINK Model of PV Cell Using P&O MPPT Algorithm

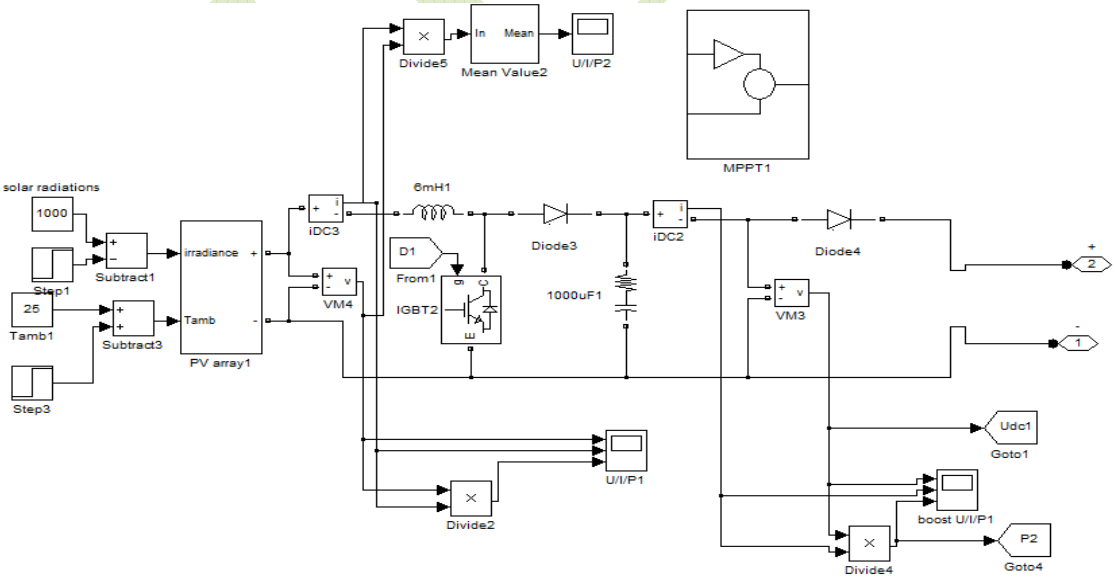

Fig.3 MPPT model of P&O method.

Different Parameter Used in Standalone PV Module
The Solar 160W PV modules are taken as the reference PV module for simulation and electrical characteristics are: Tref = 25°C,Isc = 2.02 A, Imax=1.93, Voc = 86.8,Vmax=70.4, Irradiance=1000

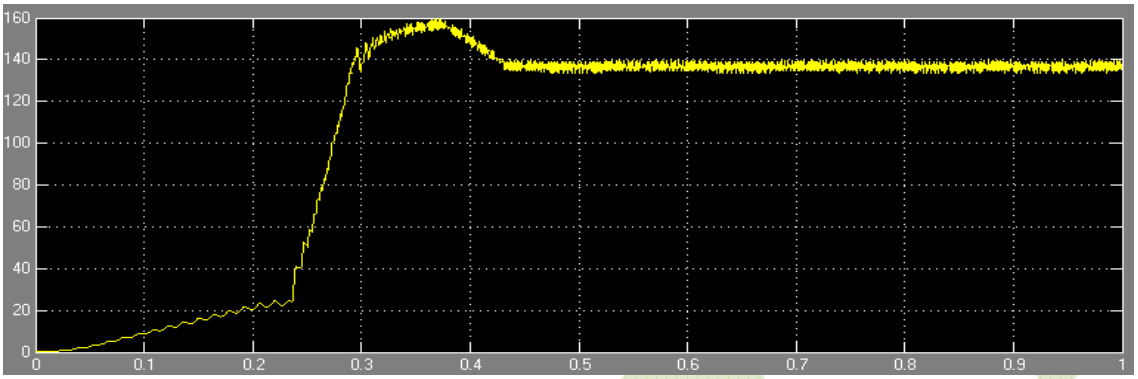

Fig4. Output of MPPT

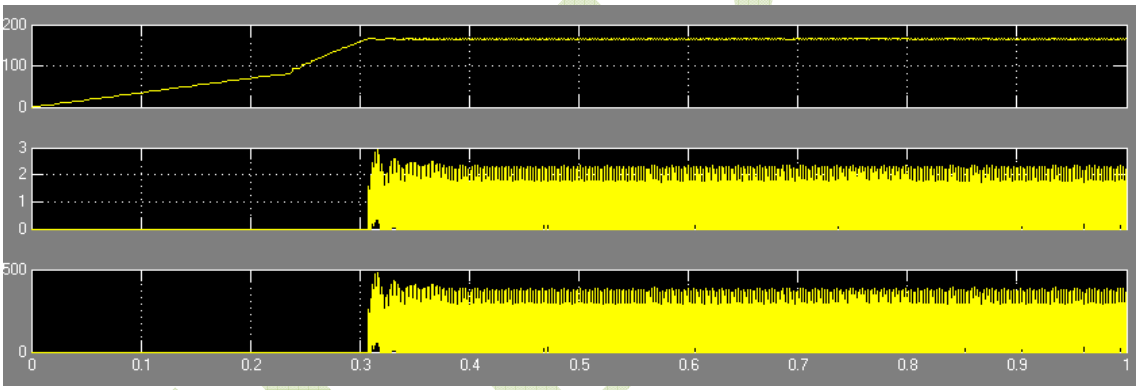

Fig5.Solar panel output after connecting MPPT Block

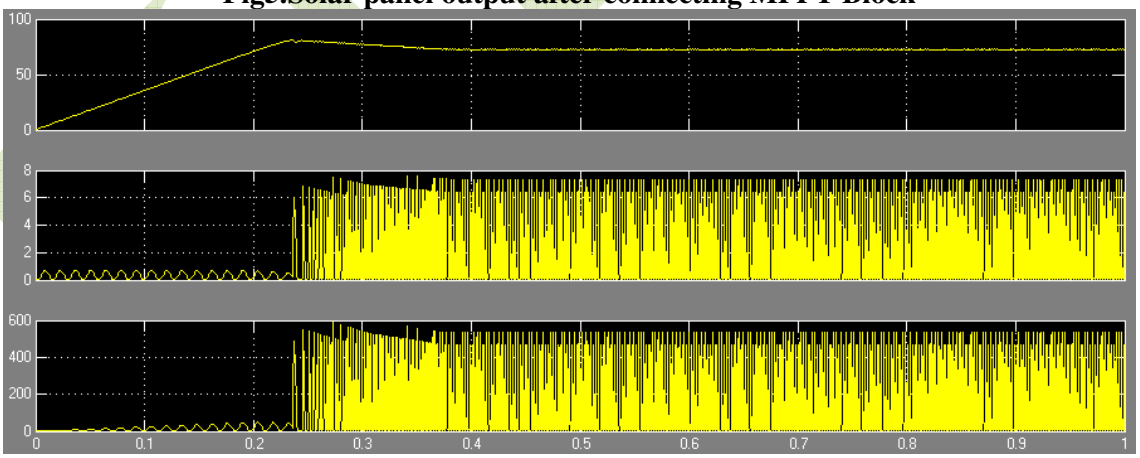

Fig6.Power output of panel before connecting MPPT

From above parameters the solar panel is designed in MATLAB by taking standard values of open circuit and short circuit voltage and current of the panel by using Perturb and observes method is used for maximum power point tracking. As shown in fig4 and fig5 the output of PV system after connecting the MPPT it shows the steady voltage, current and power as

compare to the fig 6 in which MPPT is not used for tracking. So by utilizing this technique we can extract more power and hence the efficiency increases and cost per watt of the panel decreases.

Power generating by using Wind Mill

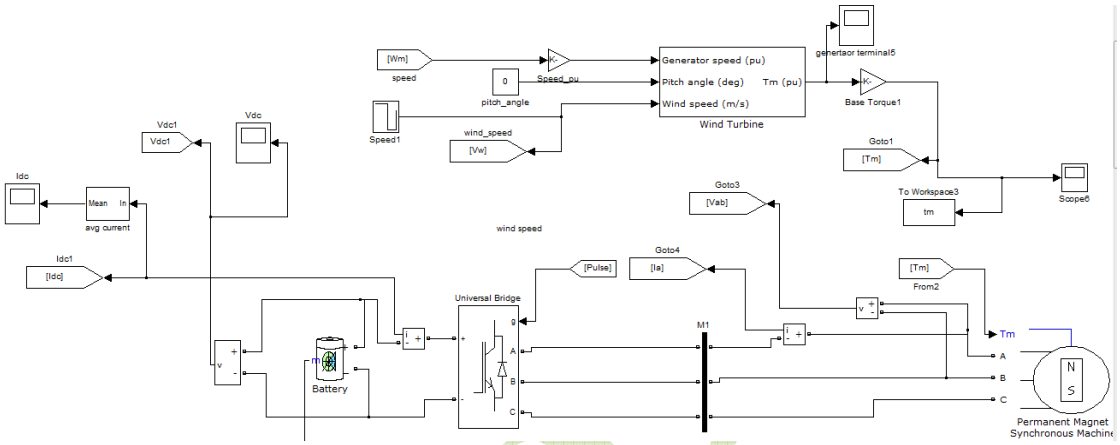

Fig7.wind mill by using PMSG

In India in the season of monsoon the air flows with high velocity. So wind mill plays key role as in this season the availability of solar radiation is less so to use alternative renewable sources it is important to go with the wind energy. In this paper PID controller and direct and quadrature i.e. dq theory is used for the study and extraction of the larger power. As well as when we used duct design around the wind mill then the velocity increases and according to formula of wind i.e. power is directly proportional to the velocity of cube we can generate large power.

Wind mill is designed in MATLAB by taking Permanent Magnet Synchronous Generator (PMSG). As shown in fig7 the step function is utilized for change of air velocity and by changing velocity we can study according to change in air velocity how we can extract more power from the generator by using the PID(proportional integral and derivative) controller. Fig 8 shows the design of PID and dq theory.

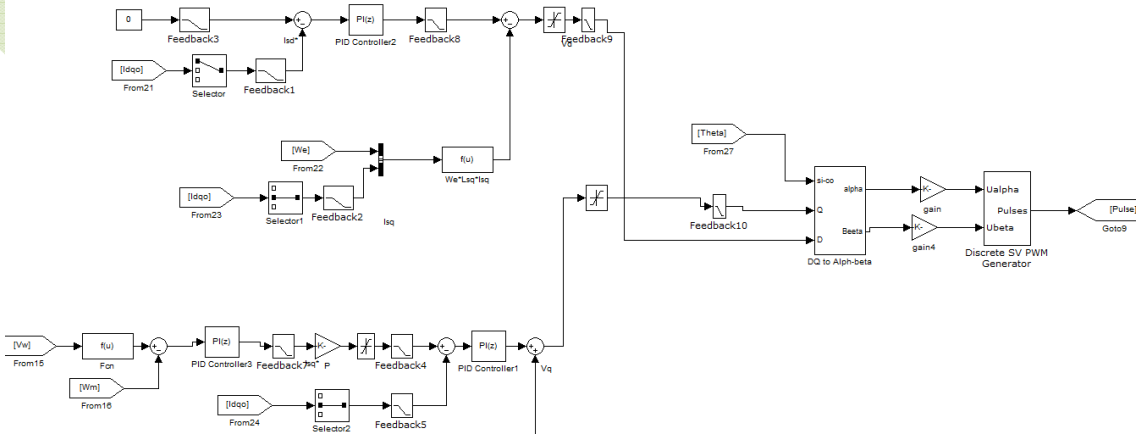

Fig8.PID and dq reference theory used for PMSG generator

The results of simulation of wind mill is as shown in fig 9 which shows speed, torque, active power and reactive power. The change of air velocity step size used is at 0.4 to 0.7 all parameters reduces only due to change in the air velocity as shown in fig 9 and 10.Similarly change in output power of wind mill is shown in fig 10.

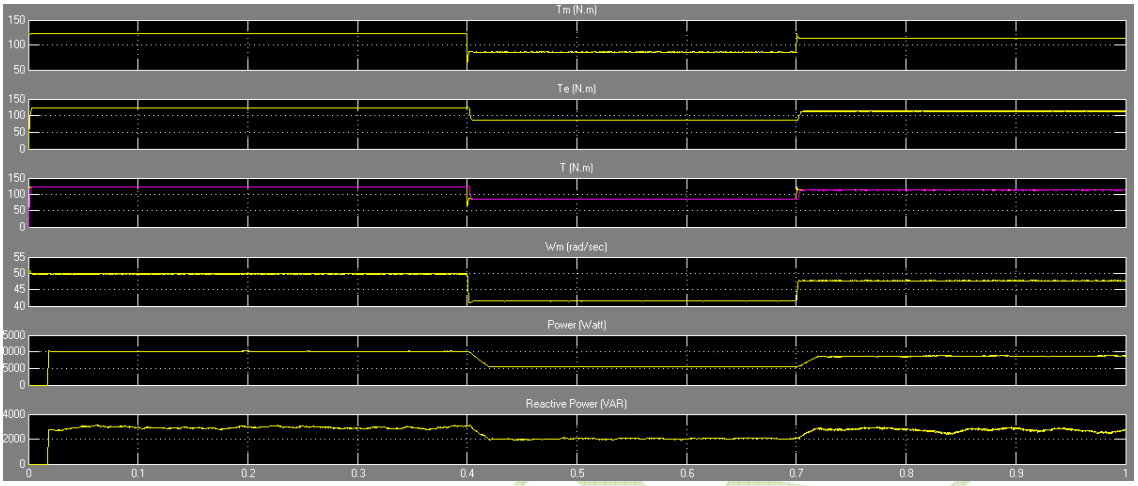

Fig 9.Speed,Torque,Power characteristic of wind mill

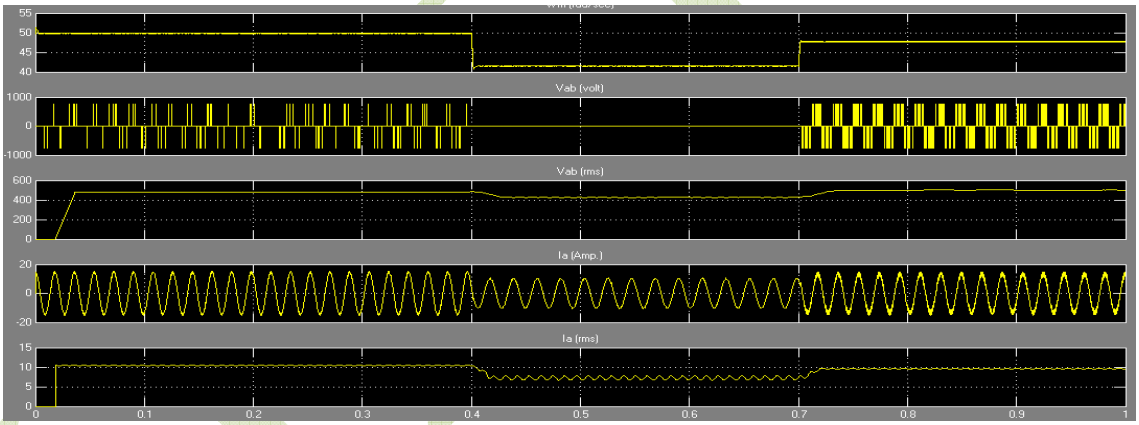

Fig 10.voltage, current characteristic of wind mill

Table-I
Generator Parameters

Sr. No	Parameter	Value
1	Speed	3000
2	Voltage	750
3	Current	8.2
4	Power	6150

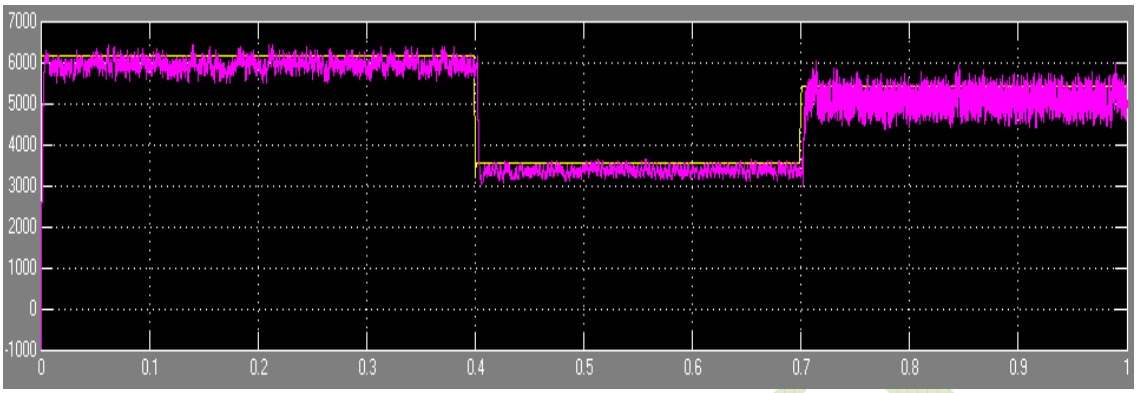

Fig 11.Output power from wind mill

Hybrid Micro grid:-

In the remote areas where it is difficult to go provide the main grid where microgrid is the solution of energy. In remote areas the availability of land is more according to the site the combination of wind energy and solar energy provides alternative to main grid with battery storage for backup. Here we are combining these two sources for the production of the power from grid.

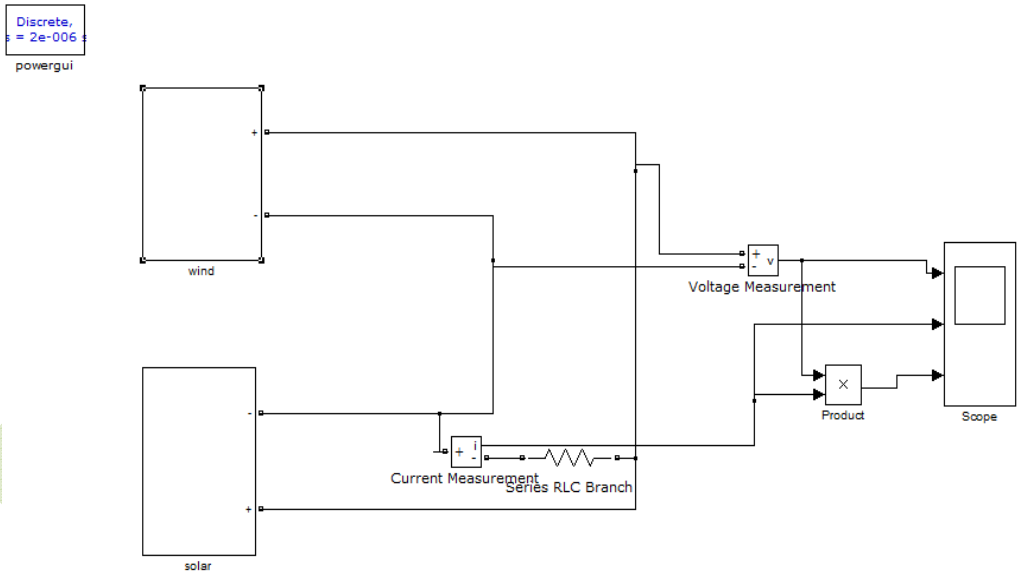

Fig12.Hybrid micro grid by connecting wind and solar with load connected

The load connected to the micro grid is purely resistive of 10ohm and values of current, voltage, power are as shown in fig13.

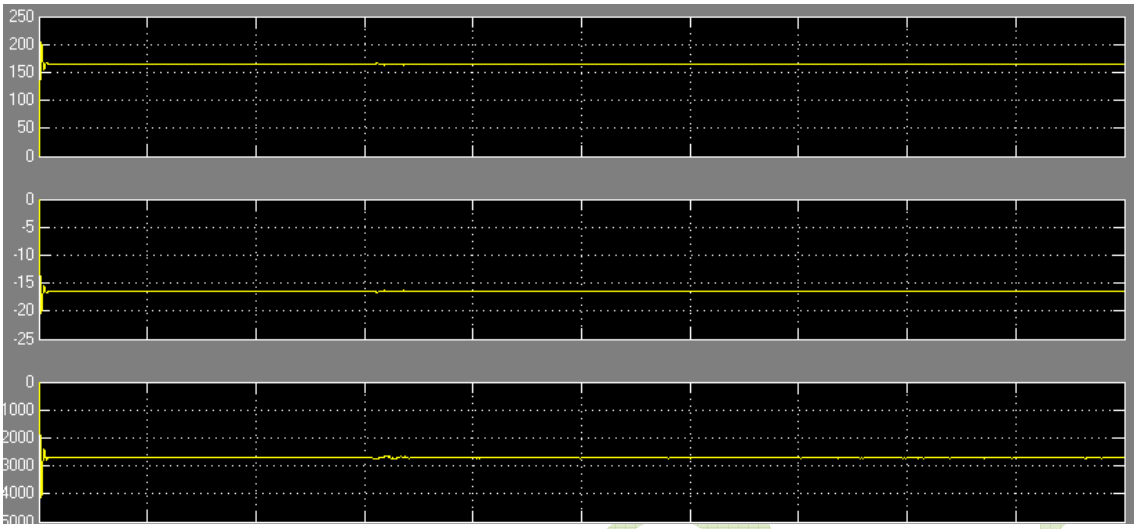

Fig13.Output of micro grid with voltage, current, power graph.

CONCLUSION

Renewable energy sources also called non-conventional type ofenergy are continuously replenished by natural processes. Hybrid systems are the right solution for clean energy production. In this paper, a new wind-PV hybrid generation system has been proposed and implemented. It shows that voltage and power can be well controlled in the hybrid system under a changing environment. The simulation model of the hybrid generation system was developed using MATLAB/Simulink. This grid-connected hybrid generation system can fully utilize the characteristics of the proposed wind generator and the PV panels to extract the maximum power from the wind and solar energy sources. The PID, dq theory and P&O methods can quickly and accurately track the maximum power output for hybrid power system. Moreover, an efficient power sharing among the energy sources are successfully demonstrated with more efficiency, a better transient and more stability, even under different load conditions and disturbance

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