

An Analysis of the Learning Outcome of the Automatic Dual-Axis Sun Tracking Laboratory for Solar Cell System

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Abstract: - The purpose of this research was to design and construct the automatic two axis solar tracking for solar cell panel. The theory of Work Related Information is used in this system. The efficiency evaluation of experimental set of Solar Cell content to Curriculum of Vocational Education in the Field of electrical, year 2003 for lower vocational certificate at Rachjasitram Technical college, Second semester academic year 2009. The instruments used in the student were as follows; (1) Experimental set of Solar Cell in the Renewable energy Course (2) Labsheet of an experimental set of Solar cell (3) achievement test. The research result revealed that (1) The efficiency of experimental set on Solar Cell the Renewable energy is higher than conventional method. The whole part and sub part of the system are used to approach learning system.

Key-Words: - Learning outcome, Experimental approach, Tracking system, solar cell, Laboratory design, Renewable energy, Work related information

1 Introduction

In order to clarify the renewable energy from Solar cell performance, the Solar 1 and 2 axis are used to demonstrate the parameter effect for Solar cell output voltage. The Solar cell panel is used to teach students with many cases. This research used experimental approach for student deep understanding[1].

For ignition of student idea, 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 and deep understanding with demonstration Solar Panel.



Fig. 1 Work Related Information

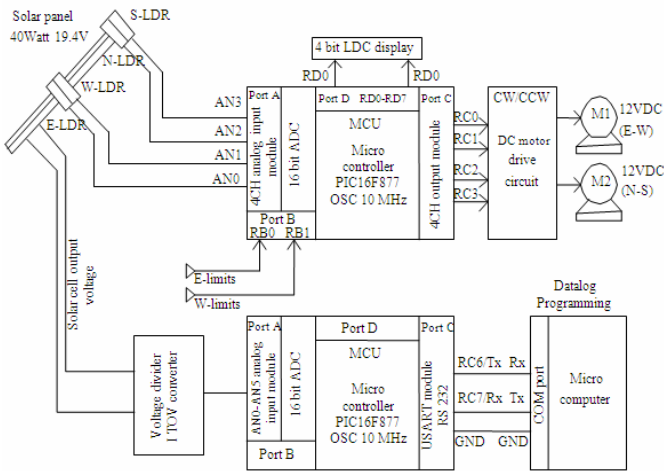


Fig. 2 Design of control system

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. 3 is the circuit designed to check the brightness of the sunlight and to send analog signal to microcontroller for further processing.

5. Experimental Design and Results

According to Graph in Fig. 4, 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.

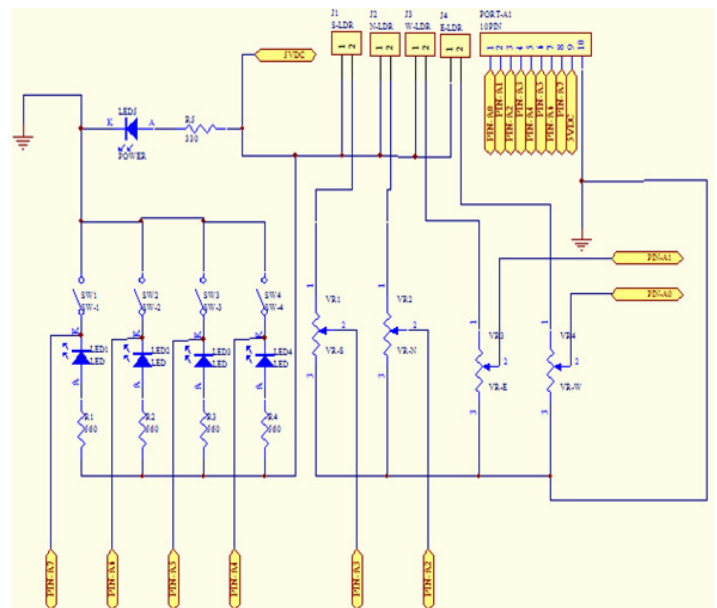


Fig. 3. Circuit to get light

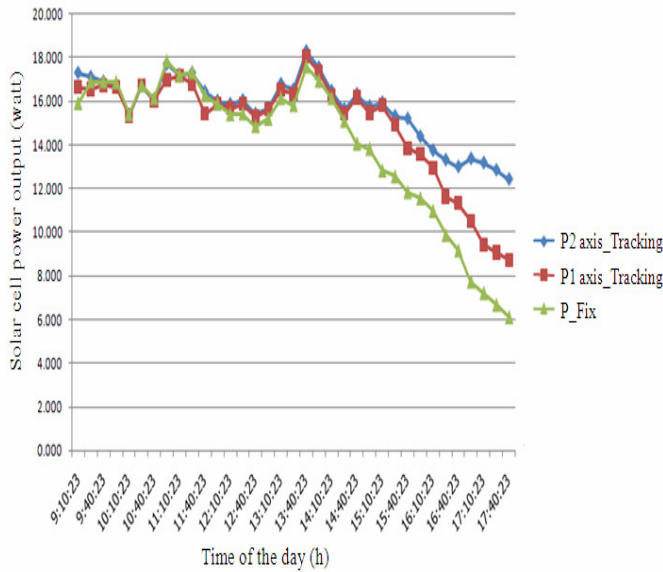


Fig. 4: Graph comparing power from three kinds of solar tracking system: Solar cell panel with 15° of inclination angle (P_Fix), single axis solar tracking system (P1Axis_Tracking) and two axis solar tracking system (P2Axis_Tracking)

6. Learning Outcome

According to the results from designing automatic solar tracking system and comparing it with two other systems, The step of teaching in this paper is work related information, guidance information, general information, technical information and operating information. 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

As above conclusions, these results are agree with the theory and commercial system. Most of students were concluded that the average electrical power from the automatic two axis solar tracking system yielded the highest electrical power when compared to two other systems more than 85 percentages. The learning achievement of the experimental student group is higher than conventional group student that without Solar model for demonstration. The work related information is used to focus the main theory and boundary content for student.

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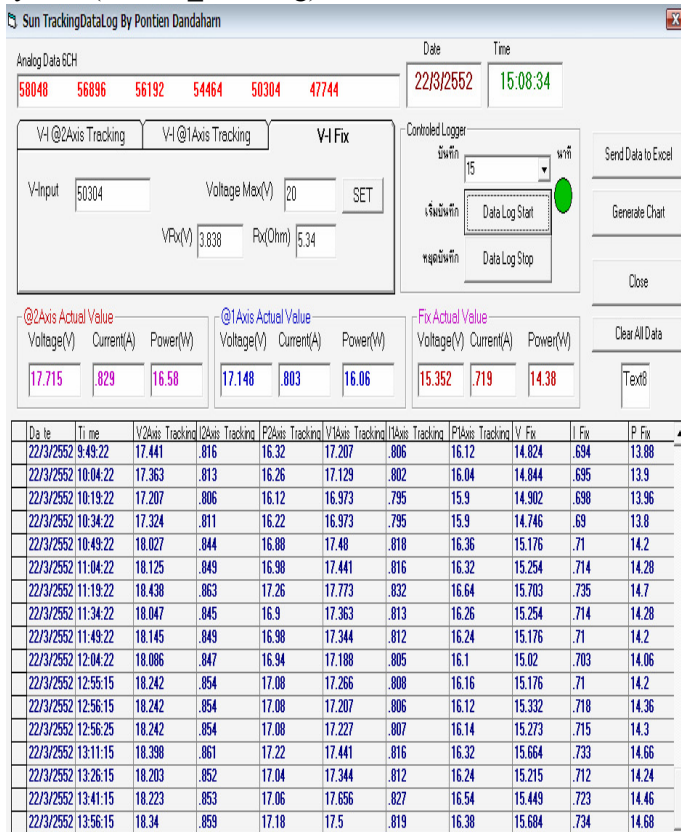


Fig. 5. Sun Tracking DataLOG

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.

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