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Design and Implementation of Maximum Power Tracking System According to the Sun Direction (Model Sun Flower)

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Abstract

Solar energy systems have stood out as a viable source of renewable energy over the past two or three decades, and are now openly used for a variety of industrial and domestic and medical applications. Improvement in the performance of a solar tracking system during summer was found to be as much as 30% for higher elevation angle and 60% for lower elevation angle. Based on the developed tracking algorithms, further it was shown that the amount of solar energy captured by a tilted collector could be increased by more than 35% by adjusting the tilt angle on a daily or monthly basis. This project is designed with AT89S52 MCU. Depending upon the light falls on LDR 3mm and 20k ohm the data will be read by the Micro-controller and the direction of the motor will be changed, with this direction the Solar panel which are fixed to the stand will also rotates to obtain the maximum sun rays. This project uses regulated 12V and 500mA power supply. 7805 three terminal voltage regulator is used for voltage regulation; Bridge type full wave rectifier is used to rectify the Ac output of secondary of 230/12V step down transformer.

Keyword:- *Sunflower, Microcontroller, photovoltaic energy system, Keil Software, PV panel*
Rheostat

Introduction

Till now day the efficiency of generating power from solar energy is comparatively low. Thus, raising the efficiency of generating power of solar energy is very important. . In the past solar cells have been hooked with fixed elevating angles. They do not follow the sun and therefore the efficiency of power generation is low. In this paper, the basic goal is to design and implement a solar tracking control system using Microcontroller (8051). The light sensitive resistors (CdS) are used from the experimental results; the proposed tracking system is achieved more efficiently in generating energy than the fixed system.

These maximum power point techniques are faster and also it can minimize the voltage fluctuation after MPP has been recognized [1] several methods and controllers have been widely developed and implemented to track the MPP. A system with an alternative Source of energy supply from photovoltaic energy system which operates in case of utility power

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failure has been discussed [2] to compare the PV array voltage (or current) with a constant reference voltage (or current), which corresponds to the PV voltage (or current) at the maximum power point, under specific atmospheric conditions[3] maximum power operating point (MPOP) of photovoltaic (PV) power generation systems changes with changing atmospheric conditions (e.g. solar radiation and temperature), an important consideration in the design of efficient PV system[4] Detailed theoretical and experimental analyses are presented for the comparison of two simple, fast and reliable maximum power-point tracking (MPPT) techniques for photovoltaic (PV) system[5] The electric power supplied by a photovoltaic power generation system depends on the solar radiation and temperature. Designing efficient PV systems heavily emphasizes to track the maximum power operating point [6] Since PV modules still have relatively low conversion efficiency, the overall system cost can be reduced using high efficiency power conditioners which, in addition, are designed to extract the maximum possible power from the PV module [maximum power point tracking (MPPT)] A very common MPPT technique [7] The proposed PV system is composed of conventional novel single axis tracking system. And PV system, The PV panel voltage is taken as input parameter to maximize the output power [8]

Figure 1: single axis tracking angle solar panel method

Problem Statement

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 is automatically track the solar power using Micro-controller as shown in figure 1. Hence the auto – solar tracking system is required to harness the solar energy and improve efficiency.

Test conducted

1. Indoor test: mobile phone flash light used to highlight on light sensor dependent LDR, to tracking the light.
2. Outdoor test: using solar/sun power falls on solar panel tracking and fixed, measured voltage and current for each hour from 7:00AM to 17:00PM, then analyzed all values in Microsoft excel program to obtain maximum power point.

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Microcontroller 8051

Microcontroller is a programmable device. A microcontroller has a CPU in addition to a fixed amount of RAM, ROM, I/O ports and a timer embedded all on a single chip. The fixed amount of on-chip ROM, RAM and number of I/O ports in microcontrollers makes them ideal for many applications in which cost and space are critical. As shown in the figure 2

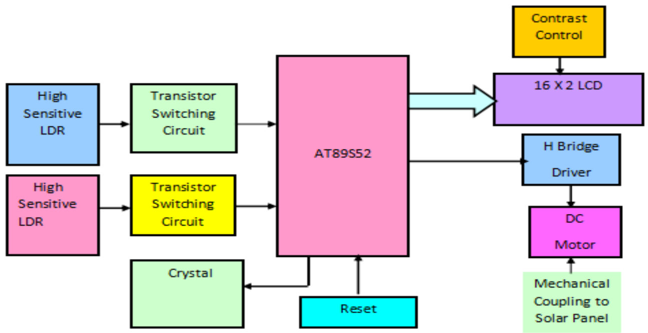

Figure 2: Block Diagram of microcontroller 8051

Keil Software:

Keil compiler is software used where the machine language code is written and compiled. After compilation, the machine source code is converted into hex code which is to be dumped into the microcontroller for further processing. Keil compiler also supports C language code. As shown in the figure 3

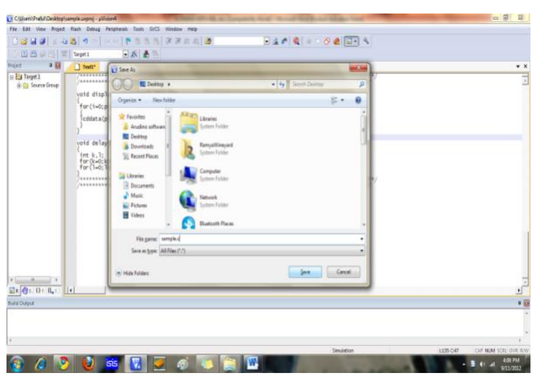

Figure 3: shown steps of the Keil u Vision4 program

1- Click on the Keil u Vision4 Icon on Desktop

2- Then Click on New Project

3- For a program written in Assembly, then save it with extension "asm" and for "C" based program save it with extension " C"

Experimental of single axis tracking angle solar panel method

This experiment has been set up on the rooftop of a building on the Tarnaka, Hyderabad India the location of the site is 13.02^{0}N lat. and 77.57 ^{0}E long. Tarnaka, Hyderabad, India, The tilt angle of PV panel

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is (- 90º to 45º) Facing due east. As shown in the figure1. Using during the second week of March 2017, and after a few minor corrections, it was performed from April 2017 to May 2017. As shown in table 1and figure 4

Table 1: List of time of multi angle experimental conducted (on 22 April 2017) and the corresponding PV panel angle at (-90.

Time (hrs) 22/4/2017	Angles	Time (hrs)	Angles
6:00am	-90	12:00pm	-13.356
7:00am	-86.856	13:00pm	4.374
8:00am	-78.236	14:00pm	20.272
9:00am	-65.358	15:00pm	33.12
10:00am	-49.44	16:00pm	41.7
11:00am	-31.7	17:00pm	45

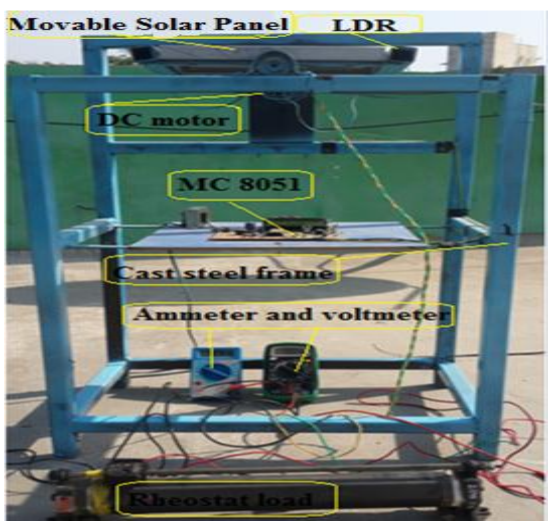

Figure 4: Experimental set-up of multi angles from (- 90) method of single axis tracking solar panel method.

- **Block diagram of experimental**

When increases the loads the output power, voltage and current will be change continuously with the atmosphere condition to obtained maximum power point and current. as shown in figure 5 (b,c) thus the load condition changes since it depends on them, The duty cycle direct current is changed continuously in order to follow the Maximum power point of the solar cell

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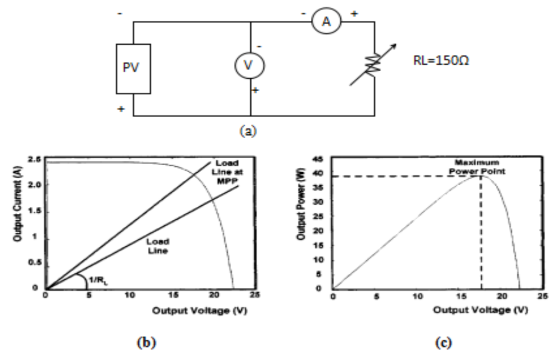

Figure 5 (a,b,c): a, Experimental circuit diagram using solar panel system. And, b,c The I-V, P-V Characteristics of a typical solar cell module respectively.

The solar panel is below the 0º axis, that's why it is -90º. The position is measured clockwise direction hence keep negative sign. When panel starts tracking from -90º to 0º, gave negative value of angles. As shown in the figure 6

Figure 6: single axis tracking solar panel at (-86.85 tracking angle with respect to the ground

Results and discussion

P-V and I-V curve of single axis tracking angle solar panel method at morning.

❖ **Experimental PV panel characteristics at 7:00AM**

PV panel and Rheostat load are connected as shows in figure 6 the current and voltage readings by Voltmeter and Ammeter, are taken the same connection is used to get the readings from morning to evening, at (- 86.85 tracking angle with respect to the ground.

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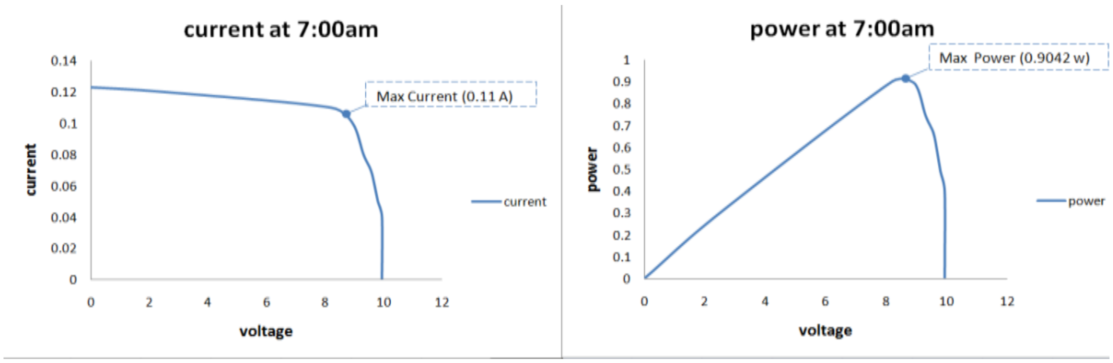

Figure 7 : I-V, P-V Panel Characteristics at 7:00AM

The Rheostat load changes from maximum to minimum value, and voltage and current at 7:00AM observed as shown in figure 7 the Maximum power at 7:00AM is (0.9042 watt) and corresponding voltage and current values are voltage is (8.22 V) and current is (0.11A), this readings observed at (-86.85 tracking angles with respect to the ground.

❖ **Experimental PV panel characteristics at 10:00AM**

The Rheostat load changes from maximum to minimum value, and voltage and current at 10:00AM observed as shown in figure 8 the Maximum power at 10:00AM is (2.5707 watt) and corresponding voltage and current values are voltage is (7.79V) and current is (0.33A) this readings are observed, at (- 49.44 tracking angle with respect to the ground.

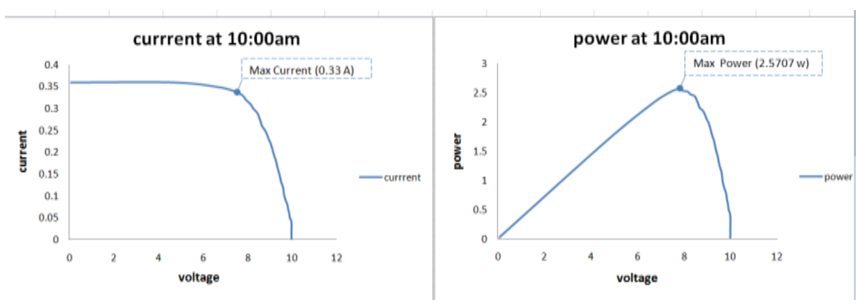

Figure 8: I-V, P-V Panel Characteristics at 10:00AM

❖ **Experimental PV panel characteristics at 17:00 PM**

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Figure 9: single axis tracking solar panel at (45^0 tracking angle with respect to the ground

PV panel and Rheostat load are connected as shows in figure 9 the current and voltage readings by Voltmeter and Ammeter, are taken the same connection is used to get the readings from morning to evening, at (45 tracking angle with respect to the ground.

The Rheostat load changes from maximum to minimum value, and voltage and current at 17:00 PM observed as shown in figure 10 the Maximum power at 17:00 PM is (0.75205 watt) and corresponding voltage and current values are voltage is (8.45 V) and current is (0.089A) this readings observed at (45 tracking angle with respect to the ground

- **Output power during single axis tracking angle solar panel method**

As explained above Maximum Power variation at different timing from each graph from (7:00AM to 17:00PM) is observed and tabulated in table 2 at multi angles from (-90 to 45 tracking angles. As shown in table 2

Time(Hrs), 22/4/2017	Maximum power (w)
7:00 Hrs	0.9042
8:00 Hrs	1.722
9:00 Hrs	2.4864
10:00 Hrs	2.5707 Max Power point
11:00 Hrs	2.4096
12:00 Hrs	2.4928
13:00 Hrs	2.07
14:00 Hrs	1.9228
15:00 Hrs	2.0208
16:00 Hrs	1.411
17:00 Hrs	0.75205

Table 2: The experimental Max power variation at different timing from morning to evening

❖ Maximum power varaiton curve during single axis tracking angle solar panel method.

The maximum power generated (2.5707W) at 10:00AM, readings are observe improvement in the morning is higher than in the afternoon, which is due to the drop in efficiency of the panel as they get heated up during afternoon. as shown in figure 11

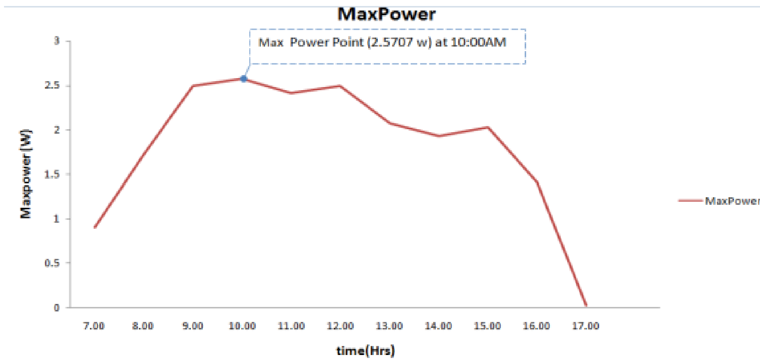

Figure 11: Maximum power variation at different timing from morning to evening using single axis tracking.

❖ Energy generated during single axis tracking angle solar panel

The maximum Energy genetrated is (18.1872Wh) at 15:00PM the readings are shown the Energy obsorpting increases in the morning till evening at (15:00PM) and starting decrease after that. as shown in figure 12

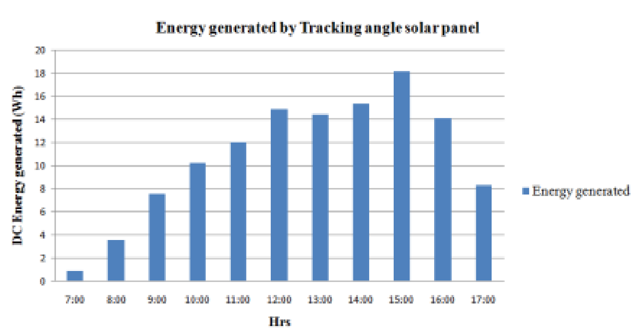

Figure 12: Energy generated level.

❖ Comparison of I-V curve during single axis tracking solar panel method.

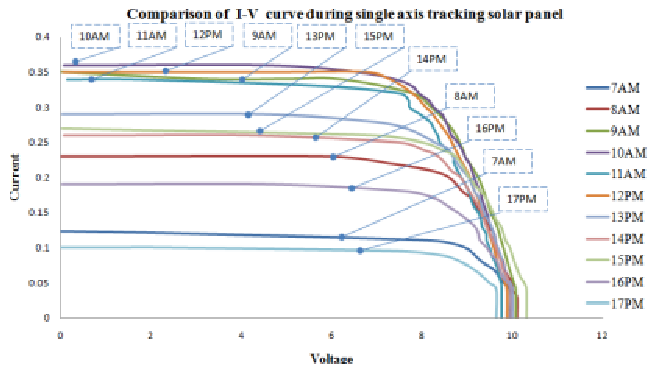

Figure 13: Comparison of I-V curve during single axis tracking angle solar panel from 7:00 AM to 17:00 PM

Figure 13: shows all graph values, the Current of all the above cases from 7:00AM to 17:00PM, using single axis tracking angle solar panel method, from this graph is observed that the current is maximum at 10:00 AM, 12:00 PM, 9:00 AM, and 11:00 AM respectively

❖ **Comparison of P- V curve during single axis tracking solar panel method.**

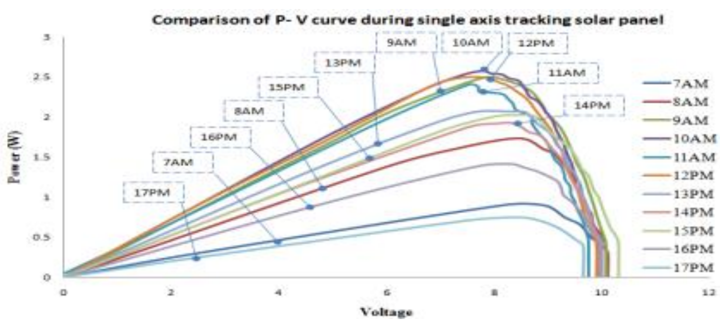

Figure 14: Comparison of P- V curve during single axis tracking angle solar panel from 7:00 AM to 17:00 PM.

Figure 14 shown all graph values, the Power of all the above cases from 7:00AM to 17:00PM, using single axis tracking angle solar panel method, from this graph is observed that The power is maximum at 10:00 AM, 12:00 PM, 9:00 AM, and 11:00 AM respectively

CONCLUSION:

- The proposed method is the single axis tracking solar panel. Can track the sun light automatically. The light sensitivity resistors (LDR) are used to determine the night day vision. Thus, the efficiency of solar energy generation can be increased.

- The experimental result also shows that the higher maximum power point (W) and Energy (Wh) using the single axis tracking angle solar panel at 10:00AM and 15:00PM. As shown in figures (11,12) respectively.
- The experimental result also shows that the maximum current (I) and maximum power (W) from 7:00AM to17:00PM. Using single axis tracking angle solar panel method at 10:00, 12:00, 9:00AM and 11:00PM . As shown in figures (13,14) respectively.

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