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A comparative analysis of the tracking angles and fixed angle systems during sunny and cloudy days under Iraqi conditions

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ABSTRACT

This paper describes design tow systems tracking angles and fixed angle solar panel to improve the performance of solar energy, during the sunny and cloudy days. Depending on the development of the solar tracking system and amount of solar energy captured by the solar panel per day actually, the project is designed with AT 89552 MC depending upon the light falls on (LDR), data will be reading by AT 89552 MC. Moreover, changing the direction of a motor in this direction, the solar panel will be moving to capture the maximum of solar energy. The tracking angle solar panel has been efficient than a fixed angle. The results show that the tracking angle solar panel has been more efficient than a fixed angle in sunny and cloudy days in morning and afternoon. The tracking angles system is generating higher power than the fixed angle system in a morning. The maximum power occurred during the tracking angles system and fixed angle system in the morning, due to drop efficiency of the panels they get heated during the afternoon.

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1. INTRODUCTION

The solar energy is one of the energy sources important in this world. Unlike other unrenewable energy sources such as gasoline and coal, solar energy is clean and inexhaustible, now widely used in a variety of industrial, domestic, military, medical application and space applications [1-2]. In the research, many authors proposed low cost and high-efficiency design of solar energy. They are suggested to give more attention to the PV system, which included free fuel supply, and no or little pollution in this system [3]. The development of electrical engineering was developing more of machines such as electronic section has more attention in this wide world [4]. The maximum power point (MPP) very faster and efficient than other techniques and can reduce the voltage of output solar panel [3] The maximum power point (MPP) of solar panel changes with changing the weather (cloudy, sunny days and temperature) very important consider efficient design PV system [5]. The detailed experimental and theoretical calculations are presented with a comparison of two system tracking and fixed angle for PV [6]. The electric power supply by PV system depending upon the atmosphere condition solar radiation and temperature, the efficient design solar panel system strongly assures to track the maximum power point (MPP) [7]. The location of a photovoltaic PV system could have more impact on the output energy, as one of the energy sources especially, in the countries that have large clouds [8].

The object of this work to a comparison between sunny and cloudy days, under the outdoor test of Iraqi climate condition for increasing the power generated by a solar panel, in the past, the solar panel system has been hooked with a fixed angle. It does not follow the sun, and therefore the solar power generation efficiency is low. A tracking angle solar panel system, designed in such a way to keep the panel tracking the sun from -90º to +45º in order to utilize maximum solar power. It automatically tracks the solar power using Microcontroller as shown in Figure 1. Hence the auto solar tracking system is required to harness solar energy, and improve efficiency, with minimizing cost.

(a) (b)

Figure 1. (a, b). Experimental setup of fixed angle (45°) and tracking angles from (- 90°to 45°) of solar panel methods

2. THE EXPERIMENTAL WORK OF TRACKING ANGLE SYSTEM AND FIXED ANGLE SYSTEM SOLAR PANEL METHODS

Two systems are experimental is tested on the rooftop of building in Iraq, AL Anbar. The location of the site is 33°N latitude and 44°E longitudes. The experimental setup depending on the PV module 3w made from polycrystalline silicon, a 600cm² areas. solar penal systems are mounted on the middle of a fixed stand cast steel structure with multi-angles, and the fixed angle by optimal tilt angle 45° facing due east. The PV module and Rheostat of load are connected and then took all the measurements voltage and current by measurement devices (Ammeter and Voltmeter) to obtain maximum output power. As shown in the Figure1 (a, b) during the sunny day on November and cloudy day on October 2017, the microcontroller is used in the tracking angles system to the direction of the motor.

3. MICROCONTROLLER AT89552

The microcontroller is a system programmable; a microcontroller consists of CPU in addition to a fixed amount of RAM, ROM and I/O ports and a timer embedded for all one chip. A fixed amount for chip RAM, ROM, and some I/O ports in MC make it ideal for many applications a scientifically and industrial, Keil software is used to programmable the microcontroller AT89552. As shown in Figure 2.

3.1. Keil Software

The Keil compiler considered important software used for a machine language code, like writing and compiling, a machine source code converted into hex code which is entered into the microcontroller for more processing. A Keil compiler also supports C language code, to running of the program. As shown in Figure 3.

a) Click on the Keil u Vision4 icon on the desktop
b) Then click on the new project
c) For a program written in Assembly. Then save it with extension “asm” and for “C” based on a program save it with extension “ C.”

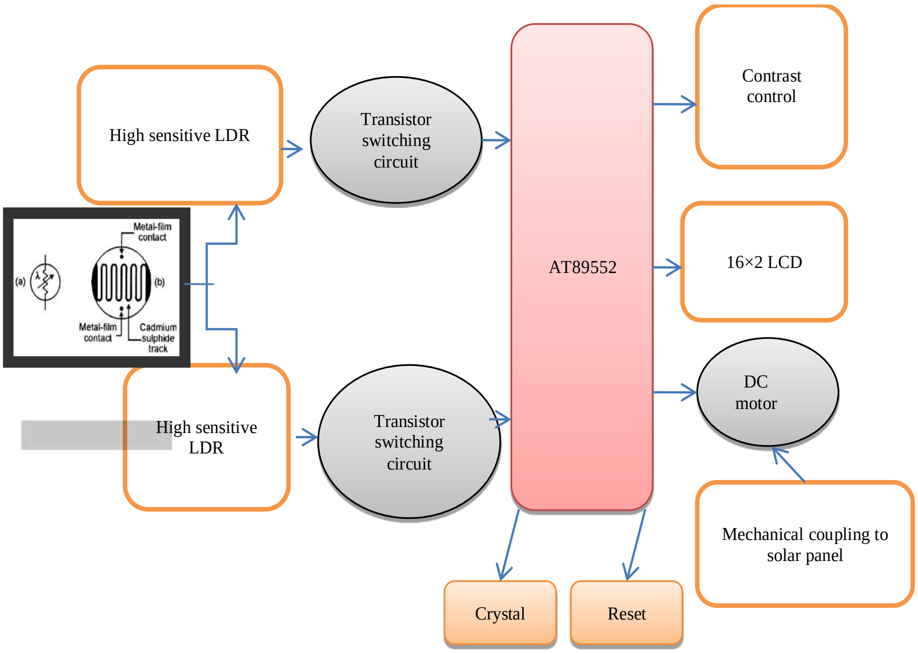

Figure 2. Block diagram of microcontroller AT89552

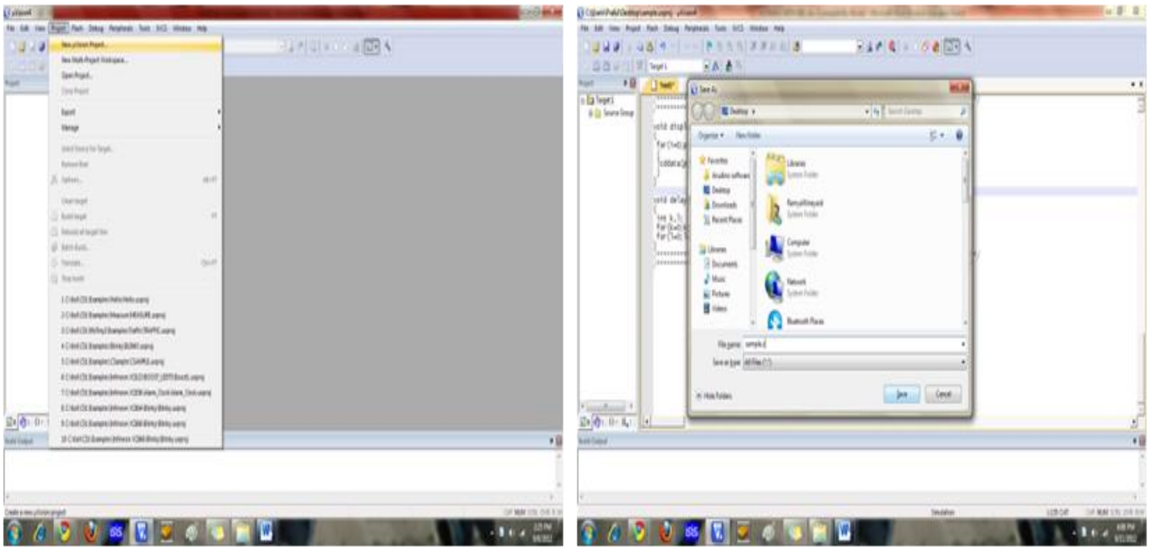

Figure 3. Shown steps of the Keil u Vision 4 program

4. RESULTS AND DISCUSSION

4.1. Comparison of P-V and I-V Curves of Tracking Angles System and Fixed Angle System Solar Panel Sunny Day Methods

Solar panel and Rheostat load are connected as shown in Figure 1 the current and voltage readings by Voltmeter and Ammeter devices, taking the same connection is used to get the reading from morning to evening at (-86.85° to 45°) tracking angle system, and fixed angle system with optimal tilt angle (45°)with respect to the ground. The Rheostat load changes from maximum to the minimum value, voltage and current, from (7:00 am to 5:00 pm) observed as shown in Figure 4 the maximum power and current during the sunny day is (2.29w, 0.31Aat 11 am) tracking angles system, and (2.094w, 0.30A at10 am)fixed angle system respectively. Corresponding voltage and current values.

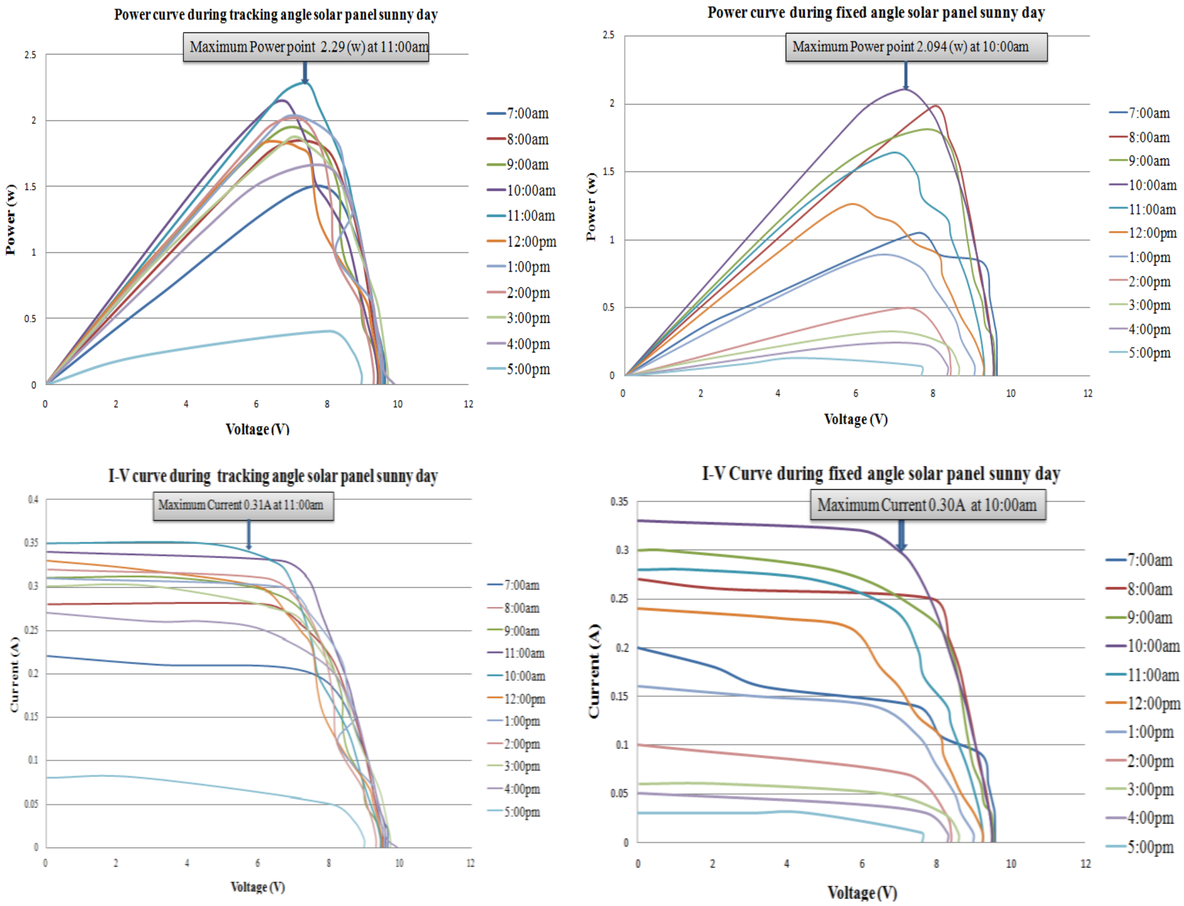

Figure 4. P-V and I-V curves during tracking angles and fixed angle solar panel from 7:00 am to 5:00 pm Respectively

4.2. Comparison of P-V and I-V Curves of Tracking Angles System and Fixed Angle System Solar Panel Cloudy Day Methods

Solar panel and Rheostat load are connected as shown in Figure 1 the current and voltage readings by Voltmeter and Ammeter devices, taking the same connection is used to get the reading from morning to evening at (-86.85° to 45°) tracking angle system, and fixed angle system with optimal tilt angle (45°) with respect to the ground. The Rheostat load changes from maximum to the minimum value, voltage, and current from (7:00 am to 5:00 pm) observed as shown in Figure 4 the maximum power and Current during the cloudy day is (1.50w, 0.16A at 9:00 am) tracking angles system, and (1.30w, 0.15A at 9:00 am) fixed angle system respectively. Corresponding voltage and current values.

4.3. Comparison of Power Generated By Tracking Angles and Fixed Angle During Sunny And Cloudy Days

The tracking angles system is generating higher power than the fixed angle system in a morning. Why the maximum power during the tracking angles system and fixed angle system in the morning, due to drop efficiency of the panels they get heated during the afternoon. The power generated values of tracking angles system are nearby from a fixed angle system in the morning, but the very wide gap in the afternoon because of the tracking system following the sun direction compared with a fixed system in which sunny and cloudy days. Increased the power generated in the morning by a tracking system on a sunny day showing that (52.35%) and (53.58%) on a cloudy day compared a fixed system, and decreased the power generated by the fixed system in a sunny and cloudy day compared with a tracking angles system the result showing that the improvement is (78.43%) on a sunny day and (75%) on a cloudy day during the afternoon by tracking angles system.

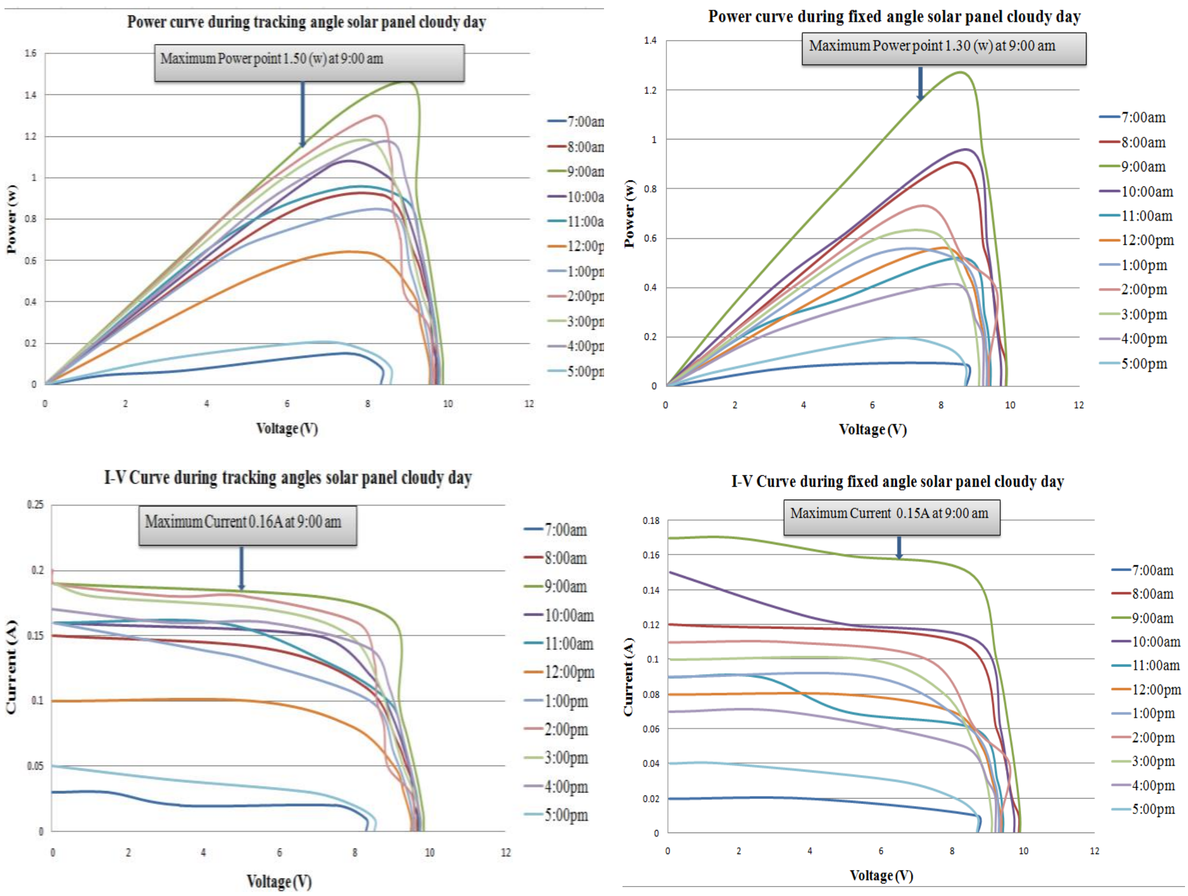

Figure 5. P-V and I-V curves during tracking angles and fixed angle solar panel from 7:00 am to 5:00 pm Respectively

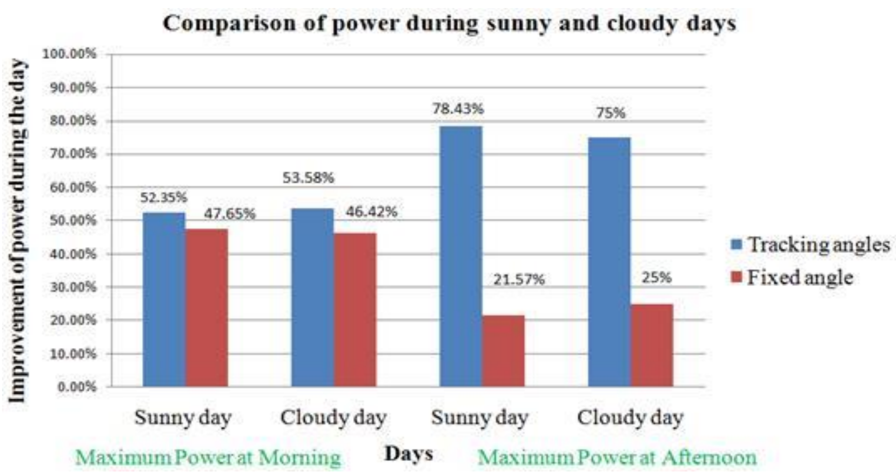

Figure 6. The improvement level of power generated during a sunny and cloudy day

5. CONCLUSIONS

In this study, the fixed and tracking solar panel system was utilized for comparison the outcomes energy between sunny and cloudy days in Iraq. The tracking angles system can track the sunlight automatically, The light sensitivity resistors (LDR) are used to determine the sunlight vision. Thus the efficiency of solar energy generation can be increased. The experimental result shows that the maximum power point and current (2.29W, 2.094W, and 0.31A 0.30A at 11:00 am and 10:00 am) on a sunny day.

Using the tracking angles and fixed angle, the tracking angles higher than fixed angle solar panel, from (7:00 am to 5:00 pm). Moreover, The experimental result also shows that the maximum power and current (1.50W, 1.30W, and 0.16A 0.15A at 9:00 am) on a cloudy day. Using tracking angles and fixed angle, the tracking angles higher than fixed angle solar panel from (7:00 am to 5:00 pm). The experimental result also shows that increasing power generated by tracking angles system and decreasing by fixed angle during the sunny and cloudy day.

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