American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-10, Issue-01, pp-277-282
www.ajer.org
Research Paper Open Access

Influence of Weather Condition on the Operation and Load - Generation Balancing Of Standlone Pv Systems

HEBA.M. A. HALIM*[1] BASEM. E. El NAGHI*[2], ALI.H.K. ALABOUDY[3], and RAMADAN .M.MOSTAFA[1].
[1]*Faculty of Technology and Education Beni-Suef University*
[2]*Electrical Engineering Dept., Faculty of Engineering, Suez Canal University, 41522, Ismailia, Egypt*
[3]*Currnty Program Manager with QNRF*

ABSTRACT
Generally, the power generation is affected by the weather condition in the photovoltaic systems. The present work is concerning the sun irradiation and climate temperature state and its influence on the system values of volt and current generation. A simulation system is built by MATLAB Simulink is examined and tested is considered. The Perturb & Observe maximum power point tracking system is considered to. The system run under the state of irradiation values was 200, 400 , 600, 800 and 1000 xxx and the climate temperature was 25℃ and 40℃. The result is recorded and clarified in curves to explain the effect of different values of irradiation and the climate temperature of volt and current of every case of suggested system run. The taken results was compared with the same values of sun irradiation and climate temperature of previous researches work which is found is fully consistent with each other,
KEY WORD*: Photo Voltaic, Maximum Power Point Tracing (MPPT), Perturb & Observe, Incremental Conductance,*

Date of Submission: 04-01-2021 Date of acceptance: 19-01-2021

I. INTRODUCTION

Photovoltaic panels have reliable properties in terms of strong electronic interfaces that can work alone or connect to networks as they are highly efficient, reliable, long-lasting, and cost-effective. They are very suitable for distributed PV generators with a low power rating. For the cleanliness of pollution-free photovoltaic energy and in light of the governments' support for excess demand year after year to replace it as an alternative to other energies. Among the characteristics of this energy generation is intermittence and the promise of stability as it has a serious impact on the stable operation of energy demand. Considering that solar radiation and heat having a dynamic motion, the solar system must have the tracking feature and those of the Maximum Power Point Tracing (MPPT) designs to obtain the maximum possible energy from the system. Some factors affecting the solar output power like, solar irradiance (power per unit area on the Earth's surface delivered by the Sun as electromagnetic radiation), Module temperature, and mount of incomplete shadow and climate conditions. Some researchers are investigating the maximum tracking point at the maximum strengths applied by the incremental conductance system (IC). Researchers have developed an IC algorithm to monitor the Buck Boost Converter service cycle and to ensure that MPPT operates effectively to produce the highest potential power[1]. The purpose of the research was to examine the MPPT implementation of the buck-boost converter using the IC process. The outcome was compared to the P&O algorithm. The PV system, MPPT and Buck-Boost converters were simulated on Matlab/ Simulink. The result revealed that the IC approach had better results compared to the P&O method. They concluded that the IC approach had effectively suppressed the oscillation around the MPP point, but the downside is that it had a longer tracking time. The tracking time can be improved by adjusting the increment/decrement period of the service cycle. The increment/decrement step also could be adaptively changed to achieve a better time response. There are many MPPT techniques that have been introduced and elaborated extensively by researchers. stated that at least 19 distinct methods have been promoted, developed and implemented to improve solar photovoltaic. Each method differs in their complexity, number of sensors used, cost and effectiveness [2]. As example These methods are ,Current sweep , Fixed

voltage method, Fractional open circuit voltage method , Perturb and observe (P&O) algorithm , Incremental conductance method, DC Link Capacitor Droop Control, $\frac{dP}{dV}$ or $\frac{dP}{dI}$ Feedback Control, Ripple Correlation Control Methods, Fuzzy Logic Control Methods, Neural Network Methods and Hybrid Methods. MPPT is a circuit used to track the maximum DC power of the solar panels. It senses the power produced by the panels and using a predefined algorithm, monitors the overall output power required by the loads. This is achieved in order to make good use of the productivity of the panel to address variable variables impacting panels such as heat and solar radiation[3]. If the energy produced pathing through MPP from the panels is instantaneous higher than the load, then a spring unit must be added that stores the generation instantaneous energy in excess of the required load and to ensure the delivery of the capacity required for the load in cases of excess generation, then this unit must be added to the system to store this energy in cases of increased generation capacity over the load.

II. LITERATURE SURVEY

In this research, we will choose two methods for tracing systems so that we obtain the required energy from the system. In the two mentioned cases, many researchers have done through tracking techniques (MPPT) that can increase the overall efficiency in photovoltaic (PV) systems by extracting the maximum available energy that has been presented and widely detailed by many researchers.**[4].**

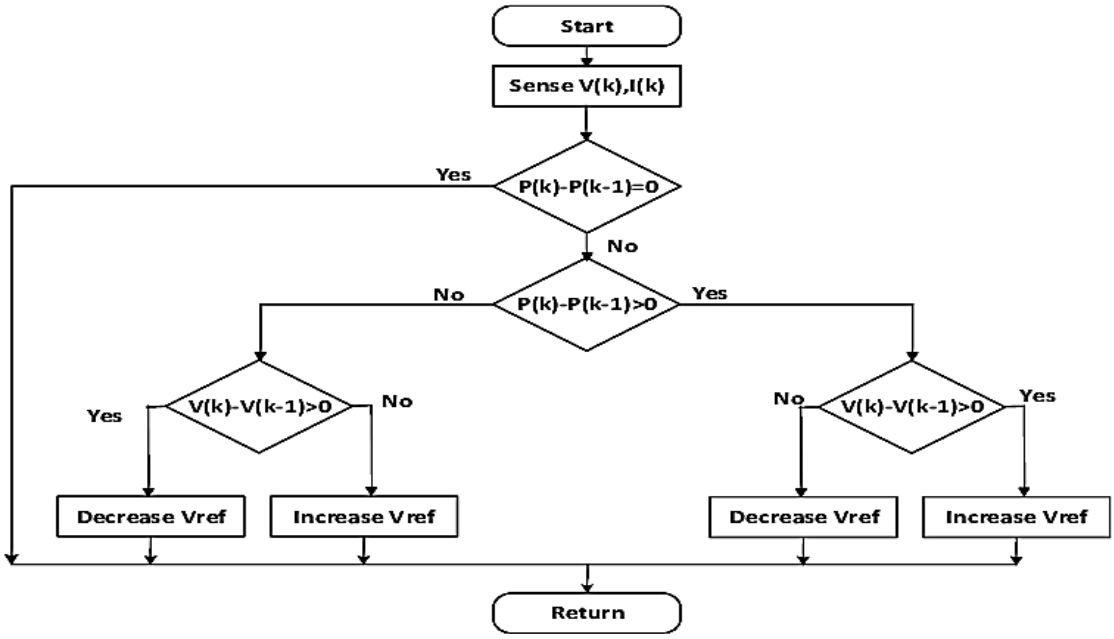


Fig 1: Flow Chart of Conventional P&O Algorithm [5]

Many studies had been done to modify the algorithm so that the tracking speed and algorithm accuracy can be improved. Many researchers have proposed variable step size concept since Perturb & Observe MPPT type with fixed step size does not provide a good tradeoff.[5] In this method, the sign of the last perturbation and the sign of the last increment in the power are used to decide what the next perturbation should be.
As can be seen in Fig. 1 on the left of the MPP incrementing the voltage increases the power whereas on the right of the MPP decrementing the voltage increases the power.

Incremental conductance method

The algorithm in Fig. 2 explains the increment a conductance, resulting from the partial derivative of the relative power of the output voltage of the photovoltaic panel to achieve the maximum power point characterized by a value $\frac{dP}{dV} = 0$ The following equations characterize this method:

$$\frac{dP}{dV} = \frac{d(VI)}{dV} = I + \frac{dI}{dV} = 0 \quad (1)$$

$$-\frac{V}{I} = \frac{dI}{dV} \quad (2)$$

The term $\frac{I}{V}$ represent the conductance and $\frac{dI}{dV}$ the incremental conductance. At maximum power point these two terms are equal but different signs.

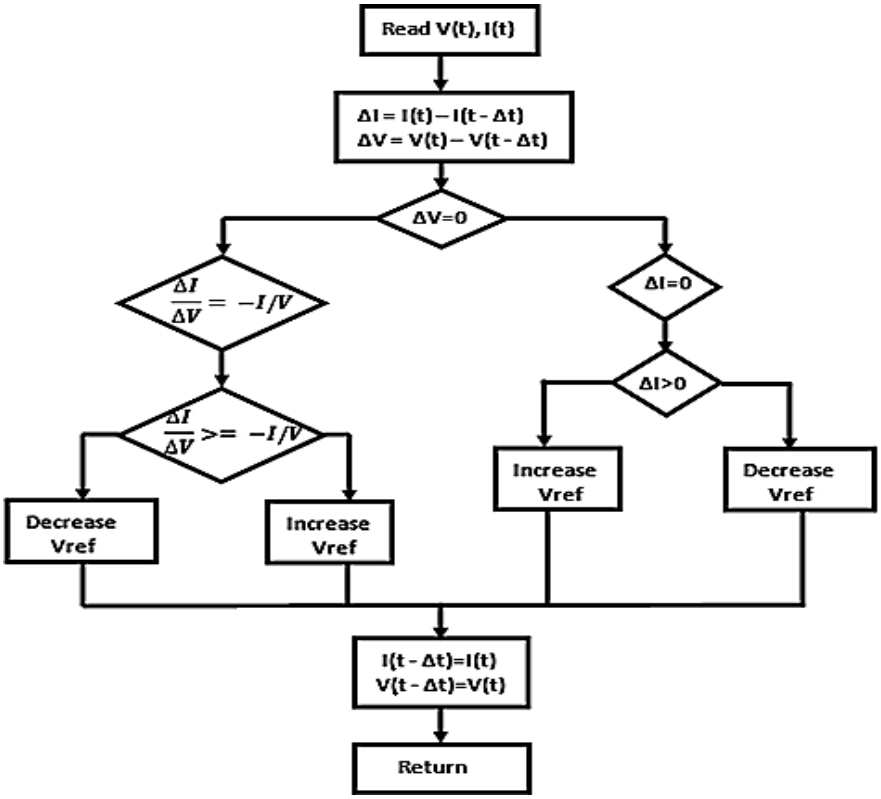


Fig. 2: Incremental Conductance Flow Chart [3]

Five major factors affecting the performance of the photovoltaic systems such as load, sun light intensity, weather temperature, shading and crystalline structure.[4]. The cell temperature of 25 C operates at the standard operation at full capacity. If the temperature rises over the 25 C the power will decreases gradually with increase the weather temperature. The solar radiation level has the major effect on the photovoltaic system. the power increase with increases the solar radiation.

In the other hand the power decrease with increase the weather temperature. [5] they introduced a study of temperature and solar radiation on photovoltaic power system. They concluded that the simulated system results the current and generated increases with increase the solar radiation and on the other hand at the rise of the panel temperature the panel power will decrease gradually. [6] Wasfi introduced the standard temperature of the working in the photovoltaic system is 25 C and the panel operates less efficiently and the voltage decreases. In this case heat is considered as resistance to flow the electrons. The effective current also may be decrease. [7] they introduced a study concerning the effect of the temperature and the solar radiation on the power generation of the panels. Some other parameter were studied in their research Therefore, solar radiation level has a the major effect on the panel power. As a result, a decrease in solar radiation level reduces the panel power. On the other hand, there is an inverse proportion between temperature and panel power. Also the panel power decreases as the ambient temperature increases.

The effect of the solar irradiance, cell temperature. wind speed on the photovoltaic system performance was studied by [8]. They construct a model on the MATLAB to study the effect these factors on the panels performance, they concluded that the independence variables of solar irradiance, cell temperature and wind speed has significant effect in the model compared to the cell temperature and wind speed. In the research of [9] studied the solar irradiations and wind temperature effects on the power generating of panels. According their results on model built in perles city and the data taken accordind this city, the results were the wind speed and wind tempratue and solar irradiance affecting on the panel generation power.

[10] introduced a study for affecting the weather temperature on the panels performance. They introduced a study through an simulated model using PV system control to evaluate the output performance control through PROVA control program. This program is special for measuring the operation temperature during the experimental procedures. The experimental results explained that the factors of solar irradiance and the ambient temperature are affected on the power generations. The effect of the ambient temperature is negative impact on output performance while the irradiance having the positive impact on the power generated.

The Aim this research

The aim of this research is to apply two consecutive systems to regulate the energy generated like power imbalance, voltage instability, voltage fluctuations and other grid related issues by the solar system. The MPPT system is applied to obtain the maximum possible energy from the PV system. The present work aimed also to study the effect of external condition such the solar irradiance and the air temperature affecting on the power generation of the photovoltaic systems.

The present work is introducing the results of Simulink model of PV unit. The simulation results of the algorithm are divided into two complete results but the changing temperature and insolation cause the point of maximum power to vary continuously. But the position of load line is constant and thus maximum power cannot be extracted from the panel. In order to draw maximum output from the PV panel at varying temperature and insolation, it is necessary to track the Maximum Power Point (MPP). One of the functions Various Maximum Power Point Tracking (MPPT) algorithms are put forward for tracking MPP. Amongst these algorithms, Perturb and Observe (P & O) method has been preferred due to its simplicity and easy control.

Matlab Simulation for PV cell

The Solar Cell Model was developed by making use of the solar cell block available in the Simscape library the connecting Current sensor and Voltage Sensor across the solar cell block is in series and parallel. A PS constant block connected to its irradiation terminal provides irradiation to the cell which can be either constant or variable depending on the type of irradiation we choose. Solver Configuration block is used to solve the equations of the solar cell. Current sensor and Voltage sensor show the output current and voltage of the cell respectively. Here, an important block used is PS, which acts as an interface between Simscape and Simulink system library blocks.

The model circuit built in the MATLAB is constructed and tested until the obtaining the stable results as in Fig. 3.

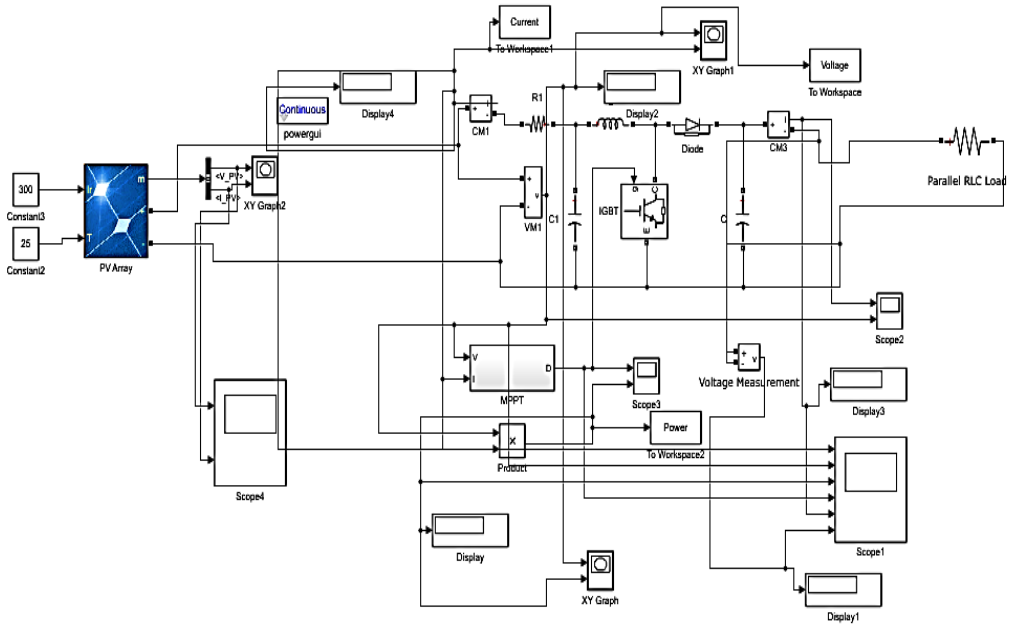


Fig. 3: Model in Matlab

The system described in section IV is realized using MATLAB/SIMULINK environment and the detailed simulation results are demonstrated below. The system parameters used in simulating the results has been given in Table II. While performing the simulation of the system, I-V and P-V characteristics of solar PV are extracted with the help of Perturb & Observe (P&O) method by regulating the duty cycle of DC-DC boost converter. I-V & P-V characteristics are depicted from respectively. It is clear from I-V characteristics that open circuit voltage VOC is 19V and short circuit current ISC is 5A and the corresponding maximum power extracted from solar PV is 85W as indicated by P-V characteristics. The date applied of the system is recorded and explained in Table (1).

Table (1) The system parameter applied on the suggested system.

P	V_{oc}	V_{mp}	I_{sc}	I_{mp}
2108.871W	36.6 V	29.3 V	7.97A	7.47A
R_{sh}	R_s	V_{rms}	F_n	Active power
350 241 Ω	0.3817 Ω	300 V	50 HZ	1000 W

The groups are applied and tested on the model are shown in Table 2. The groups are divided into two groups. These groups explain the values of value of climate temperature and the type of load .

Table 2: Experimental groups used for the load and climate temperature

Load type	R, l and C	Motor
Climate temperature	25℃	40℃
Irradiation value	200 , 400 ,600, 800, 1000	200 , 400 ,600, 800, 1000

Experimental Results

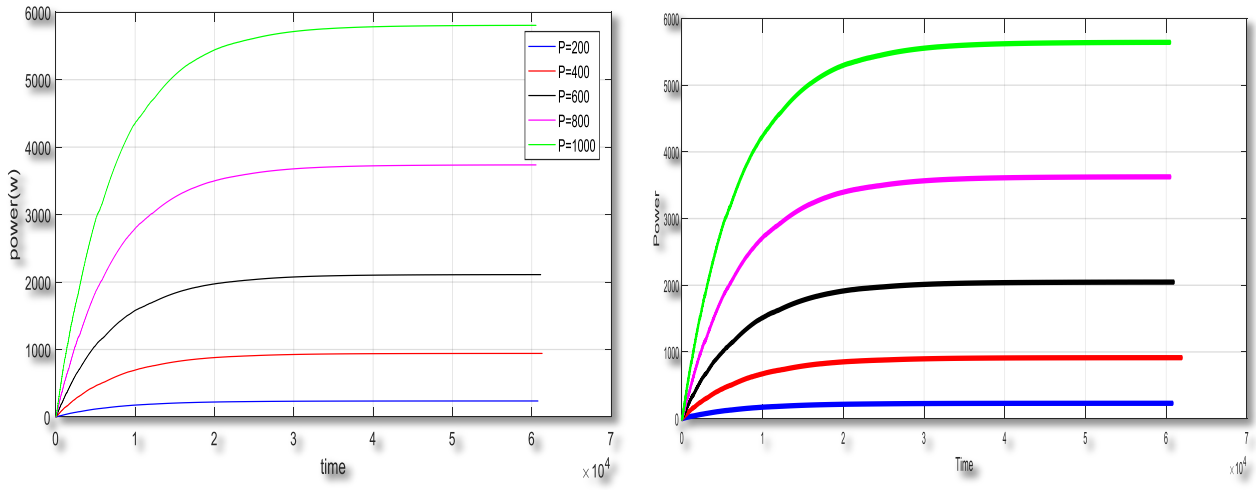
The aim of the present work as mentioned before is to study the maximum power tracing on a simulated system plotted on Matlab is explained in Fig 4. The MPPT of P&O result is applied on the system to obtain the maximum power needed for any load applied. Then the main object of the study is applied. The study of the weather temperature is applied at some values of solar irradiance. There are two case are applied as a load on the suggested system these cases are

1- The applied load is a motor
2- The applied load is R , L and C

The recorded reading and the results are plotted in the case of each date applied:

1- In case of motor applied Fig. 4 (a) is shows the relationship between the value of power generated in case of values of irradiation against the time of experiment until the arrival of the steady state according to the ambient temperature which is 25 ℃.

2- In case of motor applied Fig. 4 (b) is shows the relationship between the value of power generated in case of values of irradiation against the time of experiment until the arrival of the steady state according to the ambient temperature which is 40 ℃.

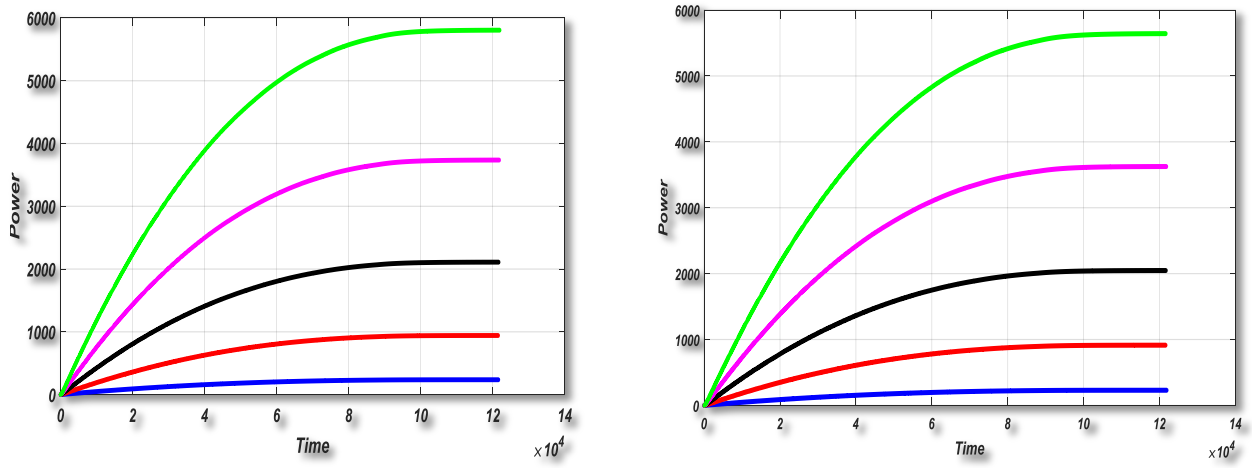


(a) **(b)**

Fig. 4: Power Generation Versus time (a) at ambient temperature 25℃ (b) at ambient temperature 40℃

3- In case of Resistance applied Fig. 5 (a) is shows the relationship between the value of power generated in case of values of irradiation against the time of experiment until the arrival of the steady state according to the ambient temperature which is 25℃

4- In case of Resistance applied Fig. 5 (b) is shows the relationship between the value of power generated in case of values of irradiation against the time of experiment until the arrival of the steady state according to the ambient temperature which is 40℃



(a) **(b)**

Fig. 5: Power Generation Versus time (a) at ambient temperature 25℃ (b) at ambient temperature 40℃

III. CONCLUSION

The results of the present work is analyzed and plotted in curves after applying the suitable MPPT method to get the system in steady state operation. system performance is work under several condition in the stable case. The different result obtained under the required condition from the ambient temperature and solar irradiance applied. As noticed that the extra ambient more than 25 ℃ the power will decrease gradually. It is noticed during the experiment, in case of the extra global solar irradiance an extra power is produced.

REFERENCE

[1]. Rozana Alik, Awang Jusoh, Tole Sutikno "A Review on Perturb and Observe Maximum Power Point Tracking in Photovoltaic System " TELKOMNIKA Vol. 13, No. 3, pp: 745 – 751, September (2015)

[2]. Esram T, PL Chapman. Comparison of photovoltaic array maximum power point tracking techniques. IEEE TRANSACTIONS ON ENERGY CONVERSION EC.; 22(2): 439. (2007)

[3]. J. R. G. a. E. R. F. Marcelo Gradella Villalva, "Comprehensive Approach to Modeling and Simulation of Photovoltaic Arrays," IEEE TRANSACTIONS ON POWER ELECTRONICS, 5, MAY 2009.

[4]. Ratna Ika Putri, Sapto Wibowo, Muhamad Rifa'I " Maximum power point tracking for photovoltaic using incremental conductance method" Energy Procedia 68 pp: (22 – 30) (2015) 8th International Power Electronics and Motion Control Conference (IPEMC-ECCE Asia) 2016

[5]. S. W. Wamna, S. P. Gawande, R. S. Pawar, M. A. Waghmare, R. N. Nagpure ,P. R. Balpande, D. S. Pande "Real-time Implementation of Electric Spring with Solar PV System in Smart Grid"978-1-5386-5793-5/18/$31.00 ©2018 IEEE .

[6]. Mahmud Wasfi ", Solar Energy and Photovoltaic Systems" , renewable and sustainable Energy (JRSE) February Edition 2011 .

[7]. Akif KARAFIL, Harun OZBAY, Metin KESLER "Temperature and Solar Radiation Effects on Photovoltaic Panel Power" ISSN: 1304-7981 Number: 12, Pages: 48-58 http://jnrs.gop.edu.tr Journal of New Results in Science, 2016.

[8]. A. Al bashir , M. Al Dwen , A. Al Ghandoor , B. Hammad and W. Al Kouz, "Analysis of Effect of Solar Irradiance , cell Temperature and Wind Speed on Photovoltaic System Performance"., International Journal of Energy Economics and policy , 10 (1) pp 353-359 , 2020

[9]. I. Daut, M. Irwanto, Y. M. Irwan, N. Gomesh, Rosnazri, N. S. Ahmad, " Potential of Solar Radiation and Wind Speed for Photovoltaic and wind power Hybrid Generatiom in Perlis , Northren Malaysia" the 5th International Power Engineering and Optimaization Conference PEOCO Shah Alam Selangor Malaysia 6-7 Jone 2011.

[10]. A. R. Amelia, Y. M. Irwan, W. Z. Lcow, M. Irwanto. I Safwati and M. Zhafarina, " Investigation of the Effect Temperature on Photovoltiac (PV) Panel Output Performance", International Journal on Advanced Science Engineering Information Technology. Vol 6 No. 5 ISSN : 2088 – 5334 , 2016

HEBA.M. A. HALIM, et. al. "Influence of Weather Condition on the Operation and Load -Generation Balancing Of Standlone Pv Systems."*American Journal of Engineering Research (AJER)*, vol. 10(1), 2021, pp. 277-282.