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DESIGN AND FABRICATION OF MICROCONTROLLER BASED SOLAR POWER RECORDER

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Abstract*-The purpose of this project is to illustrate the process about the implementation of Microcontroller based Solar Power Recorder which uses Solar cell as the input sensor and displays current, voltage, power produced by it simultaneously. Major programming languages had been introduced to outline the concept of Power Recorder, relating the methodologies of the project and finally finding out the power. Likewise, the topic of this project is to design a solar power recorder and to investigate the performance of Solar Cell and find out the maximum power rise in a flat-plate collector. The research was conducted on the basis of data collected from this device. The data from the cell is collected through special interfacing circuit to the microcontroller and analyzed using numerical analysis to find out the proper relational equations. The results are compared with Ammeter and Voltmeter, also simulated with professional software to show the effectiveness of the program. This electronic gadget depicts to highlight the importance of a structured process and data collection and analysis method. The main outcome from this project is essential for engineers to obtain the knowledge on data collection techniques and new environmental friendly technologies e.g. renewable energy technology.*

Keywords: Microcontroller, Solar Energy, Programming languages, Solar Cell, Interfacing circuit, Numerical Analysis, Renewable energy

1. INTRODUCTION

Solar recorder is a very useful electronic gadget, which one can use it to store data to a compact flash memory card. Solar Recorder is a simple data recorder for solar energy lab project built based on PIC 18F2550A. The device uses a Solar cell as the input sensor. The LCD displays the file name, current sample and real-time ADC data. The purpose of this project is to design a solar power recorder and to investigate the performance of Solar Cell and find out the maximum power rise in a flat-plate collector. [1]

2. METHODOLOGY

At first a number of readily available documentary sources were consulted and a detailed, comprehensive literature survey was carried out to investigate the state of research. This task was essentially broken down into two steps: (A) the selection of design criteria being considered. In here , we found that Wichit Sirichote has built a solar recorder that stores data to a compact flash memory card, the display shows file name, sample number, ADC reading for Ch0 and Ch1. [2] and (B) the material required of these criteria into an objective function and constraints[3] [4] [5]. After that, we learnt about the procedure how the energy is transferred from Solar cell to solar recorder[5] and how to measure the output. For this purpose, we collected data for power on daily chance of sunlight and analyzed the collected data. After analyzing the data we suggest some recommendations.

3. EXPERIMENTAL SETUP

The present work is done on 18F2550A Programmable Intelligent Computer (PIC), which is relatively faster and offers many built-in features that are not available in other micro-controllers [6][7]. The energy received by the solar panel depends on the atmospheric conditions too[8]. For example, when outside is cloudy, the solar energy received goes down to 10% from its initial value; in this situation it is not advisable to move the solar panel. The current is also displayed on Liquid Crystal Display (LCD). A 12 V battery is used to store the solar energy that is periodically discharged to maintain its terminal potential throughout the experiment. Voltage Regulator 7805 has been used to convert 12 volt power into constant 5 volt power. The charging current is monitored by measuring the differential potential difference across 1Ω resistor. There is also variable resistor to limit the LCD contract up and

down. In addition, Figure1 represents the complete block diagram of a Solar Power Recorder.

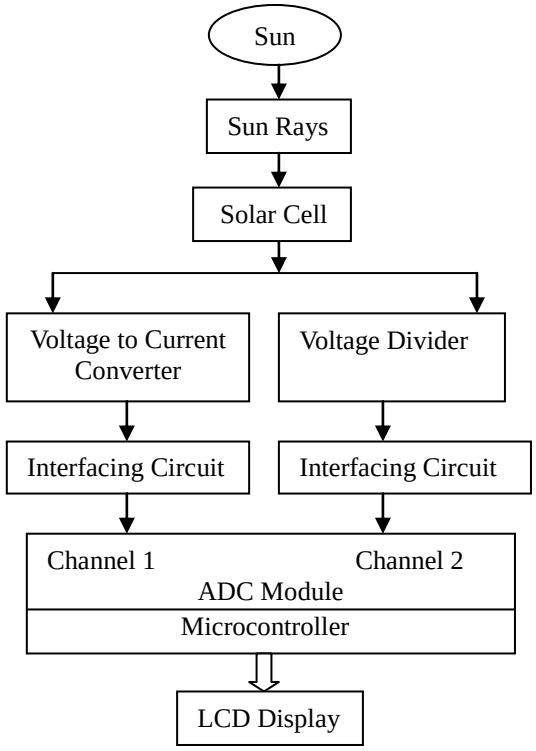

Fig 1: Block Diagram of the Hardware Design

On the next diagram, we observe the entire experimental setup of this gadget. Following this, Figure 3 illustrates the resultant output that shows the voltage (V), current (I) and power (P) produced by a solar cell time to time.

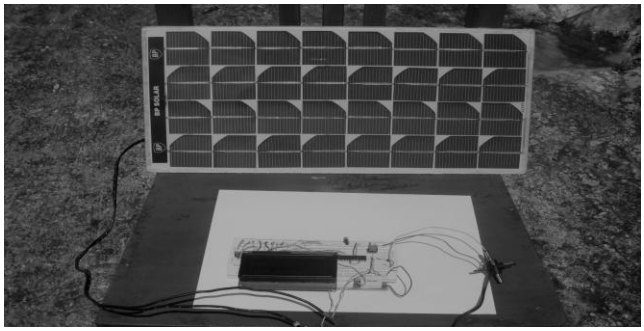

Fig 2: Experimental Setup of Solar Power Recorder

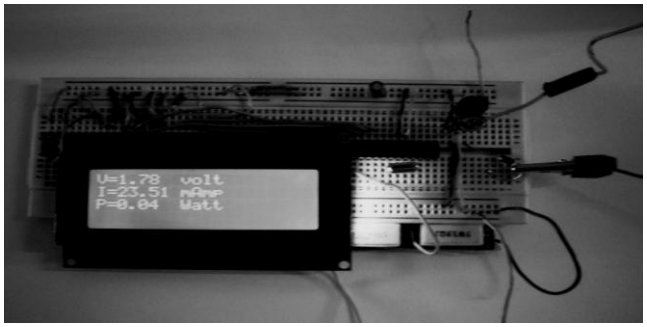

Fig 3: LCD display showing output of Solar Power Recorder

4. RESULTS AND DISCUSSIONS

At a certain time range between 7 AM to 5 PM we collected data from solar power recorder at the time interval of 1 hour. The data may vary at the certain time interval for which I have taken the most appropriate value .In the LCD display values of voltage, current and power were showing simultaneously and the values were changing with the change of sunlight. To investigate the performance of Solar Recorder we have chosen performance test parameters such as Position and Maximum Power. We placed the Solar Cell in the mid position between East side and West side in three angles (0 degree, 45 degree and 135 degree) for three days respectively.

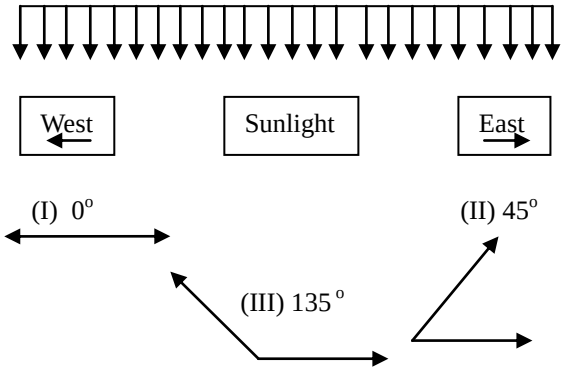

Fig 4(a): Positioning of Solar Cell at 0^o, 45^o, 135^o respectively in West-East direction

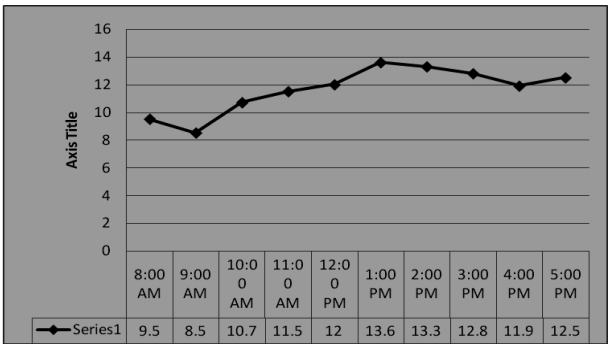

Fig 4(b): Power measurement of solar recorder (Power in Watts and Time Interval of 1 hour and solar cell placed at 0 degree)

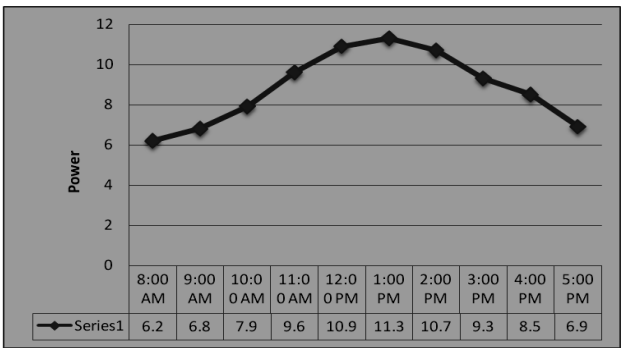

Fig 4(c): Power measurement of solar recorder (Power in Watts and Time Interval of 1 hour and solar cell placed at 45^o degree)

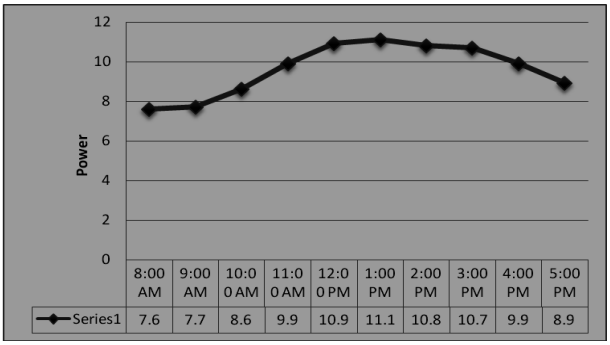

Fig 4(d): Power measurement of solar recorder (Power in Watts and Time Interval of 1 hour and solar cell placed at 135^{o} degree)

From the first graph we can see that highest power is obtained at 1 PM where,
Maximum Power: 13.6 watt
Voltage Produced: 20 volt
Current Produced: 0.68 ampere
From the next graph we observed that the power increased heavily until 12 PM to 1 PM and then it decreased steadily. And from the final graph we found that the power increased slowly and after that it reached a peak and decreased rapidly. The power was quite less in comparison to previous graph due to variation of sun intensity.

5. DATA ANALYSIS

Since the readings are taken only for fixed angle the incident radiations and other random factors are taken into account [9]. We compared the data found from both Solar Power Recorder and Multi meter which is described in the above Data Calibration Table.

Table 1: Data Calibration Table

	Reading from Solar Power Recorder	Reading from Multi meter	Difference
1(a).Voltage(V)	20 volt	18.35 volt	1.65 volt
1(b).Voltage(V)	18.5volt	16.5volt	1.7 volt
2(a).Current (I)	.68 amp	.68 amp	Zero
2(b).Current (I)	.65amp	.64 amp	0.01amp
3(a)Power(P)	13.6watts	12.48 watt	1.12 watts
3(b)Power(P)	12.025watts	10.56watts	1.465watts

6. RECOMMANDATIONS

However, for further modification we can write that,

- Solar Power Recorder can measure power of one panel, but it can be further modified so that power of whole power plant can be measured by one instrument.

- Resistance of the instrument is low which should be increased for continuous reading.

7. CONCLUSION

Renewable energy is energy which comes from natural resources such as sunlight, wind, rain, tides, and geothermal heat, which are renewable (naturally replenished). In 2006, about 18% of global final energy consumption came from renewable, with 13% coming from traditional biomass, which is mainly used for heating, and 3% from hydroelectricity[10].Solar Energy is one of the effective renewable energy, that is free and a source of ultimate energy. Likewise, it has no environmental pollution. We have a lot of scope to use solar energy [11].

From the project I can draw some conclusion that the weight of this instrument is light as possible and strong body. Moreover, data can be collected from anywhere using cables. Following that, the system do not require big amount of investment.

8. REFERENCES

[1] http://www.circuitlake.com/pic-solar-recorder.html.
[2] http://www.kmitl.ac.th/~kswichit/solarrecorder/solarrec.html.
[3] http://www.youtube.com/watch?v=Y0InAuhAre4.
[4] http://www.wikipedia.org/.
[5] http://www.howstuffworks.com/environmental/Energy/solar-cell3.html.
[6] http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=2018&mcparam=En13082.
[7] Daniel M. Kammen, *the Rise of Renewable Energy*, Issues in Science and Technology, September 2006.
[8] O.Schultz, R. Preu & S.W. Glunz, "Silicon Solar Cells with Screen Printed Front Side Metallization Exceeding 19% Efficiency", 22nd European Photovoltaic Solar Energy Conference and Exhibition.
[9] R.KANSAL and M.SINGH, "PIC Based Automatic Solar Radiation Tracker", *Asian Journal Of Chemistry,* Vol. 21, No. 10 (2009), S091-094.
[10] Godfrey Boyle, *"Renewable Energy"*, Oxford University Press, 2004.
[11] http://www.thenakedscientists.com/HTML/articles/Article/catching-energy-from-the-sun/.

9. NOMENCLATURE

Symbol	Meaning	Unit
V	Voltage	(Volt)
I	Current	(Ampere)
P	Power	(Watt)

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