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RESEARCH ARTICLE

SOLAR PANEL DUST MONITORING SYSTEM

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ABSTRACT

Solar energy has been one of the most explored sources of renewable due to its economical source of energy. However, the main barrier for solar energy generation is the present of dust particles on the panel surface that decreases its performance. Hence, persistent monitoring on dust accumulation is of importance to guarantee the optimum power is achieved. Thus, this research aims to develop the real-time dust monitoring system of the solar panel. A dust sensor with IoT will be developed for this purpose. The reading of dust accumulation will be recorded and is accessible online through smartphones or desktop.

KEYWORDS

Renewable, performance, real-time, smartphones.

1. INTRODUCTION

The worldwide increase in energy demand and exponential fatigue of fossil options has favored the development of new systems of electricity production and solar energy has absolutely been one that has the highest application in housings, buildings and also generating power plant due to its simplicity and easy implementation through the utilization of photovoltaic panels (Al-Kuwari et al., 2018). However, performance of the PV panels due to accumulation of dust has always been a concern. There are many different sources that cause dust accumulation on the PV panels' surface and may have significant impact on production of electricity. For example, shadows, snow, high temperatures, dust, dirt, bird's dropping pollen and sea-salt. Using PV panels to produce power efficiently requires removing the dirt from them regularly (Mohammed et al., 2018). The efficiency of power generation from the solar panel is minimized in a dusty environment and this attributed to the fact of dust reduces the amount of sun light received by the PV panel.

The energy and the efficiency produced by photovoltaic modules is related with solar's available irradiance and spectral content therefore care and maintenance through cleaning of PV modules is essential in improving performance and irradiance. The cleaning of PV panels helps PV system users achieve maximum power output as the PV cells surface area become fully exposed to maximum light intensity (Hudedmani et al., 2017). The developed dust if not cleaned, affects the performance of the solar PV module by shading the front surface thus obstructing solar radiation incident onto the PV panel surface. It is therefore necessary to keep PV panels clean so as to harvest as much solar radiation as possible. Monitoring of the performance of the PV panel can be done by measuring the mass of dust directly on the PV Panel surface by the sensors before and after cleaning.

2. MATERIAL AND METHODS

2.1 Materials

This research was developed using 3 main segments. The first segment is Sensor, this project is going to use one type of sensor with several units in order to obtain optimum area for sensor placement (Sulaiman et al., 2015). For processor segment is using Arduino module then the data will be submitted to the Iot server and can be monitored through mobile phone or desktop monitoring.

2.2 Methods

This research is adopting methods approach involving develop a system of measure and monitor the level of dust accumulation on solar panel and to enhance the regulation of cleansing process that is conducted by the organizers of the solar power plant. Besides that, monitoring system is including data sensing and acquisition by the sensors used and then goes to data processing and lastly data display & user interface.

2.3 Characterization

System for monitoring is including the usage of ARDUINO 1.8.5 application to construct programming while conduct the experiment and also Thinger.io that act as IoT server.

3. RESULTS AND DISCUSSION

Table 1 showed the dust level measurements taken in different area. It showed that this study placed the sensors in several areas in order to detect which area contains the most dust accumulation during a whole month of experiment. So, the results revealed the higher value of dust accumulation is on Area E which is up to 3.34mm during week4 which is

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specifically it is on the middle area of a Solar Panel. Figure 1 showed the level of dust taken in a day by 30minutes each time measured by using the same sensor. The fluctuated graph occurs because of adding and removing the amount of dust during the experiment.

Table 1: Sensor placement data

DUST LEVEL MEASUREMENTS (mm)									
	OPTIMUM AREA								
WEEK	A	B	C	D	E	F	G	H	I
1	1.55	1.93	0.44	1.21	2.02	1.51	0.77	0.54	0.89
2	1.68	1.78	0.67	2.43	2.88	2.02	1.26	1.80	0.96
3	2.44	2.50	1.02	2.77	3.05	2.81	1.99	2.11	1.53
4	2.09	2.91	1.28	3.12	3.34	3.06	2.01	2.76	1.98

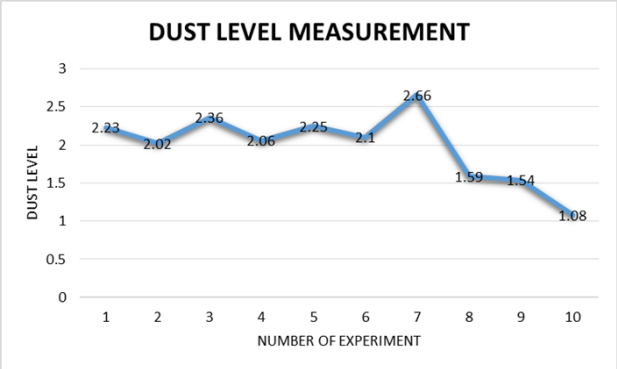

Figure 1: The line graph of measurements data

4. Conclusion

This study successfully provides a method to measure the dust level on the Solar Panel directly by using the tested sensor. The current is using only one type of sensor but next experiment will include different type of sensors in order to gain optimum result with the right usage of sensor. The experiment also will be taken in different parameters which are either by the output voltage, output current or irradiate of sunlight receive.

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