Comparing Solar Panel Performances under Certain Environment Circumstances by using Sensor Circuits

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Abstract: Solar panel produces electric current depending upon the sunlight intensity. Beside that, temperature, air moisture and other environment parameters influence the energy conversion process. Commercial solar panels are widely available in market. The price depends on solar sell capasity as well as material which determine the electric generation performance. This paper compares monocrystaline and polycrystaline solar panels by using sensor circuits. The impact of environmental parameters to solar panel is also assessed. The results show that monocrystaline outperforms polycrystaline. The voltage, current and power outputs of monocrystaline are 2.8%, 7.73% and 6.41 % higher than polycrystaline. The monocrystaline solar panel is also more stable to environmental changes. It is hown the efficiency stability.

1 INTRODUCTION

Solar panel consists of solar cell arrangements in series and parallel to produce certain voltage and current level. The material within solar cells produces electrical currenst that is captured by the electrode drawn smoothly on solar cell surface. This electrodes are interconnected from one cell to other cell forming higher electric current. The modul of cell arangements forms solar panel. Solar panel are easily found on market with specified capasity. Users often rely on this specification when purchase them.

In some cases, the solar panel may not working as expected. One of the influencial factors is the environment circumstance [1-3]. Environmental conditions are constantly changing over time. These variations change the environment parameters such as temperature, wind speed, humidity and solar radiation. Those parameters may influence the solar panel output. The radiation from the sun also fluctuate [4,5]. This paper compares solar panel performance by integrating the environment inconsistencies. All these environment inconsistences are taken into account by detecting the parameter values using sensors and measuring the output of solar panels at the same time, then comparing the solar panel performances. The sensors are assembled and controlled by an arduino module. The circuit has been presented in author previous paper (Sani, 2018). The highlighted version is presented in next session.

Besides solar panel output in term of voltage, current and power comparisons; measurement errors are also presented in this paper, as well as the environment parameters impacts to both panels.

2 RESEARCH METHOD

2.1 Sensor Circuits

Figure 1 shows the sensor circuits (Sani, 2018). Voltage and current generated by solar panel are measured using DC voltage sensor and ACS712 current sensor. DS18B20 is used to measure the temperature. Humidity sensor is performed by DHT11, a negative temperature coefficient thermistor. Piranometer is employed to measure solar radiation in watt per meter unit and the

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anemometer is for measuring wind speed. All sensors are connected to the arduino.

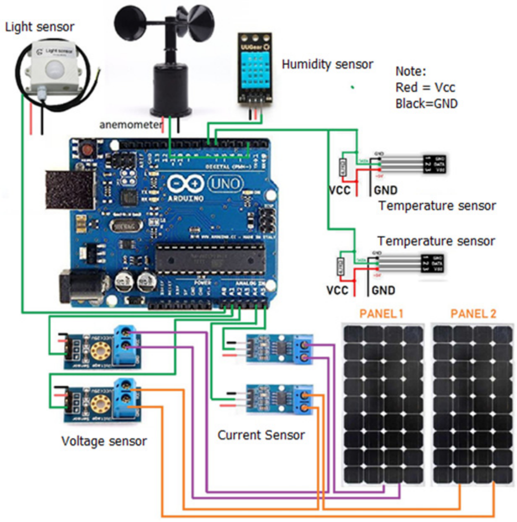


Figure 1. Solar measurement device

2.2 Experiment Scenario

The In order to measure voltage and current generated in each panel, a 100 W 24 V monocrystalline and 100 W24 V pollycrystaline solar panels were assessed. The two solar panels are placed closedly so both receives the same light intensity as well as receives the same environmental circumstances. The panel placement and the circuit arrangement are shown in Figure 2.

Figure 2. Experiment set up

The solar radiation, temperature, humidity and wind speed are measured at the same time for several days. Data is recorded. In order to validate the measurement result samples of direct measurements using voltmeter and ammeter are also presented.

As the output voltage and current are recorded as well as sensor readings, outputs of solar panels are comparable. Further, impact sensor values to panel output is also available.

3 MEASUREMENT RESULT

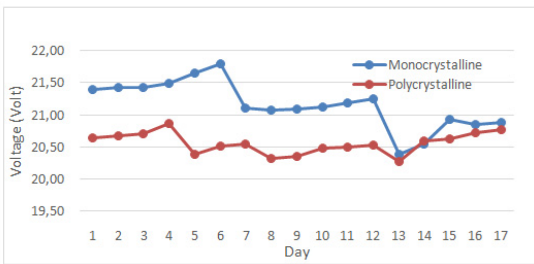
3.1 Sensor Data

Table 1 shows the sensor circuits (Sani, 2018). Voltage and current generated by solar panel are measured as daily average. The input power is obtained from the radiation sensor, while output power is obtained from the generated voltage and sensor multiplied by the solar panel factor. The efficiency is determined by the percentage of output to input power.

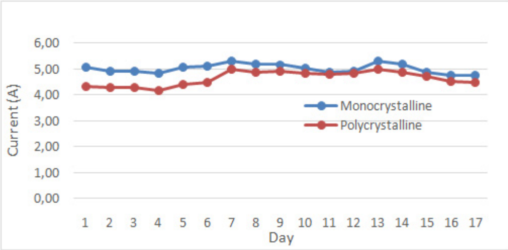
Table 1. The average output power records

Day	Monocrystalline					Pollycrystaline				
	Voc (V)	Isc (A)	Pout (w)	Pin (w)	Efficiency (%)	Voc (V)	Isc (A)	Pout (w)	Pin (w)	Efficiency (%)
1	21,39	5,09	88,96	394,65	22,54	20,65	4,33	76,16	428,96	17,75
2	21,42	4,93	86,30	396,61	21,76	20,68	4,30	75,75	431,09	17,57
3	21,43	4,90	85,82	392,69	21,85	20,71	4,27	75,35	426,83	17,65
4	21,49	4,85	85,22	392,69	21,70	20,86	4,17	74,18	426,83	17,38
5	21,66	5,08	90,08	396,61	22,71	20,39	4,42	76,64	431,09	17,78
6	21,79	5,12	91,43	390,73	23,40	20,51	4,48	78,20	424,70	18,41
7	21,10	5,32	91,51	383,55	23,86	20,55	4,98	87,11	416,89	20,90
8	21,07	5,20	89,30	378,32	23,60	20,32	4,87	84,12	411,21	20,46
9	21,09	5,17	88,88	380,28	23,37	20,35	4,92	85,13	413,34	20,59
10	21,12	5,05	86,97	378,97	22,95	20,48	4,85	84,52	411,92	20,52
11	21,19	4,87	84,19	380,28	22,14	20,50	4,80	83,74	413,34	20,26
12	21,25	4,91	85,16	380,93	22,36	20,53	4,83	84,40	414,05	20,38
13	20,38	5,30	87,56	386,16	22,67	20,28	4,98	85,83	419,73	20,45
14	20,54	5,19	86,53	397,27	21,78	20,59	4,86	85,20	424,70	20,06
15	20,93	4,89	83,33	384,85	21,65	20,63	4,70	82,57	418,31	19,74
16	20,85	4,77	80,92	379,63	21,32	20,72	4,53	79,98	412,63	19,38
17	20,88	4,75	80,72	386,16	20,90	20,77	4,50	79,66	419,73	18,98

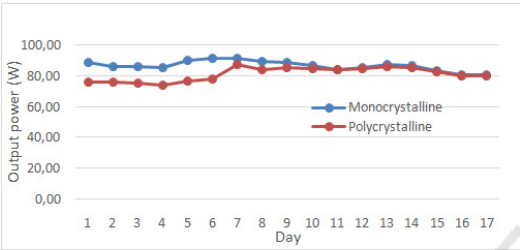
The output voltage, current and output power comparisons for monocrystaline and polycrystaline solar panel are shown in Figure 3. In average, monocrystaline solar panel produces higher voltage, current and power outputs than polycrystaline. Monocrystaline generates 2.8%, 7.73% and 6.41 % higher voltage, current and power. However, polycrystaline exerts a more stable voltage.



(a)Output voltage



(a)Output current

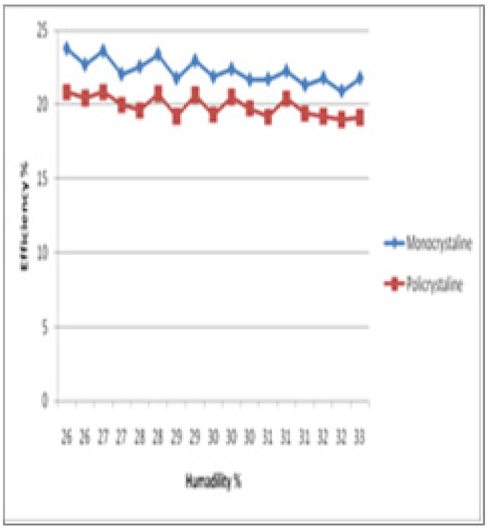


(c)Output power

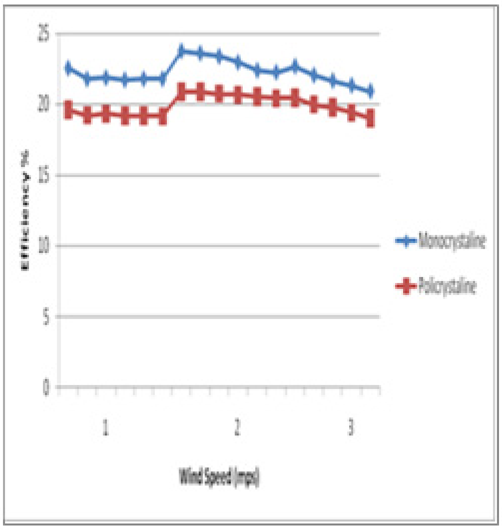
Figure 3. Output comparisons

3.2 Impact Environment Parameters to Solar Panel Output

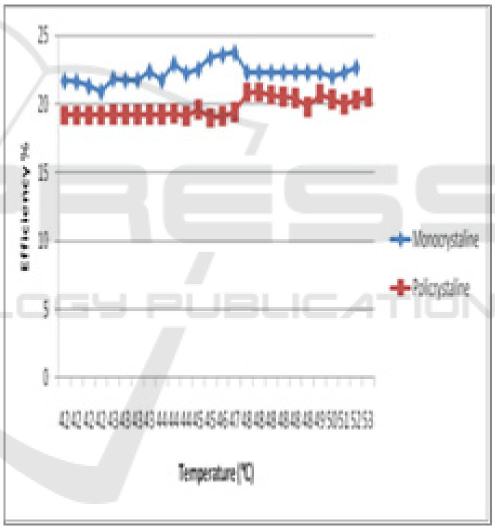
Impact environment parameters to solar panel output can be seen in Figure 4. For monocrystaline and polycrystaline solar panels, humidity and wind speed tend to reduce efficiency. While temperature which reflects the additional sunlight intensity tends to increase efficiency.



(a) Humidity



(b) Wind speed



(c) Temperature

Figure 4. Impact of environment parameters to solar panel efficiency

4 CONCLUSIONS

This paper has compared the polycrystaline and monocrystaline solar panels using sensor circuit. The measurement shows that monocrystaline produces 2.8%, 7.73% and 6.41 % higher voltage, current and powerthan polycrystaline solar panel. The polycrystaline is also more stable in term of efficiency to environmental changes.

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