

# Design of Solar PV Panel Cooling System with Data Logger

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**Abstract**—Solar energy is the most important source of renewable energy. Solar panel converts light energy into electrical energy directly. It converts 25 percentage of irradiation into electrical energy. One of the major problems in solar panel is increase in the panel temperature which leads to decrease in efficiency. For every one degree rise in temperature above the normal operating temperature there will be 2.2 mV reduction in the output voltage. Cooling the panel is the only way to overcome this problem of temperature rise. This project deals with the designing of solar PV panel cooling system. Design comprises of natural fibres wetted with water is placed on the back side of the panel. The fibre placed panel is compared with the normal panel using data logger circuit and arduino .This comparison process helps to identify efficient panel.

**Keywords**—temperature rise; maximum power extraction; cooling; data logger

## I. INTRODUCTION

People have harnessed solar energy for centuries. As from the past till now solar energy is the only inexhaustible source. One of the main obstacles in the operation of photovoltaic panels (PV) is overheating due to excessive solar radiation and high ambient temperatures. There are many factors that reduce the efficiency of solar panel. some of the factors are Shading, angle of solar panel in the same position, Various irradiation on solar panel throughout the day due to various climatic changes ,temperature rise.

Among all the factors, temperature rise is the most important problem which is to be solved to extract maximum power. To reduce overheating of the solar panel there are several conventional cooling system available which are of high cost. The cooling techniques are either is passive or active. Passive cooling technique uses natural convection. Active cooling technique uses forced air cooling. Design consideration of cooling system includes several factors. They are single or two phase system, with or without cogeneration, Working fluid, moving parts or stationary parts. The cooling of Solar PV panels is a problem of great practical significance. It has the potential to reduce the cost of

solar energy in three ways. First, cooling can improve the electrical production of standard .at plate PV modules. Second, cooling makes possible the use of concentrating PV systems. Finally, the heat removed by the PV cooling system can be used for domestic or industrial use. Various Solar PV panel cooling systems have been developed in past.

The main objective of this project is to develop a system for reducing the temperature of the PV panel so as to increase the power output and lifetime. The general block diagram of the proposed work is shown in Fig. 1.

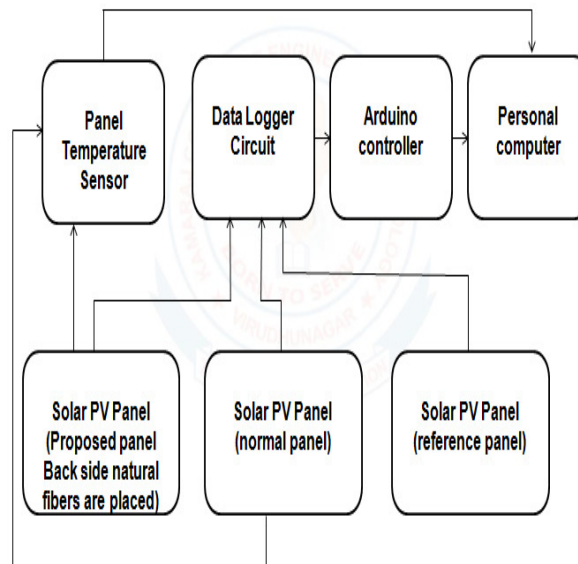


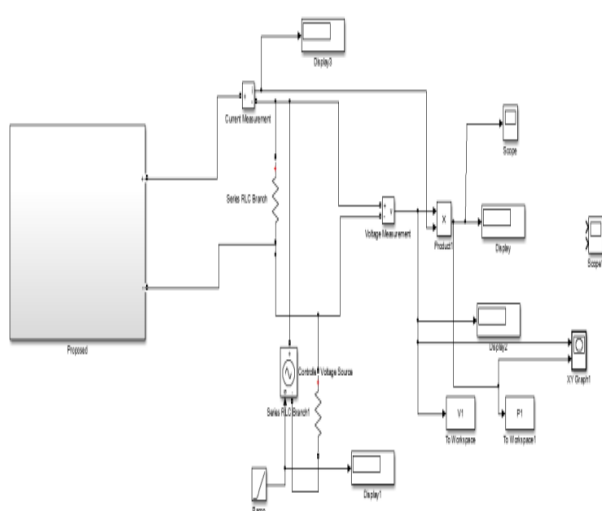
Fig. 1. General block diagram

This project is to increase the efficiency of the solar panel by temperature reduction. Three panels are used in this setup. In first panel natural fibers are placed at the backside. Second panel is a normal panel. Third panel is a reference panel. These three panels are connected to the data logger circuit to read the output parameters at the instant. Temperature sensor is to sense the difference in temperature between the cooling incorporated panel

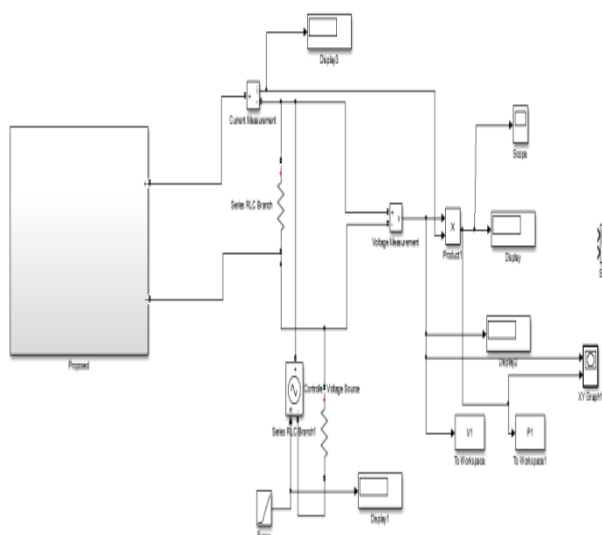
and normal panel. Data logger circuit is connected to the Arduino.

Arduino reads the analog readings from data logger and normalizes it into corresponding output parameters. These readings are stored in the personal computer. The data stored in the computer is used for comparing the cooled panel with normal panel.

## II. SIMULATION OF THE PROPOSED WORK



(a)



(b)

Fig. 2. Simulation model in MATLAB (a) Cooled panel model (b) Normal panel model

Fig. 2. Shows the simulation model of the panels in both normal mode and cooled mode. In this simulink model, there are two blocks. First one is for proposed panel (cooled panel). Second one is for existing panel (Normal panel). Temperature and Irradiation are given as an input for both blocks. Then corresponding power output for both blocks are taken as an output. From the power output, one can compare which panel is more efficient than the other.

### III. HARDWARE IMPLEMENTATION OF PROPOSED WORK

### A. Coco Peat

Coco peat is a natural fibre. It is made out of coconut husk. The extraction of coconut fibre from it husk gives Coco peat and is shown in Fig. 3.



Fig. 3. Dry and water absorbed coco peat

Coco peat has high water holding capacity. This fiber is selected based on its moisture retentivity. It can hold water up to 8 times of its weight. It is biodegradable and degrades after a long 3-4 years. The water absorbed coco peat is shown in Fig. 3.

### B. Fabrication of panel with fibre



Fig. 4. Coco peat placed at the back side of the panel

Coco peat is placed at the back side of the panel as shown in Fig. 4. A sheet is used to cover the panel on rear side. Cotton is inserted through the hole in the sheet. It acts as a water transferring medium. It transfers water from water container to the coco peat.

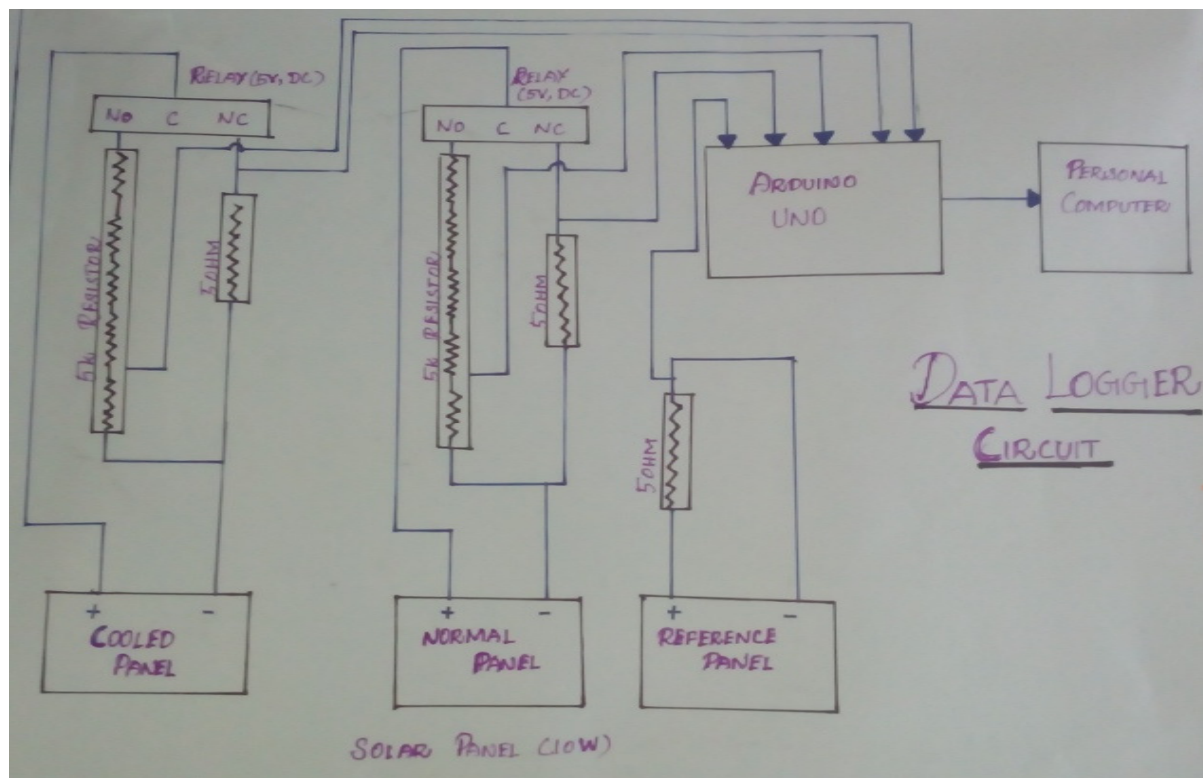


Fig. 5. Circuit diagram of data logger

The circuit diagram of data logger is shown in Fig. 5. The main purpose of a data logger circuit is to read the output parameters of the three panels at same irradiation intensity. Data logger circuit consist of two NONC relay (5V, DC), 1K resistors and 5 ohm resistors. The relay is connected to both cooled and normal panel. The purpose of the relay is to open and close the circuit. The resistors are connected to read the voltage and current of the panel. The reference panel is used to find the irradiation intensity.

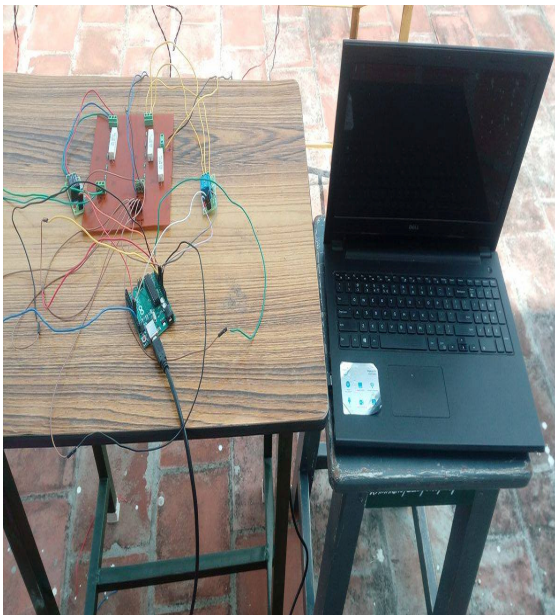


Fig. 6. Data logger circuit hardware with Arduino

The hardware setup of the data logger with Arduino microcontroller is shown in Fig. 6. Arduino controller is used here for reading analog values from a data logger. It normalizes the analog readings in to corresponding output parameters. The program for normalization process is loaded in the Arduino. It is then connected to PC to store the results.

### C. Flow chart

The flow chart shown in Fig.8. Represents the sequence of instructions about the process of reading the values.



Fig. 7. Experimental setup for comparing proposed and existed work



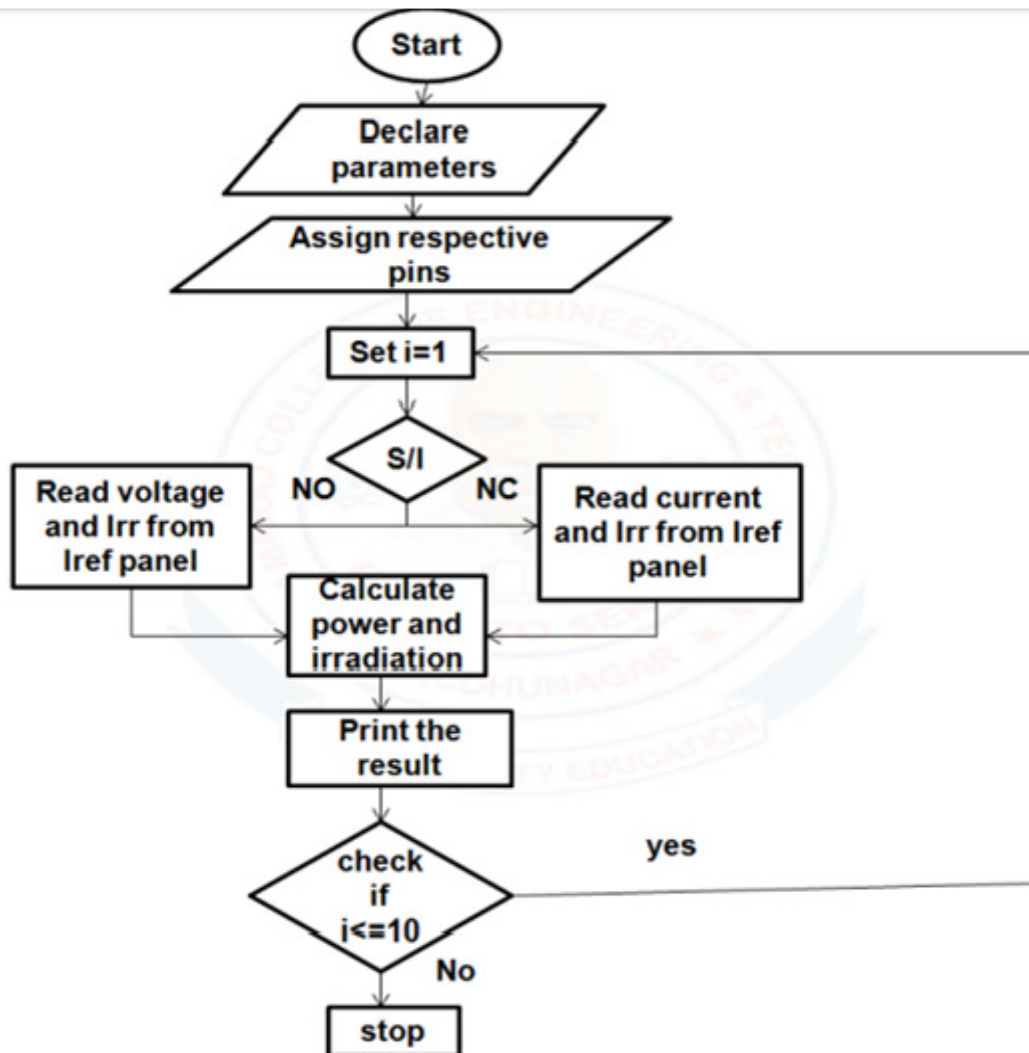


Fig. 8. Flow chart for reading the values using arduino microcontroller

Fig. 7. Shows the experimental setup for comparing the normal and cooled panel. The data stored in the PC shows variations in the power output. This data helps in finding the efficient panel in tracking maximum power.



Fig. 9. A simple prototype model of the cooling system

Fig. 9. Shows a simple prototype model of cooling system. This model holds the fiber placed panel at 12 degree angle. Wasted bottle is used as a water container. Cotton transfers water from bottle to the coco peat. There is a collector below the panel to collect the rain water so that it can be reused for cooling.

#### IV. RESULTS

To claim this proposed work the following results are explained in detail

- (i) 10 to 15 degree temperature difference between the cooled and normal panel.
- (ii) There is 2.5% increase in the efficiency in the panel by the proposed work.

Table I shows the comparison results between the existing and proposed work. The temperature differences between the panels of proposed work and the existing work are given. The increase in the percentage of power output from panel is also given in the Table I.

TABLE I. COMPARISON OF OUTPUTS BETWEEN PROPOSED AND EXISTING WORK

Time(min)	Temperature(deg cel)		Output power(Watts)				% increase in power
	Proposed	Existing	Proposed		Existing		
			Simulation	Practical	Simulation	Practical	
5	38	47	9.3996	9.3885	9.2355	9.2333	1.74
10	42	54	9.3305	9.2984	9.0892	9.0265	2.5
15	44	56	9.2936	9.3456	9.0450	9.0350	2.6
20	47	55	9.2355	9.3588	9.0672	9.1686	1.8
25	40	51	9.3659	9.4232	9.1536	9.0435	2.3
30	41	53	9.3484	9.3454	9.1109	9.0150	2.5
35	42	54	9.3305	9.3205	9.0892	9.0024	2.6
40	37	48	9.4157	9.4256	9.2155	9.2563	2.1
45	38	49	9.3996	9.2569	9.1951	9.2234	2.2
50	43	53	9.3123	9.2562	9.1109	9.0267	2.2
55	40	51	9.3659	9.3456	9.1536	9.1567	2..3
60	44	55	9.2936	9.4523	9.0672	9.0457	2.4

#### V. CONCLUSION

By implementing the proposed cooling system, 10 to 15 degree temperature of the proposed panel is reduced as compared to normal panel and 2.5 % increase in efficiency is obtained.

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