

Literature Review on Solar Panel Cleaning System

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Abstract- Energy is one of the major issues that the world is facing in India, the supply of energy has been one of the major problems for both urban and rural households. About 60% to 70% of the energy demand of the country is met by fuel wood and agriculture residues. Solar energy is a renewable source of energy, which has a great potential and it is radiated by the sun. Renewable energy is important to replace the use of electric energy generated by petroleum. Solar power has become a source of renewable energy and solar energy application should be enhanced. The solar photovoltaic modules are generally employed in dusty environments e.g. tropical countries like India. The dust gets accumulated on the surface of the module and blocks the incident light from the sun. It reduces the power generation capacity of the module. The power output reduces as much as by 50% if the module is not cleaned for a month. The cleaning system designed cleans the module by Arduino programming control. The main objective is to remove the dust in the photo-voltaic modules to improving the power generating efficiency of the solar power generation system.

Index Terms-Rolling Brush, Arduino Board, DC Geared Motor, Gear Wheels.

1. INTRODUCTION

The Solar energy is the most abundant source of energy for all the forms of life on the planet earth. The technology of photovoltaic (PV) is developing continuously in many applications, so it generates electricity with no harmful effect on environment. Nowadays, energy-related aspects are becoming extremely important. They involve, for instance, a rational use of resources, the environmental impact related to the pollutants emission and the consumption of non-renewable resources. Various source of energy like coal, gas, hydro, nuclear, diesel and some of them are going to get exhausted within few years. For these reasons there is an increasing worldwide interest in sustainable energy production and energy saving. But the solar technology has not matured to the extent of the conventional sources of energy. It is facing lots of challenges such as cost, unpredictability of nature and low efficiency of the panel.

The main factor that affects a PV panel's efficiency is dust, which can reduce its efficiency by up to 50%, depending on the environment. The solar PV modules are generally employed in dusty environments which is the case in tropical countries like India.

2. LITERATURE SURVEY

Many research studied the effect of dust and other impurities on the solar panel and much experiments have been carried out to clear up this troubles. Under are a few theories and researches which can be related to this mission. The phenomenon of converting light directly into electricity was discovered by Henri Becquerel back in year 1839. Then Albert Einstein explained the principle of photovoltaic in year 1905 using quantum theory. Significant use of PV power systems has started in space application in the 1905's and its modest use in

global application began in the 1960's. However, at the start of 1970's and 80 saw a superior and substantial use of PV power system.

[1] H. Hottel and B. Woertz,, "Performance of flat-plate solar-heat collectors," Trans. ASME (Am. Soc. Mech. Eng.); (United States), vol. 64, 1942. [1]:

First studied the effects of dust on solar panel presentation with the aid of analyzing the dust collecting on such panels. A 3 month test becomes done in a business location close by a four-tune railroad 90m away from Boston, Massachusetts. They located a mean of one% loss of occurrence solar radiation changed into caused by dirt that accumulated on the surface of the sun panel with a slant attitude of 30°. The very best dilapidation defined for the duration of the check duration become 4.7%. The researchers found out a correction issue, defined as the ratio of the transference from a polluted or exposed glass plate to clean one, of zero. Ninety nine, with a 45° slant angle; this value changed into general and hooked up in the layout of flat plate collectors till 1970. Kimber et al. tested the consequences of soiling on large grid-linked PV panels in California, USA in 2011. The goal of the have a look at became to deliver a better model to correctly are expecting soiling patients all through the 12 months barely than presumptuous a continual annual fee. Every other objective changed into to illustrate the final results of soiling on PV arrangement for general area slightly than for a particular area. For that examine, to illustrate soiling losses over the dry season, a linear deterioration version changed into used. After except for websites with nonlinear conduct of soiling and large rainfall of the web sites, the information from 250 sites have been accumulated and later filtered to 46 machine records sets.

[2] Ali Omar Mohamed, Abdulazez Hasan, "Effect of Dust Accumulation on Performance of Photovoltaic Solar Modules in Sahara Environment" Journal of Basic and applied scientific Research, Volume 2, Issue11, Pages 11030-11036

Considered the southern area of Libya which usually carries the dust and sand in the period from February to May, which is also called as seasonal wind. So the small particles of the sand, trees, debris and droppings of birds are accumulated on the PV model surface, which yield a shading sunlight on the modules. Here the area of study divided as rural desert, where the amount of solar irradiance is large over the year. Thus it inspires to adopt the clean energy resource on desert region. Hence a framework of weekly cleaning on PV modules throughout the period involves the experimental set up and a simultaneous measuring is implemented in maximum operating voltage and currents on each module for both before and after washing modules. Weekly water washing is carried out through periods of February to May in order to evaluate performance of PV panels. So the maximum current and voltage is measured at the terminal using the digital multi-meter device, before and after washing in order to gain the maximum power at the operating point generated by PV module. During study water wash is done once in a week on module without any automatic cleaning technologies, manually by mixed detergents with water and use of hand cleaning materials. Furthermore to wash surface module, spray nozzle is fixed at the top. Approximately each module consumes around 5 liters of water. In fact it is necessary to maintain an optimum performance in desert region by regular cleaning of PV module. However accumulated dust causes the impact on output power and the system efficiency. Hence periodically cleaning, maintained performance losses between 2 to 2.5%.

[3] Shaharin A. Sulaiman ``Effects of Dust on the Performance of PV Panels` International Journal of Mechanical, Aerospace, Industrial, Mechatronics and Manufacturing Engineering Vol:5, 2011

Dust accumulation from the outside environment on the solar photovoltaic (PV) panels system is natural. There were studies which showed that the accumulated dust can minimize the performance of solar panels, but the results were not evidently quantified. The purpose of this research was to study the dust accumulation effects and then analyze the performance of solar PV panels. Experiments were conducted by utilizing dust particles on solar panels with a steady power light source, to conclude the resulting electrical power generated and efficiency. The effect of presence of dust was studied using artificial dust (mud and talcum) under a constant irradiance conducted in an indoor lab. Dust has consequences on the solar PV panel performance. The decline in the peak power generation can be equal to 18%. It was also given away that under larger irradiation; the effect of dust became somewhat minimized but not negligible.

[4] Satish patil, Mallaradhyha H M (2016) design and implementation of microcontroller based automatic dust cleaning system for solar panel. international journal of engineering research and advanced technology (ijerat) issn: 2454-6135 special volume. 02 issue.01, may-2016

The aim of this paper is to give an innovative concept to handle energy demand around the world is increasing rapidly for many applications. Renewable sources of energy are solar, wind and geothermal which are inexhaustible. Solar energy is abundant in nature and is proving its existence for many applications like street lighting, house hold appliances, water heating, agricultural and industrial purpose. One of the way to harness solar energy is done by using solar panels. Limitation of solar energy is its efficiency for any application due to the factors like dust, humidity, temperature etc. Electrical parameters of solar panel are sensitive to accumulated dust density and will affect the transmittance of the solar panel thereby reduce its efficiency. In order to overcome this problem, it is necessary to clean the solar panels regularly.

[5] Kutaiba-Sabah, Sabah Nimma Faraj (2013) Self-Cleaning Solar Panels to Avoid the Effects of Accumulated Dust on Solar Panels Transmittance. International Journal of Science and Research (IJSR), India Online ISSN: 2319-7064

In the experiment which is previously done, dust accumulation for the solar panels being investigated for a long period of time that is approximately for one year. The experiments have been done in different countries which have climate conditions of the dusty weather. Those countries are Iraq, Egypt and UAE. The solar panels were never cleaned, initially for one month, and then for two months and so on. The results were there was a decreasing in the transmittance of the solar panels, which is emphasize the effect of accumulated dust, even though the changing in the tilt angle which is in concurrence with the dust deposition on the panels. A well designed auto cleaning system to clean the solar panels will be added to the panels to keep the transmittance of the solar planes fixed approximately and to reduce the cost- of periodic cleaning. Actually, there are many benefits from such a project. First, economical benefit, where there is no more money will be paid to a cleaning agency. Second, it is time saving, where there is no time will be spent to clean those solar panels. Besides that, recurrently cleaning will make sure that the solar panel works with a good transmittance. Finally, safety and health of workers in sites. Since robots are capable of working in perilous environments, more dangerous operations are being handled by robots.

[6] S. B. Halbhavi, S. G. Kulkarni, Dr. D. B. Kulkarni , "Microcontroller Based Automatic Cleaning of Solar Panel" International Journal of Latest Trends in Engineering and Technology (IJLTET)ISSN: 2278-621XVol. 5 Issue 4 July 2015

This paper added an automated cleansing device, which senses the dirt on the sun panel as a way to easy the dirt frequently. If the panel isn't wiped clean then 50% of the module performance might be reduced. The 8051 microcontroller is used to control the tools motor and to implement the automated gadget. The mechanism consists of a sensor and also consists of the sliding brushes while cleansing the PV modules. The analysis of the dust can be examined below the different

conditions with the deposition of the unique pollutants like ash, sand, silica, calcium carbonate and crimson soil. Later retaining the PV model cool and clean, effects are acquired for effective device presentation. The strength generation in each instances become experimentally determined. Sooner or later by way of the use of the above said computerized cleaning scheme the power output can be expanded approximately 30%, as compared to other cleansing technologies. Also recurrent periodic cleansing guarantees that the panel works with true conduction step by step.

3. CONCLUSION

Economical benefit, where there is no more money will be paid to a cleaning agency. It is time saving, where there is no time will be spent to clean those solar panels. Besides that, frequently cleaning will ensure that the solar panel works with a good transmittance. Since robots are capable of working in hazardous environments, more dangerous operations are being handled by robots. Thus the safety and health of workers is ensured, thereby reducing expenditures on health and medicines.

The performance analysis of the experimental setup is purely based on the amount of power generated on the dusty panel and a cleaned panel. The output power may reduce considerably by the large amount of dust accumulation on the panel. Dry cleaning can eliminate the dust particles on the surface. The assembly is found to be lightweight. In comparison of costs in manual operation cleaning and automatic cleaning, the cost for automatic cleaning is demonstrated to be more economic and significantly less burden particularly in the system having large number of solar panels. The power output is varying for the different weather conditions. A regular periodic cleaning ensures the variation of power measured in both before and after cleaning conditions by showing the significant performance of the cleaning technology.

REFERENCE

- [1] Shishir Kumar Das, Ankit Srivasan, And Lucky ShrivastavSsipmt, Raipur, Chhattisgarh, India. - Hardware Design, Design Concept.
- [2] Athira Sivan , Lakshmi Priya G S and Sera Mathew, “International Research Journal of Engineering and Technology (IRJET)” Volume: 04 Issue: 05 | May -2017
- [3] Dabhi Chirag , Gandhi Mayank , JadejaMandipsinh , PrajapatiParimal, Design“International Journal of Advance Engineering and Research DevelopmentScientific Journal of Impact Factor (SJIF)”: 4.72 Special Issue SIEICON-2017,April -2017 By-
- [4] Mohammadreza Maghami1, HashimHizam, Chandima Gomes, “Impact of dust on Solar Energy Generation based on Actual Performance” International Conference on POWER AND ENERGY.978-1-4799-7297-5/14/\$31.00 ©2014 IEEE.