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Real-time investigation of dust collection effects on solar PV panel efficiency

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Abstract

The amount of the light distraction on the PV is made by the accumulation of particles of dust which in turn decreases efficient performance as well as leads to a reduction of money flow for the investors. More studies and tests were carried out inside the laboratories that cannot find a proper solution to mitigate the same. This study can enable the proper cleaning schedules of the PV panels as this work is being carried out on a real-time basis on the rooftops. The measurement of required parameters like irradiation, output power from the panels, and the amount of dust particles accumulated was done on an hourly, monthly, and yearly basis. It is found that nearly 8% of the performance could be dropped annually. For making a sustained operation of the PV panels it is required to have a cleaning process for 45 days intervals, especially for small-scale systems.

Keywords: Dust impact, Solar Photovoltaic, System Performance, IoT web server

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1. Introduction

Almost all power sectors in the world use non-renewable energy sources for generating their electrical energy. However as per the statistics [1], the energy source will deplete at some time in the future. So, the world should move forward with energy sources that are sustainable and eco-friendly. Of all the renewable energy sources, solar power is an environmentally friendly, abundant, and encouraging source. The benefits of photovoltaic systems are: (i) can be used in the long run (ii) can be used at any place where the availability of sun rays and (iii) can be one of the economical solutions for the electrical energy requirement.

As per the data from the International Energy Agency, there will be an increment in global energy consumption of about 53% in the year 2030 with a growth rate of 70% among developing countries. Many countries around the world follow one of the aforementioned solutions to overcome a deficit dilemma of energy through the application of green technology. It was witnessed that solar energy stands as the foremost anticipated energy source among them all the available sustainable energy resources [2], [3].

In general perception of solar PV, the cost of the system is expensive with a limited period life duration of about 25 years. It is due to pores and voids in the glass, worn-out glass, and corrosion between the cell's tracks. These parameters led to the slumping of its efficiency and could not achieve the desired output. One of the significant reasons is the buildup of dust particles atop solar cells. Moreover, bird-dropping, stains are created by stagnated water salt. However, the nature of the problem varies concerning locations. These sorts of problems make the system seem to be unappealing to the PV energy market [4]. Generally, dust settlement depends on various properties like chemical properties, size of the dust