An Analysis of the Performance of the Automatic Sun Tracking System for Dual-Axis Solar Cell

YANAWAN KENGTHANOOMMAR[1], NARONG MUNGKUNG [2]

[1]Graduate Student, Learning innovation in Technology Program
[2]Department of Electrical Technology Education
Faculty of Industrial Education and Technology
King Mongkut's University of Technology Thonburi, Bangkok, THAILAND
e-mail: yanawan_k@hotmail.com, narong_kmutt@hotmail.com

Abstract: - This research was conducted to design construction and testing the automatic two axis solar tracking for solar cell panel. The purposes were to teach and compare performance of the learning out come about the solar tracking. The system was driven by two direct current motors and controlled by microcontroller PIC 16F877. That was programmed by the C language. The four independent light resistors were used for checking the solar time and daylight time. It was found that most of students were understood the system of the solar cell panel.

Key-Words: - Sun tracking system, solar cell, microcontroller, dual-axis , learning outcome.

1 Introduction

Electrical power is important for human beings on the Earth but the production of electrical power needs a lot of natural resources for the generator. To generate electricity, the cost needs to be considered a lot[1]. Many generators have been developed to generate electricity from wind and water. However, both systems need to have distribution through electrical wires. Therefore, solar energy seems to be the cheapest investment and suitable for the remote areas where there are no wires. Solar cell is an electronic invention which changes the brightness of the sunlight to become electricity and it is widely used in many regions of the world.

Installation of solar cell panel is normally done in 15 degrees of inclination angle of the Earth. The generation of electricity cannot be done with efficiency all day long[2]. Therefore, a solar cell which can move according to the position of the Sun will be an alternative way which the researchers initiate so that the solar cell panel can produce the electricity with efficiency all day long. Therefore, automatic single axis solar tracking system is widely used.

The position of the sun is not the same in each season. So, the single axis solar tracking system cannot generate the electricity to its full potential for all year long[3]. There were many researchers who tried to develop and invent dual axis solar tracking system by using different technologies like mobile solar cell panel which can track the position of the Sun based on the calculation in each period in the year or by using the control system by using linear IC devices. Both systems have advantages and disadvantages as follow: The system which is controlled by computer is expensive and the computer has to work all day, resulting in damage. The system with linear IC is low cost but the efficiency and the flexibility is not good enough. Moreover, it responds to the system very slowly.

According to the above-mentioned reasons, the researchers would like to develop dual axis solar tracking system for solar cell panel by microcontroller because the researchers think that microcontroller is more flexible in the usage[4]. Microcontroller is also developed by many manufacturers like Atmel, micro chip, etc. In this research, the researchers used the microcontroller developed by micro chip company, number 16F877. Its benefit is that it processes the data fast and it is easy to be accessed in terms of commands and functions, when compared to microcontrollers by other companies.

In order to teach the solar system with various the angle of solar panel, one axis and dual axis were purposed to compare the optimization of solar panel angle for maximum generated power.

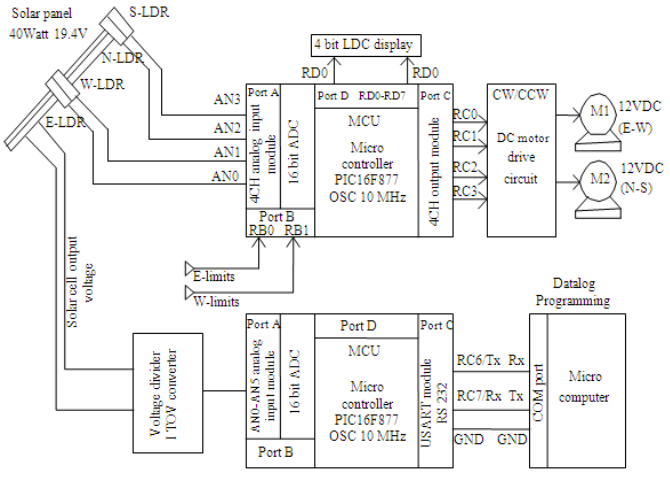


Fig. 1 Design of control system

2. System design

In this research, the researchers used engineering designing method to design and test voltage from automatic two axis solar tracking system, automatic single axis solar tracking system and the system with 15 degrees of inclination angle according to the skyline.

3. Control system

The design of automatic two axis solar tracking system consisted of 4 major structural components: signal input, display, drive and the processing unit or MCU. In the signal input circuit, the researchers used 4 items of LDR to check the brightness of the light to send the data to microcontroller to process and change signals from analog to digital type. The changed value will be displayed through LCD module with 4 bit signal. The signal received in the microcontroller will be compared with the signals from E-LDR and W-LDR or N-LDR and S-LDR, respectively. According to the processing of MCU, there will be signal to control motor through DC motor drive circuit which can control both clockwise and counterclockwise. Moreover, the researchers designed a tool to collect Data:OG which is about the circuit to divide voltage and converter to become voltage in order that the value sent to the microcontroller is analog system. Microcontroller will convert the input value to digital value through ADC Module. Microcontroller will be connected to microcontroller through USART Module inside the microcontroller at ports RC6/Tx, RC7/Rx and COM Port of the computer. Data were collected by Sun tracking Data:OG[5]. Visual Basic 6.0 Enterprise Edition. The value comes from microcontroller. The database used in this research was done in Microsoft Access 6.0, which is flexible and accessible.

4. System Record

The data were recorded using sun tracking DataLOG program[7,8]. The researchers designed and tested the program in 2 sections: Voltage and communication sections. The communication used is RS 232 which is the basic and can be done by USAT Module inside the microcontroller itself. The microcontroller also has RS 232 communication port on the main board, that is COM Port[9]. Circuit to get light: The circuit to get light as shown in Fig. 2 is the circuit designed to check the brightness of the sunlight and to send analog signal to microcontroller for further processing.

5. Experimental Results

According to Graph in Fig. 3, during the period from 9:10:23-13:40:23, the power from solar cell panel was similar because all solar cell panels were at the same position to get the light. After 13:40:23, the power showed different value obviously because the power from automatic two axis solar tracking system yielded the highest power when compared to automatic single axis solar tracking system and the system with 15 degrees of inclination angle. According to the mean score of the Graph, it was found that automatic two axis solar tracking system could provide 16.847 Watts on average per day.

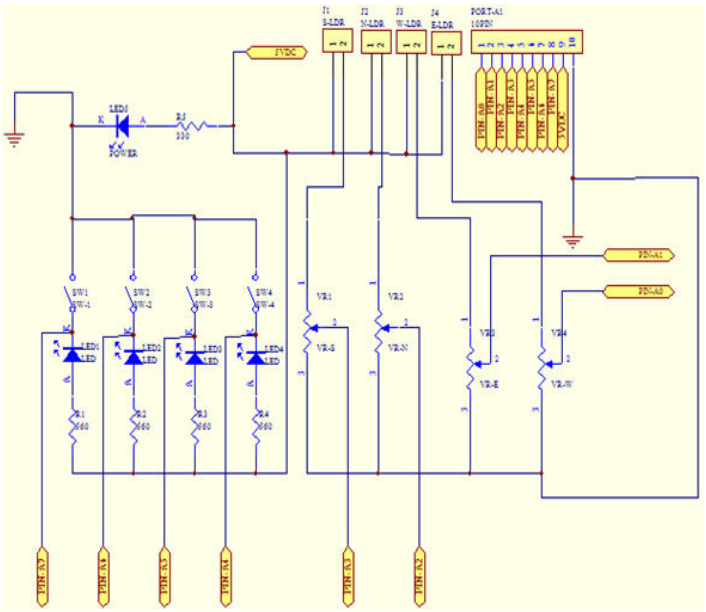


Fig. 2. Circuit to get light

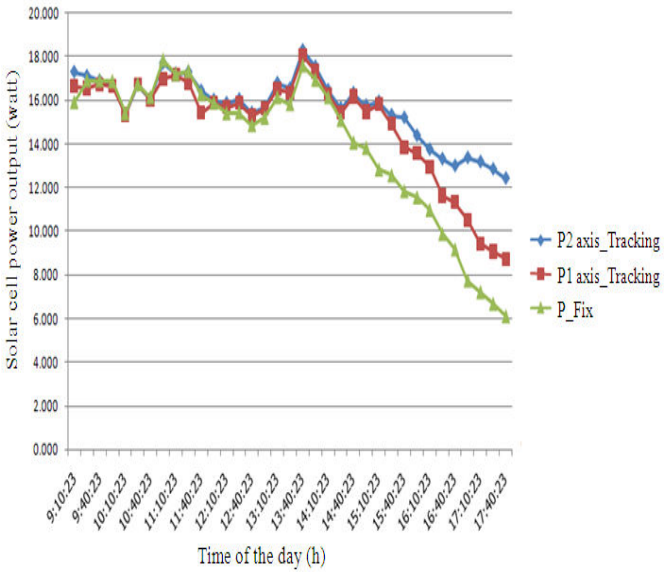
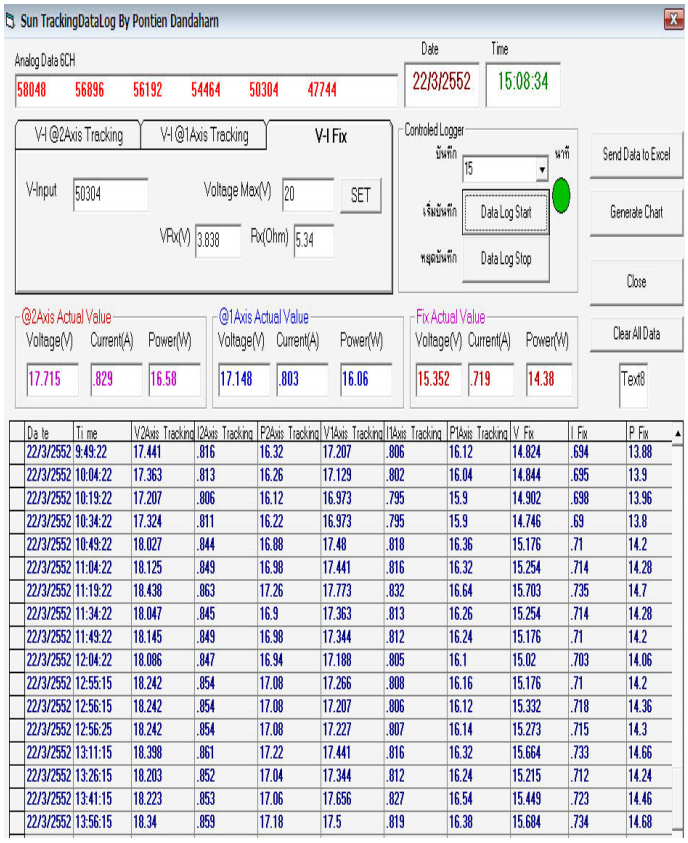


Fig. 3: Graph comparing power from there kinds of solar tracking system: Solar cell panel with 15° of inclination angle (P_Fix), single axis solar tracking system (P1Axis_Tracking) and two axis solar tracking system (P2Axis_Tracking)



Da te	Ti me	V2Axis Tracking	I2Axis Tracking	P2Axis Tracking	V1Axis Tracking	I1Axis Tracking	P1Axis Tracking	V Fix	I Fix	P Fix
22/3/2552	9:49:22	17.441	.816	16.32	17.207	.806	16.12	14.824	.694	13.88
22/3/2552	10:04:22	17.363	.813	16.26	17.129	.802	16.04	14.844	.695	13.9
22/3/2552	10:19:22	17.207	.806	16.12	16.973	.795	15.9	14.902	.698	13.96
22/3/2552	10:34:22	17.324	.811	16.22	16.973	.795	15.9	14.746	.69	13.8
22/3/2552	10:49:22	18.027	.844	16.88	17.48	.818	16.36	15.176	.71	14.2
22/3/2552	11:04:22	18.125	.849	16.98	17.441	.816	16.32	15.254	.714	14.28
22/3/2552	11:19:22	18.438	.863	17.26	17.773	.832	16.64	15.703	.735	14.7
22/3/2552	11:34:22	18.047	.845	16.9	17.363	.813	16.26	15.254	.714	14.28
22/3/2552	11:49:22	18.145	.849	16.98	17.344	.812	16.24	15.176	.71	14.2
22/3/2552	12:04:22	18.086	.847	16.94	17.188	.805	16.1	15.02	.703	14.06
22/3/2552	12:55:15	18.242	.854	17.08	17.266	.808	16.16	15.176	.71	14.2
22/3/2552	12:56:15	18.242	.854	17.08	17.207	.806	16.12	15.332	.718	14.36
22/3/2552	12:56:25	18.242	.854	17.08	17.227	.807	16.14	15.273	.715	14.3
22/3/2552	13:11:15	18.398	.861	17.22	17.441	.816	16.32	15.664	.733	14.66
22/3/2552	13:26:15	18.203	.852	17.04	17.344	.812	16.24	15.215	.712	14.24
22/3/2552	13:41:15	18.223	.853	17.06	17.656	.827	16.54	15.449	.723	14.46
22/3/2552	13:56:15	18.34	.859	17.18	17.5	.819	16.38	15.684	.734	14.68

Fig. 3. Sun Tracking DataLOG

The single solar tracking system provided 16.241 Watts on average per day. The solar cell panel with 15° of inclination angle provided 16.524 Watts day1.

6. Conclusions.

According to the results from designing automatic solar tracking system and comparing it with two other systems, The summary from all students concluded as the following:

According to the experiment and comparison of voltage output obtained from automatic two axis solar tracking system, the single axis solar tracking system and the solar cell panel with 15° of inclination angle under normal environment, it was found that the average power per day from each system was as follow:

1. For an automatic 2 axis solar tracking system:
   The highest power 18.3 Watt
   The lowest power 13.44 Watt
   The average power 16.9 Watt

2. For an automatic 1 axis solar tracking system:
   The highest power 17.74 Watt
   The lowest power 12.76 Watt
   The average power 16.35 Watt

3. For the solar cell panel with 15° of inclination angle:
   The highest power 18.10 Watt
   The lowest power 11.93 Watt
   The average power 16.64 Watt

It was found that the average electrical power from the automatic two axis solar tracking system yielded the highest electrical power when compared to two other systems. Although the values of this system are small due to only 1 plate of solar cell is used. If the value of powers are high when many plates of solar cell are used in the system for network.

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