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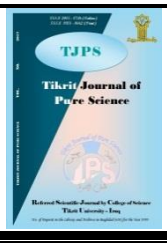

Fabrication and study of solar panel tracking system

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Abstract

Solar energy is one of the most important task of renewable energy. Since the relative sun's motion to the Earth is variable with the seasons and from sunrise to sunset, so the energy produced by the panels is variable. To overcome this problem, we build a solar tracker that follows the sun and thus get the greatest amount of solar radiation most of the time. In this research, a solar tracking system has been manufactured locally and tested experimentally .It is found that our tracking system gives a good results in tracking the source of energy.

Introduction

To overcome On a crisis Global energy produced by fossil fuel. Sun energy can be used, where it is present all the time and everywhere. The efficiency of solar cells is low and fluctuating, therefore, in order to provide enough energy to power appliances or others, the efficiency of cells must be increased before using solar energy as an alternative energy source to meet the world's growing demands. The overall performance of the cells can be attributed to two factors: cell efficiency and the intensity of the radiation on the cell, Researchers continued to work on the development of the efficiency of solar cell Tejasbhai R. in 2015 Automatic solar tracking system using a Pilot Panel. Where the automatic solar tracking system is exposed to a single axis to keep the main solar panels almost in the right corner with the falling photon using an additional panel, called a panel designed to boost power output from the main panel [1]. Kailash Krishna In 2015, a one-axis solar tracker system is achieved through the use of a cost-effective controller.. The performance was tested and the results were compared with the hardboard, indicating that there was an improvement in efficiency when using the rotor. [2] Md. Khalid Iqbal and others in 2015 installed solar tracking system automatic single-axis single axis automatic solar tracking system.. This paper presents a reliable and reasonable strategy to adjust the alignment of a solar module with the sun taking into account the ultimate goal of maximizing power output. [3]. Also there are many searchers studied this subject such as C. Saravanan[4],. Koh Kiong Chai[5], Gagari Deb[6], Tiberiu T[7], Shahriar Bazyari [8], Kamala J[9], Bala Kalanithi[10].

In this work we design dual axis solar tracking system and we found the system is suitable for tracking and the efficiency 15%.

Theoretical part

efficiency of solar cell is very important factor . to calculation of conversion efficiency from current (I) and voltage (V),by use equation [11]:

$$"\eta = \frac{J_{sc}\,V_{oc}}{P_m}\ " \text{ ----------(1)}$$

J_{sc} =current of open circuit.

V_{oc}=Voltage of open circuit

P_m= generation of pane and the power incident.

When use the solar panel there are many losses, According to manufacturing and other factors, including the method of fixing the cell and these losses, due to non-absorption of long wavelengths, Thermal loss due to the excess energy of the photons loss of absorption is incomplete due to limited thickness, Loss due to recombination , shading losses, Voltage factor, fill factor .

equation (2) shows conversion efficiency of solar panel[11]:

$$"\eta = \frac{\int_0^{\lambda_G} \Phi^0\ (\lambda)\frac{hc\ d\lambda}{\lambda}}{\int_0^{\infty} \Phi^0\ (\lambda)\frac{hc\ d\lambda}{\lambda}} \cdot \frac{E_G \int_0^{\lambda_G} \Phi^0\ (\lambda)\, d\lambda}{\int_0^{\lambda_G} \Phi^0\ (\lambda)\frac{hc\ d\lambda}{\lambda}} \cdot (1 - R^*) \cdot QE^*_{opt}\, \eta^*_G \cdot QE^*_{el} \cdot \frac{A_f}{A_{tot}} \cdot \frac{qV_{oc}}{E_G} \cdot FF" \text{—(2)}$$

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Where the
QEel is the quantum efficiency ,
QEop, optical quantum efficiency
Af /*Atot*. This ratio is called the *coverage factor*
λ_G is the wavelength of photons that corresponds to the band gap energy
R is the reflection
FF is the fill factor
Several measures are taken to deal with solar cell losses, including during manufacturing and other during installation and operation .the tracking system One of the solutions to losses of solar cells due to the failure of the fall of radiation directly on the surface of the solar cell at all time of operation which defined to
1-single tracking, 2- dual tracking
In any design of solar systems it is very important to be able to calculate the solar height and azimuth angles at anytime and anywhere on earth. This can be done using the three angles (latitude, clock angle and angle of deviation). For this derivation, we will determine the direction of the sun's rays on the Earth's surface and then move it mathematically to the Earth's center with a different coordinate system. Using Figure (1). as a guide, select the S direction vector indicating the Sun from the observer position Q from the following equation[13] :

$S = S_z i + S_e j + S_n k$ --------- (3)

From figure (1) Solar zenith of central sunlight along the direction vector S. The vector units i, j, and k also appear along their axes. The Earth's coordinate system for the observer in Q shows the solar azimuth angle A , the solar elevation angle α, and the solar zenith angle (θ_e)for a central sun ray along direction vector ***S***. Also shown are unit vectors ***i***, ***j***, ***k*** along their respective axes [13].

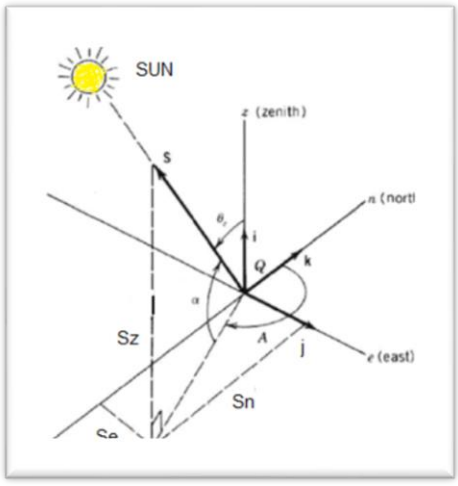

Figure (1) Earth surface coordinate system for observer at *Q*

The solar azimuth angle A can be determined by the following equation[13]:

"$A = \cos^{-1}(\frac{Sin\ \delta\ cos\varphi - \cos\delta cos\omega \sin\varphi}{\cos\alpha} - - - (4)$"

"we now have equations for both the sun's altitude angle and azimuth angle written in terms of the latitude, declination and hour angles. This now permits us to calculate the sun's position in the sky, as a function of date, time and location (*N*, ω, Φ)" [12,13].

Experimental work

The practical part includes the manufacture of parts of the mechanical and electronic tracking system as well as the examination and study of cell performance without and with the system,

Tracing system

1- Mechanical part

The system consist of 1 meter height rotating base the upper end of the base include a "U" shape like base that rotate and in the middle of it there is a rectangle base (45*55)cm ,we instilled a liner motor between the "U" base and the lower base, this motor helps the "U" Base to rotate left and right, we also instilled another liner motor on the rectangle base to let it move up and down .Figure (2).

Figure (2) Show the dual mechanic of the tracking system

2-The electronic part:

We used an electrical circuit that include IC 324 quart operation Amplifier this IC was used as a comparator between signal that comes from the sensor Cds with reference by 2 resistor the output is digital every 2 comparator control one movement for example up and down and another comparators left and right Figure (3,4).

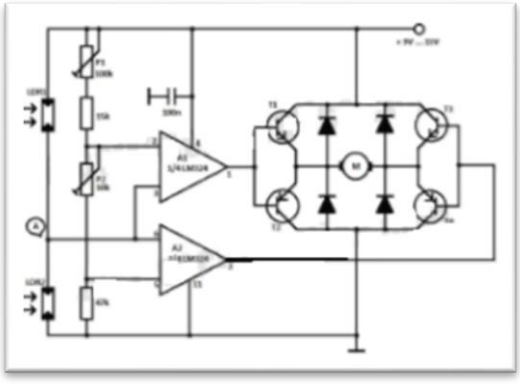

Figure (3) see electronic circuit of tracking

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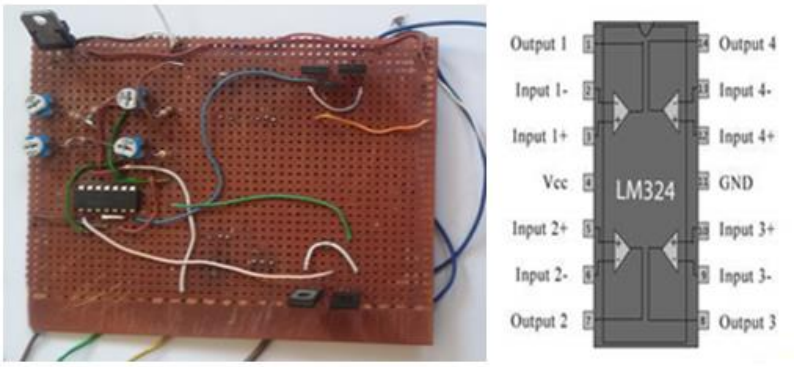

(A) **(B)**

Figure (4) (A): pcb tracing system (B):IC lm324 show four operation amplifier

There are (4) light depend resistors (CdS) used in the tracking system Figure (5).

1- LDR1 is used to detect light in the east direction. The output from the circuit

Divider voltage to the input of non-inverting terminal of the comparator 1.

2 - LDR2 is used to detect light in the west direction. The output from the circuit Divider voltage to the input of non-inverting terminal of the comparator 2

3- LDR3 is used to detect light in the south direction. The output from the circuit Divider voltage to the input of non-inverting terminal to the comparison 3

4- LDR4 is used to detect light in the north direction. The output from the circuit Divider voltage to the input of non-inverting terminal to the comparison 4.

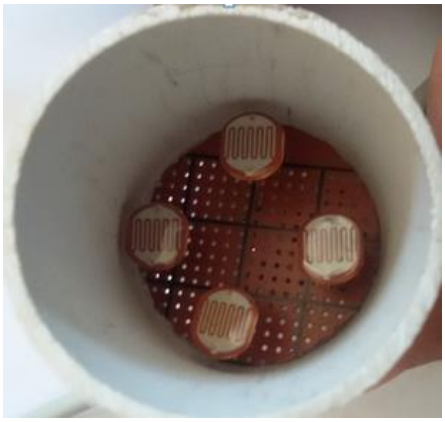

Figure (5) show head of photocell.

Result and discussion

1 -Study the solar radiation in Tikrit

Figure (6) shows the relationship between time and solar radiation on 27\ 4 \ 2017. Where the atmosphere was clear most of the time Clear Day where we note from the figure that the solar radiation began to increase gradually over time until the twelfth hour where the values of radiation is almost constant and at 1:30 am the value of radiation to the maximum value and then gradually decreased.

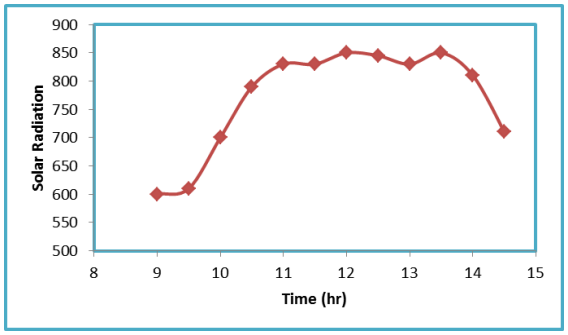

Figure (6) solar radiation with time at clear day

Figure (7) shows the relationship between solar radiation and time on 29/3/2017. Where the atmosphere was accompanied by cloudy, also we notice a relative increase of radiation from nine to nine and a half and then decreased radiation because of the presence of dense clouds and then began to increase radiation over time as it was the greatest value at one o'clock at noon, and then began to decline gradually.

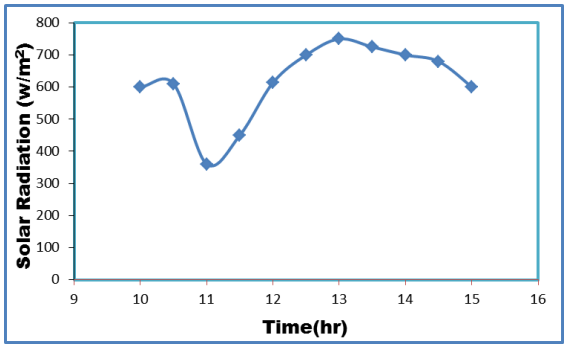

Figure (7) solar radiation with time at cloudily day

2- Study the efficiency of solar cell (fixed) with variation angle

Figure (8) shows the relationship between efficiency and time at different angels on 29/3/2017, Where there is considerable variation in efficiency values due to the presence of clouds. When there are clouds, this leads to a decrease in solar cell capacity and thus a decrease in efficiency The cell was to the south. The greatest efficiency was at 11 o'clock at 40 degrees angle due to the angle of fall of the aisles that are vertical on the solar cell. The rest of the angles

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between the (60 °) angle are the best at 12 o'clock and the rest of the angles are much lower.

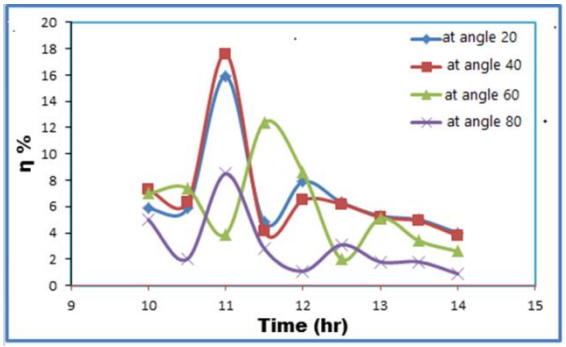

Figure (8) illustrates the relationship between efficiency and time at different angles

3-Tracking

When use solar tracking Figure (9) show the increasing the power with tracking with time because the solar radiation incident to panel directed at all-time otherwise the solar radiation decrease without tracking system so as when solar radiation increasing the current and voltage of solar panel [12,13].

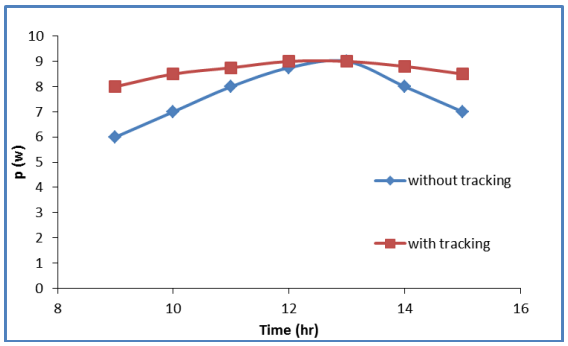

Figure (9) Show the relation of power with and without tracking with time

Conclusion

It is possible to conclude that solar radiation is suitable for the application of solar energy in Iraq . Also, we note that the best angle when the use of solar cells is fixed is (40 degrees) also increase efficiency of (10-15)% when using solar tracking the system low cost and simple but effected for solar panel.

Reference

[1] Tejasbhai R. Parmar," Automatic Solar Tracking System Using Pilot Panel", International Journal of Advanced Research in Electrical ,Vol. 4, Issue 7, July 2015.

[2] Rajesh. and Kailash Krishna Prasad. B,"Hardware Realization of Single Axis Solar Tracking System by Using a Cost Effective Microcontroller", International Journal of Engineering Trends and Technology (IJETT) – Volume 23 Number 7- May 2015.

[3] Md. Khalid Iqbal," Construction of Single Axis Automatic Solar Tracking System", International Journal of u- and e- Service, Science and Technology, Vol.8, No.1, pp.389-400 ,2015.

[4] C. Saravanan," A Novel Low Cost Automatic Solar Tracking System ",International Journal of Computer Applications (0975 – 8887) Volume 31– No.9, October 2011.

[5] Koh Kiong Chai, "Development of a solar photovoltaic system equipped with a sun tracker system ", IJRRAS 7 (4) , June 2011.

[6]Gagari Deb," Use of Solar Tracking System for Extracting Solar Energy", International Journal of Computer and Electrical Engineering, Vol.4, No.1, February 2012.

[7] Tiberiu TUDORACHE," PERFORMANCE EVALUATION OF A SOLAR TRACKING PV PANEL", U.P.B. Sci. Bull., Series C, Vol. 74, Issn . 1, 2012..

[8] Shahriar Bazyari," A Study on the Effects of Solar Tracking Systems on the Performance of Photovoltaic Power Plants", Journal of Power and Energy Engineering, 2, 718-728 , 2014,

[9]J. Kamala," Solar Tracking for Maximum and Economic Energy Harvesting", ISSN: 0975-4024 Vol 5 No 6 Dec 2013-Jan 2014.

[10] Bala Kalanithi, S. Rajesh," MPPT CONTROLLER BASED SOLAR TRACKING SYSTEM", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)

[11] R.J. van Overstraeten, R.P. Mertens, Physics, Technology and Use of Photovoltaic, Adam Hilger Ltd, 1986.

[12] C. Christopher Newton. A concentrated solar thermal energy system. Master's thesis, Florida State University, 2007

[13] B. William Stine and Michael Geyer" Power From The Sun" http://www.powerfromthesun.net/book.html2001.

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تصنيع ودراسة منظومة تتبع شمسي للوح شمسي

ياسين حميد محمود ، فارس صالح عطا الله ، سارة ساجد توفيق

قسم الفيزياء ، كلية العلوم ، جامعة تكريت ، تكريت ، العراق

الملخص

تعتبر الطاقة الشمسية من اهم مصادر الطاقة المتجددة التي لا تنضب. وبما ان الحركة الظاهرية للشمس بالنسبة للأرض تكون متغيرة بتغير الفصول وساعات النهار، لذلك فان الطاقة التي تنتجها الالواح الشمسية متغيرة وللتغلب على هذه المشكلة يتم استخدام متتبع شمسي لنحصل على اكبر قدر من الاشعاع الشمسي معظم الوقت.

في هذا البحث تم تصنيع منظومة تتبع شمسي ودراستها تجريبيا، تتألف هذه المنظومة من لوحة كهروضوئية ومتحسسات ضوئية(LDR) ومحركات خطية مع بناء دائرة تحكم لكي يتم السيطرة على حركة المنظومة. بينت النتائج بان المنظومة المصممة من قبلنا قد اعطت نتائج ممتازة.