Practical Performance Investigation of the Solar (PV) Panel System of the Electronic and Control Engineering Department - Kirkuk

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Abstract. Scientific research and development in solar cell systems is often focused on studies that include radiation availability, some effective operating strategies, and re-engineering of these systems. In Iraq in particular, the experience of using solar energy systems is almost new to be used to provide clean energy. Therefore, it was necessary when installing solar energy systems in Kirkuk governorate in Iraq, especially in the Department of Electronics and Control Engineering in the Kirkuk Engineering Technical College, that the performance of these cells or systems should be examined and measured, especially that the department made full use of solar energy. The electrical performance of photovoltaic panels has been experimentally studied for the effect of dust particles deposited, as well as when there is fog and when there is bright sun and for a number of consecutive days. The energy efficiency and energy output of the photovoltaic system are calculated based on experimental data. The conclusion is that dust significantly reduces the efficiency of photovoltaic solar panels.

Keywords: Solar Panels, Renewable Energy, Performance of Solar Cells, Photovoltaic.

1 Introduction

These days, elements of strength have come to be very fundamental. It includes, for example, rational and low cost makes use of of resources, in addition to environmental affects related to emissions, pollution and intake of non-renewable resources [1]. For those reasons, there may be a developing and accelerating hobby global in sustainable strength manufacturing and strength savings [1,2]. Among the technology that would play a position in sustainable and big-scale strength era, thrilling answers are photovoltaic (PV) cells, wind generators, biomass flora and gasoline cells. In particular, photovoltaic structures may be taken into consideration as one of the maximum famous answers with big margins of development even as making sure electricity era with low environmental impact [2].

Solar panels are utilized to capture the energy of sunlight to convert it into electrical energy [3]. When multiple systems are combined, the photovoltaic units are installed as an integrated system, pointing to a single surface, called the power panel [1,3]. Photovoltaic is a new technology field with relatively new applications in solar power generation, but it is still often used exclusively for generating electricity from sunlight [2,3]. Photovoltaic cells are used to

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detect light or other electromagnetic radiation near the visible light matrix, such as detecting infrared radiation or measuring light intensity [3].

Photovoltaic cells through which sunlight is directly converted into electricity, by using semiconductors such as silicon, which is extracted from pure sand [2,3]. Generally, the materials of these blocks are coarse-crystalline materials such as crystalline silicon or fine amorphous materials such as amorphous silicon aSi and cadmium or other materials. Their energy is considered a clean and renewable energy because it does not cause waste, pollutants, radiation, noise, or even no fuel [4]. But compared with other energy sources, the acquisition cost is higher. Solar cells continue to produce direct electricity (such as traditional dry batteries and liquid batteries) [5, 6]. The current intensity depends on the duration of the sun and the intensity of solar radiation, as well as the efficiency of the photovoltaic cell itself in converting solar energy into electrical energy. When connected in series, these solar cells can provide hundreds of volts of direct current (DC) [7].The resulting energy can also be stored in lead-acid or nickel-cadmium-acid batteries [8]. DC current can be converted into AC current by inverters for use and management of ordinary household and industrial electrical appliances [9, 10]. Its advantage is that it has no moving parts subject to failure [11]. For this reason, it operates over satellites with high efficiency, especially since it does not require maintenance, repairs, or fuel, as it operates in silence, but the dirt of the photovoltaic cells as a result of pollution or dust leads to a reduction in their efficiency, which calls for cleaning them at intervals [6, 11,12,13].

Few research analyzed this impact and the resultant performance degradation. Current studies on PV device overall performance and the results of the deposition of dirt is confined because of the reality that powder is a complicated phenomenon this is encouraged with the aid of using distinctive environmental and climate conditions [12,14]. A quick experimental illustration of the elements that determines the setup of the PV panels is proven in setup of experiment. A targeted evaluation of the impact of the PV modules overall performance is proposed on this paper. Based on most of these statistics the results of the PV panels electric performances were highlighted. During the examine of the overall performance of sun pv panel with and without, then the subsequent elements considered:

2 Experimental Methodology

The test is performed through the use of the three 360 w solar panel installed on a stand. The electric parameters like voltage & current were measured to examine the impact of environmental numerous impact. The internet impact of fog, dirt, and direct solar at the energy discount turned into evaluated & analyzed. The impact of dirt may be quantified through evaluating the performance of panel uncovered to dirt & with out dirt. In this work, the machine of measurements is includes a silicon sun panel of vicinity 2 m*m, MUST inverter turned into used for size of producing the the voltage, current, and the temperature and something associated with the solar panel. The experimental examine turned into carried out withinside the Kirkuk city, Technical Engineering College - Kirkuk, Electronics and Control Department. The ambient temperature fluctuates withinside the variety of 15 to 33ºC in the course of the measurements. The sun photovoltaic panel turned into examined and the parameters like Voc, Isc, solar irradiance, and ambient temperature ,etc, wished for the assessment of the structures have been measured at interval of 1 hour and a half between 10.30 AM and 12.00 PM. The ambient temperature and the incident solar radiation depth turned into measured the use of the inverter.

Table 1. Specifications of the PV module

Parameter	Value
Model	Tata BP 184459
Maximum power	360 W
Open circuit voltage	12V
Short circuit current	2A
Number of cells	60
Dimensions	2*1*0.1 m^3
Wieght	25 kg

3 Experimental Setup

In this part of the research, an integrated solar energy system was established on the Department of Electronics and Control Engineering Technique with a capacity of 5 kilowatts, 30 solar Panels and 8 batteries of 200 amp/hour, but the experiment was done on 3 panels only 360 watts (all information is in Table 1) A smart MTS invertor was used to take measurements and data. Figure 1 represents the practical part and its details that were already explained. It is noted that the solar panels are divided, and this is what can be made good to collect the most possible energy, and even if there is shadow or dust on part of the panels and the cells, the rest of the panel will not be affected as a result of the panel division into two parts, meaning that the first part does not affect the second part and vice versa. The readings were taken as shown in Figure 2, where a laptop was used, and a program was installed to take the readings directly from the inverter that was connected between the batteries and the solar panels.

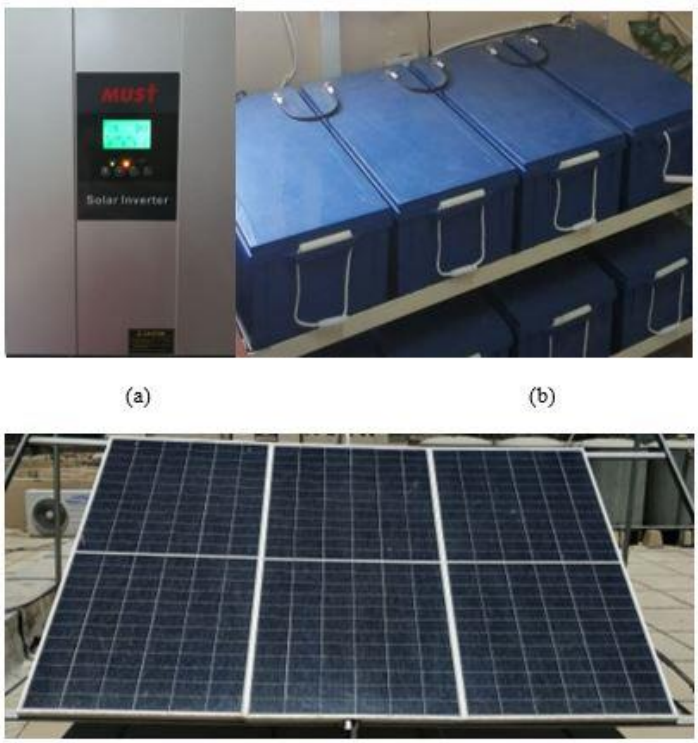

Fig. 1. The parts of the system: (a) Inverter (MUST); (b) Recharchabel battery (200 A/h); (c) Solar panel (360 w)

Fig. 2. Collecting data process from the system

4 Results and Discussion

The experiments were carried out in different weather conditions. The first test took place on the first day, as the weather on the first day was mostly dusty, which was very suitable for doing the first test. The data recording process took place from ten thirty in the morning until twelve o'clock in the afternoon, and it represents a full 8 hours. As for the date of today's test, the first day was 8th of April, 2021. As for the second day, it was 3 days after the first day, when the weather was partly cloudy. On the third and fourth day, the weather was clear and the maximum temperature was 33 degrees Celsius as well as we tested one dusty day.

The results of the temperature of the solar panels as well as the power were recorded in all the conditions mentioned above. It is noticeable in Figure 3, that the temperature of the solar panels increases as the time approaches noon, and this is actually expected, especially in the month of April in Iraq, regardless of the weather.

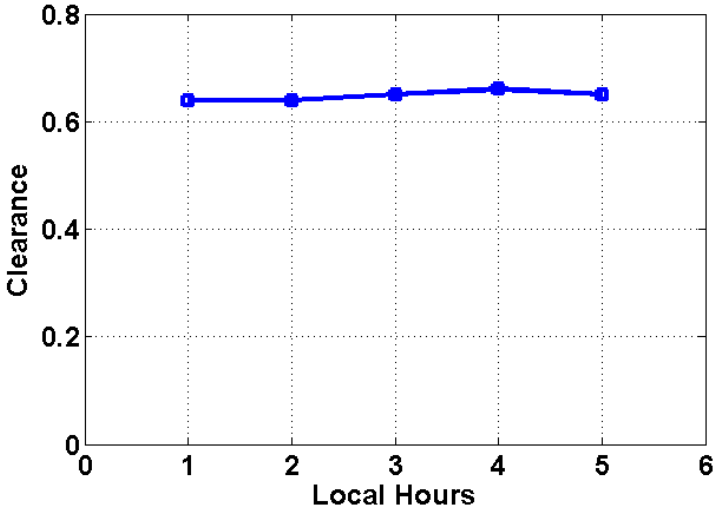

Fig. 4. The recorded clearance of the weather for five continuing days

As for the energy obtained, it is volatile in most circumstances, but it is noted in Figure 4 that the power obtained on a day when the weather is clear, the power is high compared to other days, especially if the weather is cloudy or dusty.

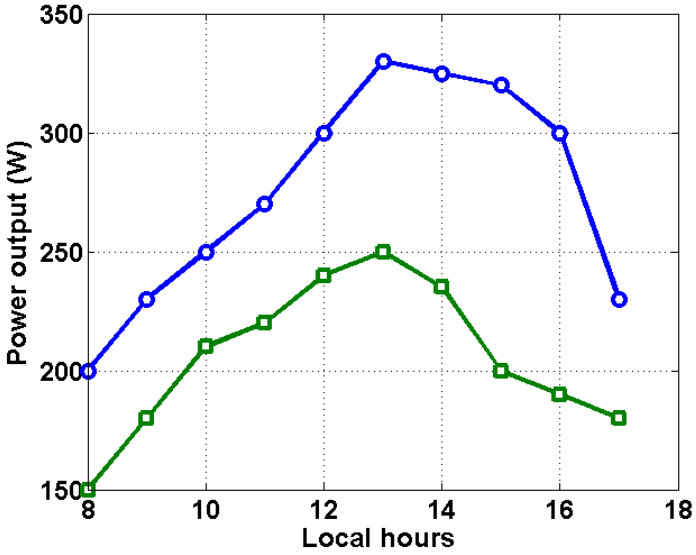

Fig. 4. Power of the panel of two days clear day (blue) and cloudy day (grean) versus local hour

Figure 5 shows the power taken for three days one clear day and cloudy day and the last day is the dusty day.

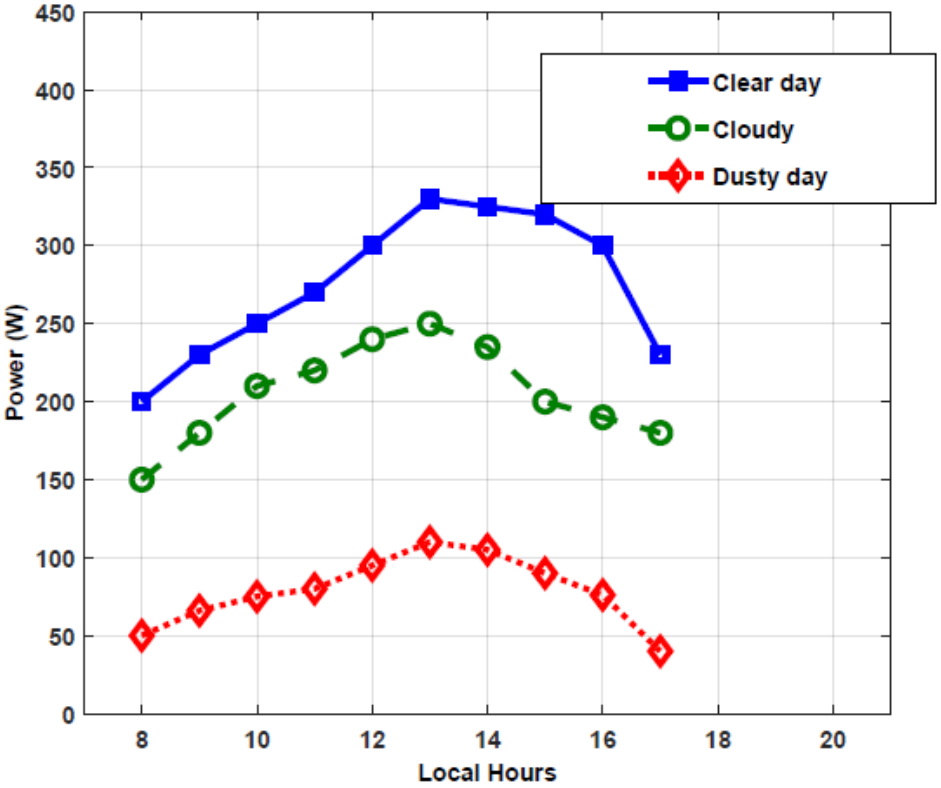

Fig. 5. Power versus local hours for three different days

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