iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** II **Month of publication:** February

DOI: http://doi.org/10.22214/ijraset.2019.2127

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue II, Feb 2019- Available at www.ijraset.com

Matlab Simulation of Hybrid Solar-Wind Renewable Energy System for Electrification

Mohit Kumar[1], Mr. Rishabh Shukla[2], Mr. Lalit Jain[3]
[1]*Research Scholar,* [2]*Assistant Professor,* [3]*Assistant Professor, Department of Electrical and Electronics Engineering, Oriental College of Technology, Bhopal (MP), India*

Abstract: ***Now a day's electricity is most needed facility for the human being. All the conventional energy resources are depleting day by day. So we have to shift from conventional to non-conventional energy resources. In this the combination of two energy resources is takes place i.e. wind and solar energy. This process reviles the sustainable energy resources without damaging the nature. We can give uninterrupted power by using hybrid energy system. Basically this system involves the integration of two energy system that will give continuous power. Solar panels are used for converting solar energy and wind turbines are used for converting wind energy into electricity. This electrical power can utilize for various purpose. Generation of electricity will be takes place at affordable cost. This paper deals with the generation of electricity by using two sources combine which leads to generate electricity with affordable cost without damaging the nature balance. Index Terms- electricity, hybrid, solar, power, wind.***

Keywords: Solar energy, Wind energy, PV array, Boost Converter, Wind Turbine, Inverter, MPPT.

I. INTRODUCTION

Electricity is most needed for our day to day life. There are two ways of electricity generation either by conventional energy resources or by non-conventional energy resources. Electrical energy demand increases in word so to fulfill demand we have to generate electrical energy. Now a day's electrical energy is generated by the conventional energy resources like coal, diesel, and nuclear etc. The main drawback of these sources is that it produces waste like ash in coal power plant, nuclear waste in nuclear power plant and taking care of this wastage is very costly. And it also damages he nature. The nuclear waste is very harmful to human being also. The conventional energy resources are depleting day by day. Soon it will be completely vanishes from the earth so we have to find another way to generate electricity. The new source should be reliable, pollution free and economical. The non-conventional energy resources should be good alternative energy resources for the conventional energy resources. There are many non-conventional energy resources like geothermal, tidal, wind, solar etc. the tidal energy has drawbacks like it can only implemented on sea shores. While geothermal energy needs very lager step to extract heat from earth. Solar and wind are easily available in all condition. The non-conventional energy resources like solar, wind can be good alternative source. Solar energy has drawback that it could not produce electrical energy in rainy and cloudy season so we need to overcome this drawback we can use two energy resources so that any one of source fails other source will keep generating the electricity. And in good weather condition we can use both sources combine.

II. HYBRID ENERGY SYSTEM

Hybrid energy system is the combination of two energy sources for giving power to the load. In other word it can defined as "Energy system which is fabricated or designed to extract power by using two energy sources is called as the hybrid energy system." Hybrid energy system has good reliability, efficiency, less emission, and lower cost. In this proposed system solar and wind power is used for generating power. Solar and wind has good advantages than other than any other non-conventional energy sources. Both the energy sources have greater availability in all areas. It needs lower cost. There is no need to find special location to install this system.

1) *Solar Energy:* Solar energy is that energy which is gets by the radiation of the sun. Solar energy is present on the earth continuously and in abundant manner. Solar energy is freely available. It doesn't produce any gases that mean it is pollution free. It is affordable in cost. It has low maintenance cost. Only problem with solar system it cannot produce energy in bad weather condition. But it has greater efficiency than other energy sources. It only need initial investment. It has long life span and has lower emission.

2) Wind Energy: Wind energy is the energy which is extracted from wind. For extraction we use wind mill.The wind energy needs less cost for generation of electricity. Maintenance cost is also less for wind energy system. Wind energy is present almost 24 hours of the day. It has less emission. Initial cost is also less of the system. Generation of electricity from wind is depend upon the speed of wind flowing.

The major disadvantages of using independent renewable energy resources are that unavailability of power for all time. For overcoming this we use solar and wind energy together. So that any one source of power fails other will take care of the generation. In this proposed system we can use both sources combine. Another way is that we can use any one source and keep another source as a stand by unit. This will leads to continuity of generation. This will make system reliable. The main disadvantages of this system are that it needs high initial cost. Except that it is reliable, it has less emission. Maintance cost is less. Life span of this system is more. Efficiency is more. A main advantage of this system is that it gives continuous power supply.

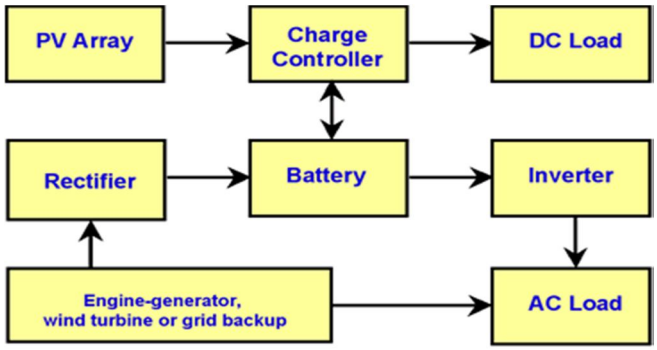


Fig.1 Block diagram of Hybrid energy generation system

III. MAXIMUM POWER POINT TRACKING

MPPT control system is a completely electronic system which can deliver maximum allowable power by varying the operating point of the modules electrically.

A. MPPT Algorithm

There are many algorithms which help in tracing the maximum power point of the PV module. They are following:

1) P&O algorithm
2) IC algorithm
3) Parasitic capacitance
4) Voltage based peak power tracking
5) Current Based peak power tracking

B. Perturb And Observe

Each and every MPPT algorithm has its own advantages and disadvantages. Perturb and observe (P&O) method is widely used due its simplicity. In this algorithm we introduce a perturbation in the operating voltage of the panel. Perturbation in voltage can be done by altering the value of duty-cycle of dc-dc converter.

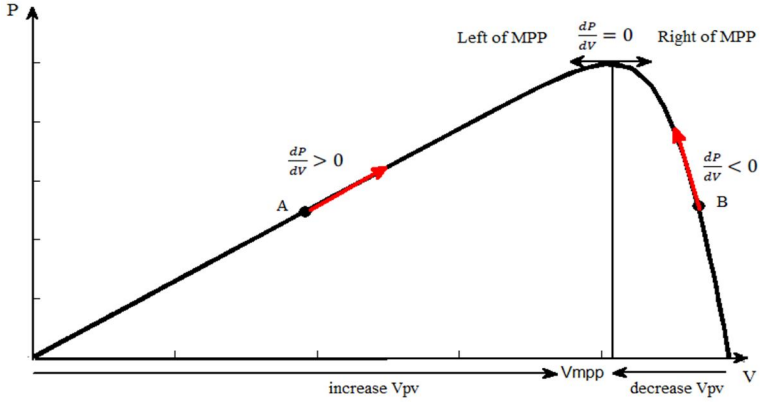
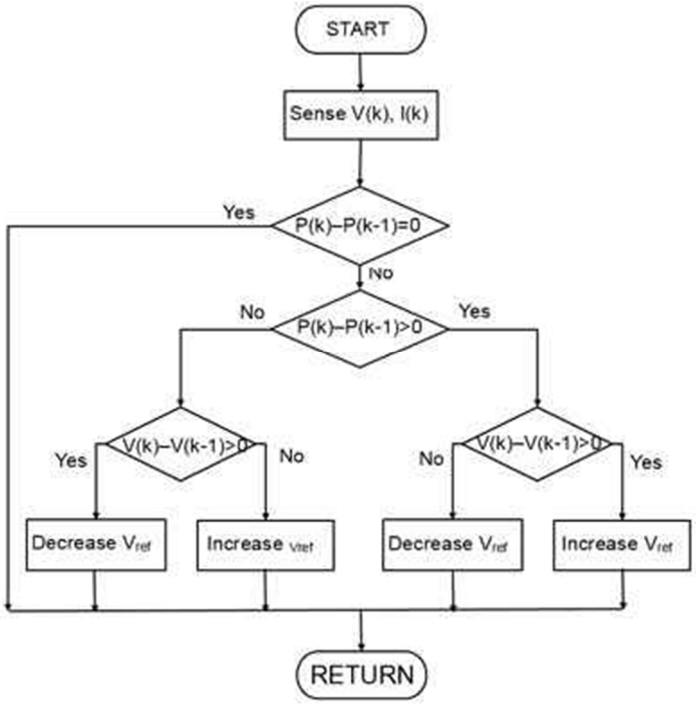


Fig.2 P-V characteristic (basic idea of P&O algorithm)

Fig.2 show the p-v characteristics of a photovoltaic system, by analyzing the p-v characteristics we can see that on right side of MPP as the voltage decreases the power increases but on left side of MPP increasing voltage will increase power. This is the main idea we have used in the P&O algorithm to track the MPP. The flow chart of P&O algorithm is manifested in figure. As we can see from the flow chart first of all we measure voltage and current, by using these values we calculate power, calculated power is compared with previous one and accordingly we increase or decrease the voltage to locate the Maximum Power Point by altering the duty cycle of converter.



Flowchart of Perturb & Observe MPPT algorithm

IV. PERFORMANCE EVALUATION

Fig 3, 4 represent solar voltage and wind voltage respectively. Fig 5 shows hybrid voltage of solar and wind system. Fig 6 shows solar power developed. Fig 7 and 8 shows the output voltage and output current respectively. Fig 9 represents power supplied to load. Fig 10 shows battery charging current.

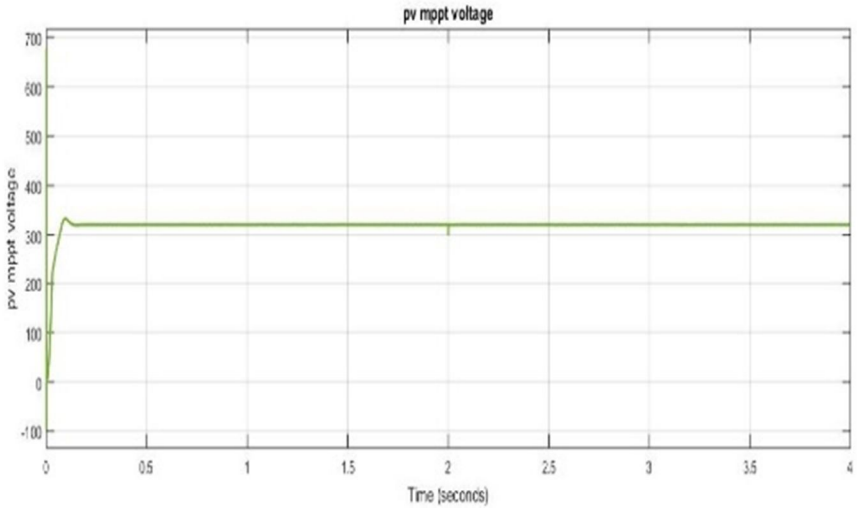


Fig. 3 Voltage of PV module

From this figure we can observe that voltage developed by solar module is approx. 320V and is nearly constant after a certain time period.

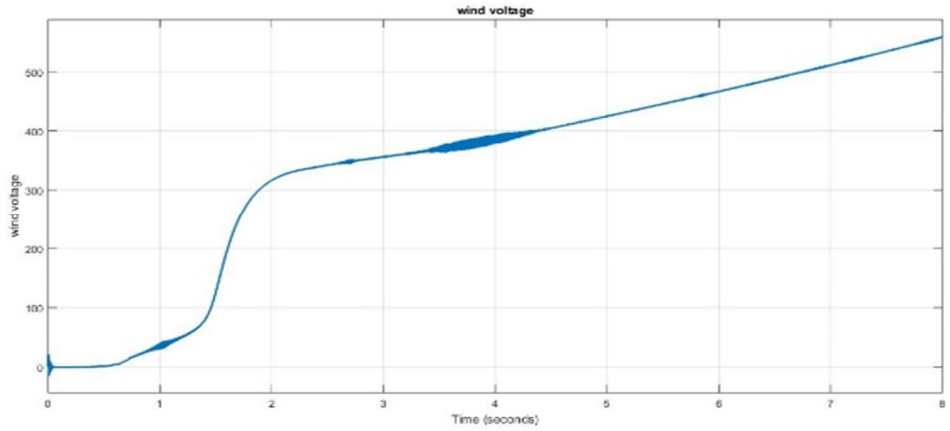


Fig.4 Voltage waveform of Wind power system

Since wind energy is not constant all the time and turbine speed keeps fluctuating all the time, that's why the voltage developed by it is somewhat variable and depends on wind speed.

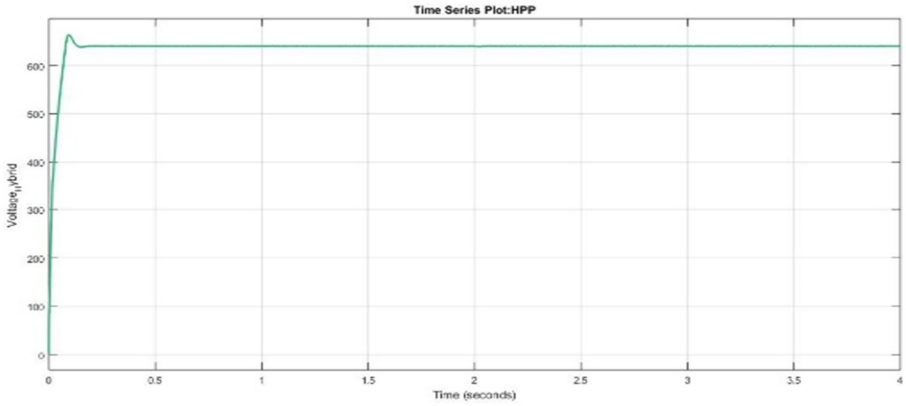


Fig.5 Voltage of hybrid system

From this result, it is observed that the hybrid voltage obtained by linking solar and wind energy system is approx. 630V and it is almost constant and within the limits.

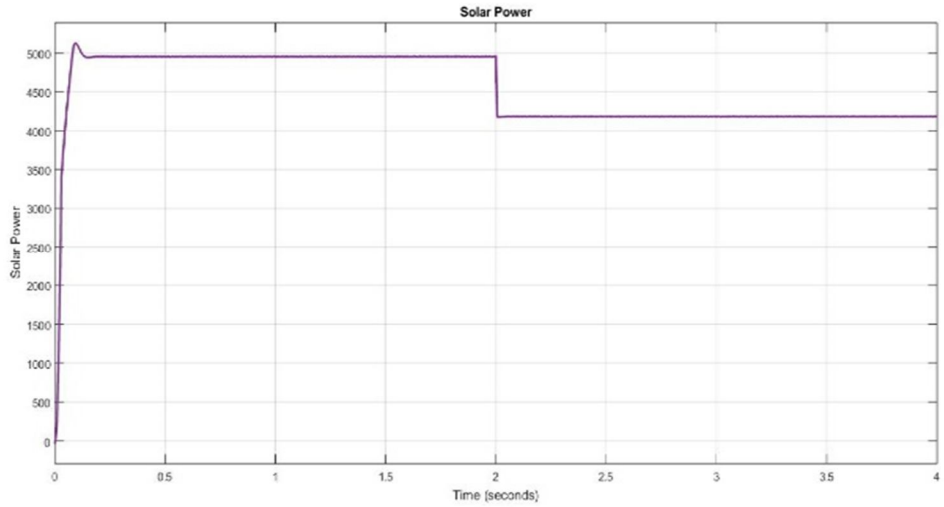


Fig.6 Solar Power

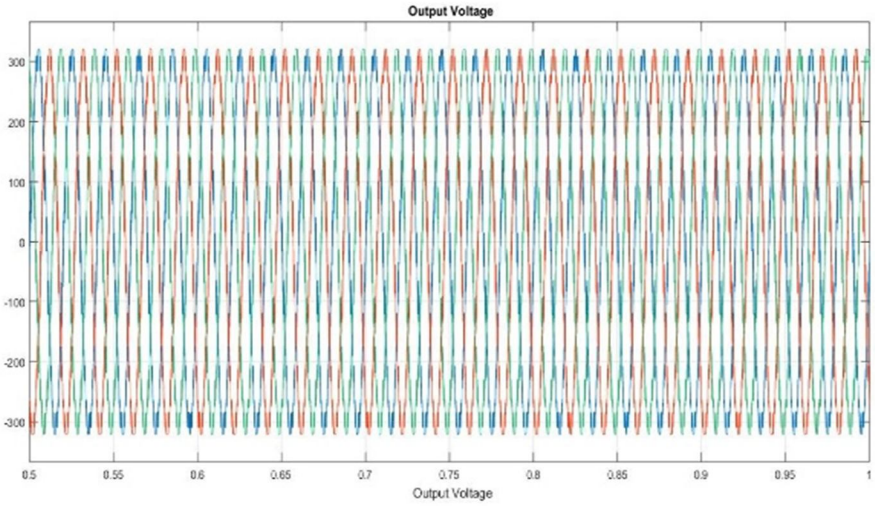


Fig 7 Output Voltage

Here, the output voltage obtained is purely sinusoidal in nature without harmonics and disturbances having magnitude of 230V. This voltage is fed to the load .

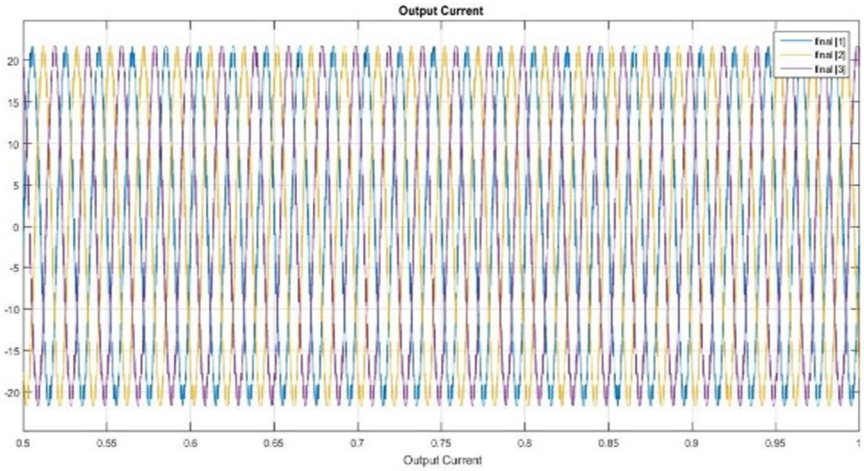


Fig.8 Output Current

From this result , it can be observed that the current fed to load is purely sinusoidal in nature having the magnitude of 15A.

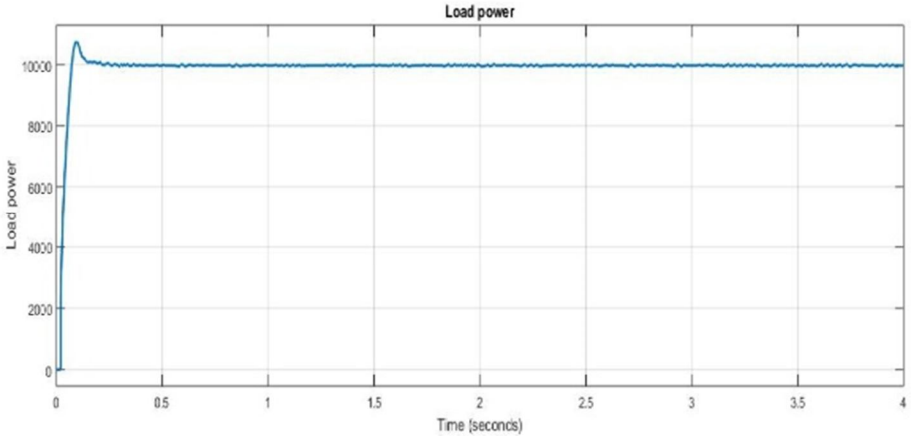


Fig.9 Load Power

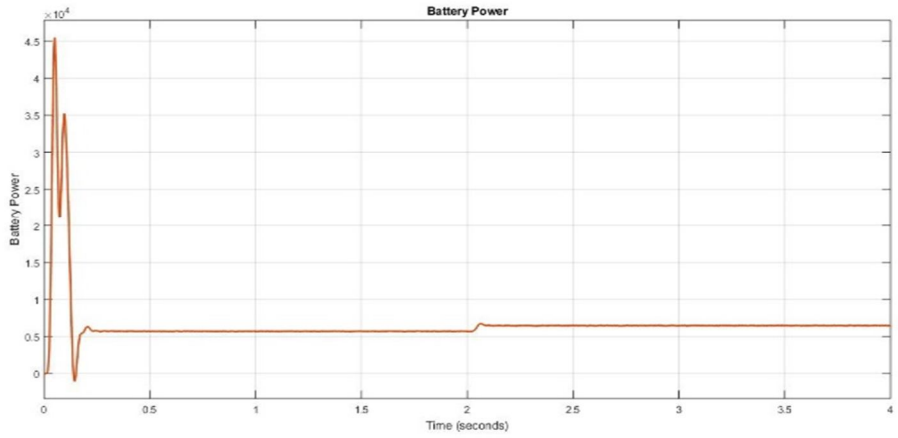


Fig.10 Battery Power

From the fig 10, it can be observed that the battery can deliver power of 5KW to the load in the situation when both the solar and the wind energy system are not capable to generate the sufficient power required to the load. Fig.11 shows the output voltage and current waveform at non-linear load. At 0.2 - 0.3 sec circuit breaker operates and thus the waveform is as shown.

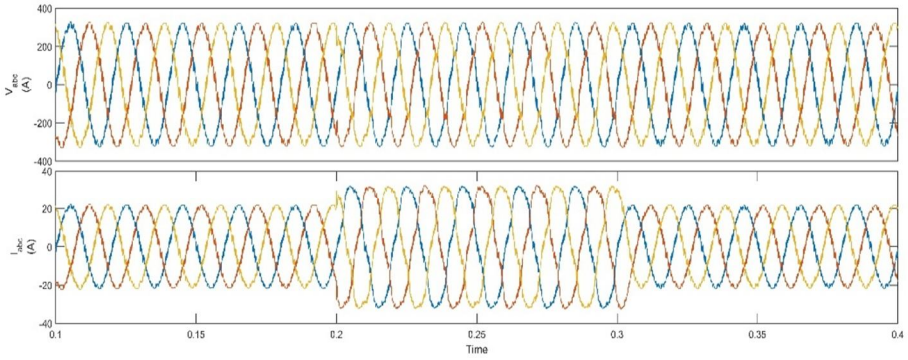


Fig.11 Output voltage and current waveform with non-linear load

V. CONCLUSION

A. PV cell, module and array are simulated and effect of environmental conditions on their characteristics is studied.
B. Solar power obtained is according to the procedure of the proposed model.
C. The results obtained are free of any harmonics and disturbances.
D. Wind energy system has been studied and simulated.
E. Maximum power point of operation is tracked for both the systems using P&O algorithm.
F. Both the systems are integrated and the hybrid system is used for battery charging and discharging.
G. This system is designed for considering the adverse conditions and it works good in a condition of high power requirement.

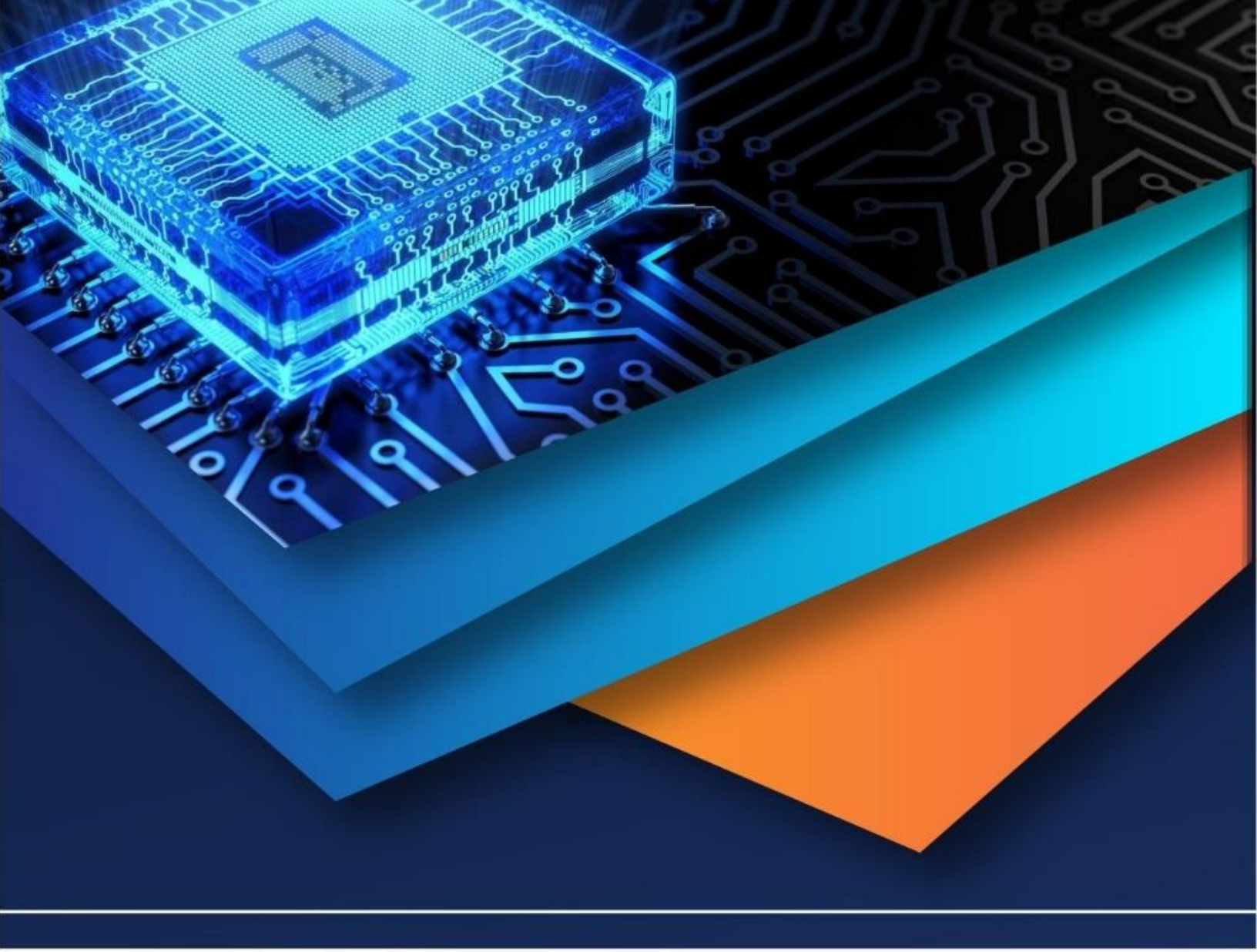
VI. FUTURE SCOPE

Following are the future research avenues and the areas which can be further explode as a continuous research:

A. MPP can be tracked using different algorithms .
B. Battery charge controller can be designed for more reliable operation and better battery life
C. Cost can be considered to make it economical.
D. It can be connected to grid system to provide power at peak load conditions.
E. It can be used as an alternative to the present power generation system as a renewable source of energy.

REFERENCE

[1] T. Salmi, M. Bouzguenda, A. Gagtli, "MATLAB/Simulink based modeling of solar photovoltaic cell," International journal of renewable energy research, vol.2, no.2, 2012.
[2] S. Meenakshi, K.Rajambal, S. Elangovan "Intelligent controller for stand-alone hybrid generation system," IEEE, May. 2006.
[3] Nabil A. Ahmed, Masafumi Miyatake, "A stand-alone hybrid generation system combining solar photovoltaic and wind turbine with simple maximum power point tracking control," IPEMC 2006, IEEE, 2006.
[4] Ashish S. Ingole, Prof. Bhushan S. Rakhonde, "Hybrid Power Generation System Using Wind Energy and Solar Energy", International Journal of Scientific and Research Publications, Volume 5, Issue 3, March 2015
[5] M. G. Villalva, J. R. Gazoli, "Modeling and circuit based simulation of photovoltaic arrays," Brazilian power electronics conference (COBEP), 2009.
[6] Marcelo Gradella Villalva, Jonas Rafel Gazoli, "Comprehensive approach to modeling and simulation of photovoltaic arrays," IEEE transaction on power electronics, vol.24, no.5, May 2009.
[7] Hiren Patel and Vivek Agarwal, "Matlab based modeling to study the effect of partial shading on PV array characteristics," IEEE transaction on energy conversion, vol.23, no.1, March 2008.
[8] Mohammed Abdulazeez, Ires Iskender, "Simulation and experimental study of shading effect on series and parallel connected PV modules," IEEE transaction on energy conversion, vol.27, no.2, March 2008.
[9] SiyuGuo, Timothly Michael Walsh, "Analyzing partial shading of PV module by circuit modeling," IEEE 2011.
[10] Zhou Xuesong, Song Daichun, Ma Youjie, Chen Deshu, "The simulation and design for MPPT of PV system based on Incremental conductance method," Wase International conference on information engineering, 2010.
[11] Azadeh Safari, Saad Mekhilef, "Simulation and Hardware Implementation of Incremental Conductance MPPT with Direct Control Method Using Cuk Converter," IEEE transaction on industrial electronics, vol. 58, no. 4, april 2011.
[12] Mihnea Rosu-Hamzescu, Sergiu Oprea, "Practical guide to implementing Solar panel MPPT algorithm," Microchip technology Inc, 2013.
[13] M. Gengaraj, J. Jasper Gnanachandran, "Modeling of a standalone photovoltaic system with charge controller for battery energy storage system," International Journal of Electrical Engineering, vol.6, no. 3, 2013.
[14] T. Taftichat, K. Agbossou, "Output power maximization of a permanent magnet synchronous generator based stand-alone wind turbine system," IEEE ISIE July 9-6 2006.
[15] Roger Gules, Juliano De pellegrin Pacheco, "Maximum power point tracking system with Parallel connection for PV stand-alone application," IEEE transaction on industrial electronics, vol.55, no.7, July 2008.
[16] S. Rahmani, Ab. Hamadi, A. Ndtoungou, "Performance evaluation of a PMSG-based variable speed wind generation system using maximum power point tracking," IEEE electrical power and energy conference 2012.
[17] Majid Jamil, Ravi Gupta, "A review of power converter topology used with PMSG based wind power generation," IEEE, 2012.
[18] Eftichios Koutroulis, Kostas Kalaitzakis, "Design of a maximum power tracking system for wind-energy conversion application," IEEE Transaction on industrial electronics, vol. 53, no.2, April 2006.
[19] C. Lin, S. yang, G.W. Wu, "Study of a non-isolated bidirectional dc-dc converter," IET power electronics. vol.6, 2013.
[20] M. Ahmadi, K. Shenai, "New, Efficient, low-stress buck-boost bidirectional dc-dc converter," IEEE, 2012.
[21] Zhilling Liao, Xinbo Ruan, "Control strategy of bi-directional dc-dc converter for a novel stand-alone photovoltaic power system," IEEE vehicle power and propulsion conference (VPPC), September 2008.
[22] Mohd. Hasan Ali, "WIND ENERGY SYSTEMS Solutions for Power Quality and Stabilization" 2012.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY