



# **iJRASET**

International Journal For Research in  
Applied Science and Engineering Technology



---

# **INTERNATIONAL JOURNAL FOR RESEARCH**

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

---

**Volume: 7      Issue: XI      Month of publication: November 2019**

**DOI: <http://doi.org/10.22214/ijraset.2019.11057>**

**[www.ijraset.com](http://www.ijraset.com)**

**Call:  08813907089**

**E-mail ID: [ijraset@gmail.com](mailto:ijraset@gmail.com)**

# A Review on Solar Panel Cleaning Techniques and Systems

Ms. Megha S. Rane<sup>1</sup>, Prof. Kiran A. Dongare<sup>2</sup>, Prof. M.O. Sharma<sup>3</sup>, Pravin S. Rane<sup>4</sup>

<sup>1,3</sup>Pankaj Laddhad Institute of Technology & Management Studies, Buldana

<sup>2</sup>Ram Meghe College of Engineering & Management, Bandera, Amravati

<sup>4</sup>G.H. Raison College of Engineering Nagpur

**Abstract:** Solar energy usage has been increasing rapidly owing to the awareness among people regarding the limited availability of non-renewable energy resources like coal, wood, petrol etc. The technological advancements have facilitated the use of solar panels in domestic as well as industrial places. Rural areas which are yet to have proper electricity connections have now started to opt for solar panel installations and use of solar panels on streetlights as well. Thus it becomes crucial to study the causes of reduction in efficiency of solar panels. The main factor was the inability of system to adapt with sun movements and for which solar tracking systems were installed with solar panels. Another problem that has raised slight concerns is the accumulation of dusts on solar panels. It has been observed that the efficiency of system reduces by around 23-28% approximately due to accumulation of dust and dirt on these solar panels. This paper presents a study on techniques employed to clean these solar panels and increase the efficiency of the system.

## I. INTRODUCTION

Solar energy is absorbed by the solar panels to generate electricity through it. The solar panels come in different watt ratings. Dust accumulation takes place due to many environmental factors but the main focus of this paper is to emphasize on the cleaning techniques that are in use at present or have been developed for this purpose. The impact of dust accumulation has been stated that it reduces the efficiency by 23-28% [1]. The dust accumulation becomes a barrier for energy absorption. Although earlier its impact on efficiency was not considered but studies have shown that over the time if left neglected it shall further decrease the efficiency. The cleaning of solar panels is not an easy task because generally they are mounted on terrace and heightened areas. Many techniques have been adopted to clean the solar panels and they can be broadly classified into three categories

- A. Manual Cleaning Techniques
- B. Semi-Automatic cleaning techniques
- C. Automatic Cleaning Techniques

The above stated techniques have their own listed advantages and disadvantages. This paper is divided into two sections where section I emphasizes the technologies and section II focuses on the relevant works done in the mentioned category.

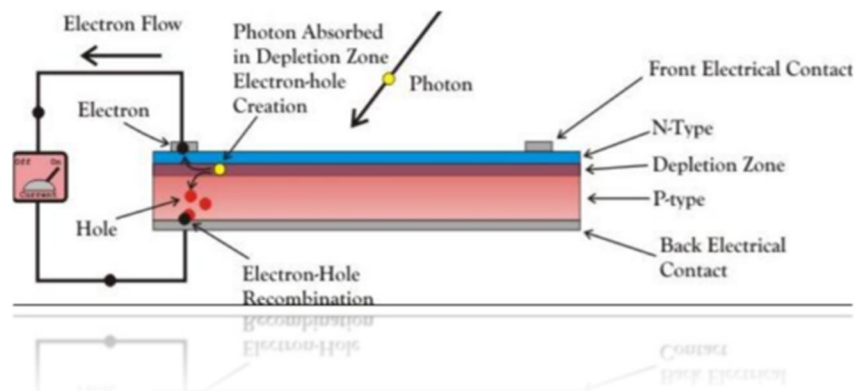


Fig 1. Basic Working of Photo-voltaic cell

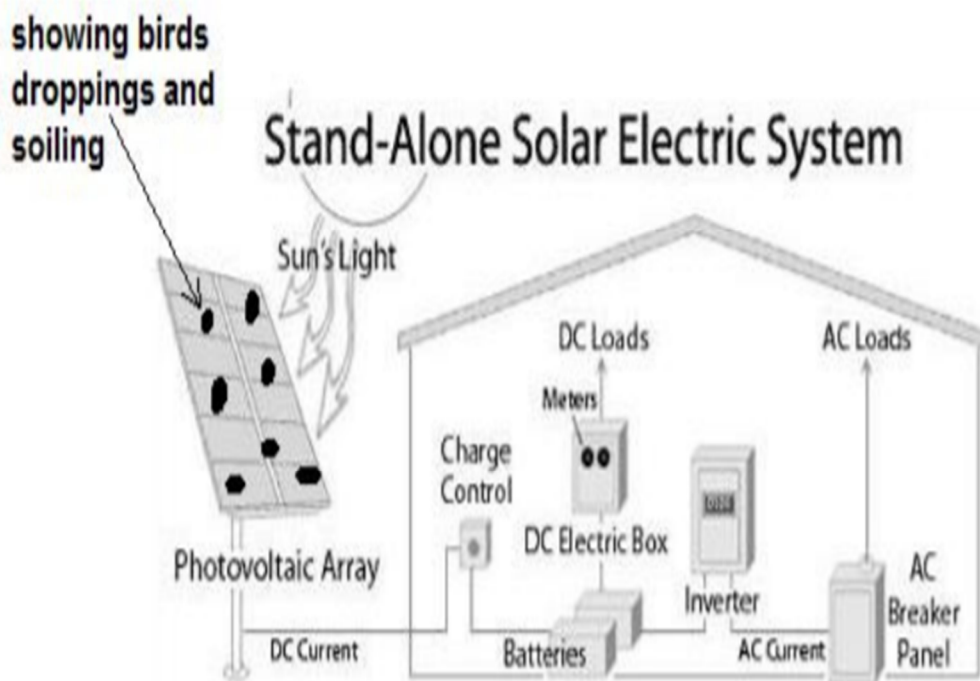


Fig 2. Solar panel with dust accumulation

## II. CLEANING TECHNIQUES

### A. Manual Cleaning Techniques For Solar Panel

Laborers are employed by contractors to periodically clean the solar panels. The solar panels are installed at heightened locations like terraces, rooftops etc which are not easily accessible and pose a major threat to laborers in form of injuries. Another major problem associated with manual cleaning systems is that they cannot be periodically maintained owing to factors like high labor costs, maintenance by the customers is not feasible as the soiling does not show immediate efficiency reduction rather is a long term effect. The general dust accumulation does not only include basic dust particle but also considers bird droppings, leaves, or any other particle matter which may affect the energy absorption.

The major disadvantages of this technique are high labor costs, low periodical maintenance and danger of injuries to workers involved in the cleaning task. Due to these disadvantages there rose a need to design systems that are automated or have some part of automation to reduce potential risk of injuries.[2]

### B. Semi-Automatic Solar Panel Cleaning Techniques

These systems perform the cleaning tasks in an automated manner but need partial human monitoring and intervention. The basic example can be of remote controlled robots, cleaning machines that cannot work without the presence of humans. These systems reduce the number of laborers required for completing the task but involve at least a single worker to be present at the cleaning site. This system is useful in cases where the solar panels are placed at accessible locations and in areas where dust accumulation is not in greater amounts. The next systems which were evolved are fully automated systems which do not require any human intervention for its working.

### C. Automatic Cleaning Techniques for solar panel Cleaning

These systems are rapidly evolving as they do not need any human intervention and are low maintenance systems. They are either programmed to perform the task periodically or can detect the dust and start the process of cleaning. These systems shall be more useful in working as they do not require any labor or worker to monitor its working and is just a onetime investment along with solar panel installation.



### III. IMPLEMENTED TECHNIQUES

- 1) *Arduino Uno Based Solar Panel Cleaners:* These systems are programmed to function periodically i.e., clean the systems at daytime to ensure full efficiency of the system. Kelabone [4] in his paper designed a solar panel cleaner using simulation on Proteusb8 professional.

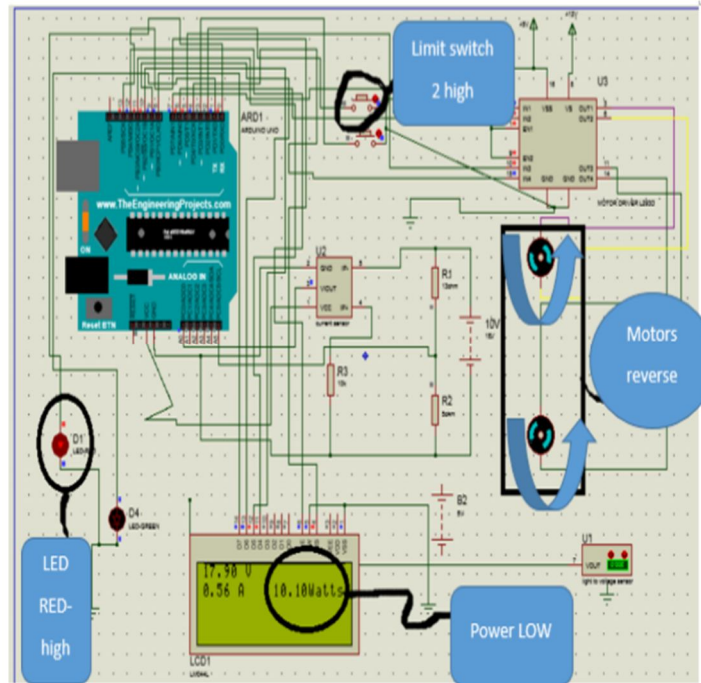


Fig3. Solar Panel Cleaner simulation

- 2) *Automated Solar Panel Cleaning System:* Shajan K. Thomas et.al [5], designed a solar panel cleaning system having a nylon brush and two wipers on a rectangular frame which can be mounted above the solar panel system and it can help to clean the system periodically.



Fig4. SPAC system

- 3) *Automated Microcontroller PIC based Cleaning System:* It uses microcontroller based system to design a low power cleaning system. Distilled water is used to clean the solar panels to avoid the deposition of salts caused by hard water[6].

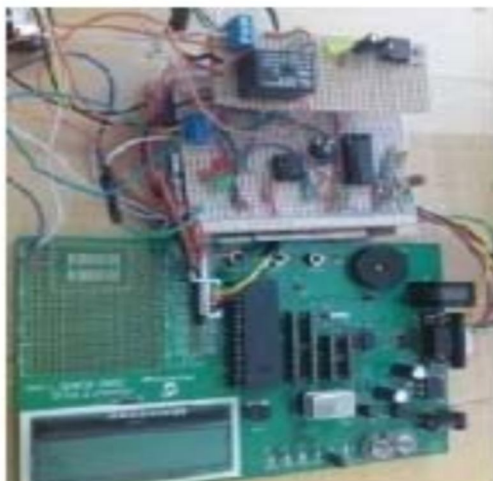


Fig5-a Solar panel cleaning system



Fig5-b Solar panels with wiper connected

#### IV. CLEANING HEADS USED

The mechanism used to clean the solar panel is very important as it comes in contact with the photovoltaic cells and it may cause damage to the photovoltaic cells. Scratches or water getting into the encapsulation assembly is the major loss in the cleaning systems.

- 1) *Wipers:* These are most widely used to clean the systems but have a major disadvantage that they cannot clean the systems properly with dried fixed dirt.



- 2) *Roller Brushes*: The roller brushes are majorly used where the dirt accumulation is greater as it is softer than the wiper and does not cause friction.



- 3) *Water Sprinklers*: The water gets sprinkled periodically on the solar panel. This comes with a major disadvantage that the system can get water leaked inside the encapsulated assembly leading to damage of solar cells.[7]



## V. DISCUSSIONS

The solar panel cleaning systems used majorly are evaluated and analyzed to understand the advantages and disadvantages of the currently used techniques.

The major role play of designing an efficient system is to take into consideration technical specifications like use of cleaning heads, choice of controller to take action, use of cleaning methods. The choice of cleaning methods are broadly classified as dry cleaning method and wet cleaning method.

### A. Cleaning Methods

- 1) *Dry Clean Method*: In this method no liquid is used to clean the solar panel rather only a Brush is used with motors to clean the solar panels. This technique is favorable in areas where less dust accumulation takes place but is rarely used because it cannot clean the system properly until it utilizes cleaning heads with microfibers which cannot clean dried dirt particles.
- 2) *Wet Cleaning Methods*: It makes use of water or liquid to clean the solar panels. The solar panels need to be cleaned but also be protected from liquids getting leaked into the assembly. Another main element is the correct choice of water as hard water tends to settle salts on the solar panel. The solar panels are therefore preferred to be cleaned with distilled water.

## VI. CONCLUSION

Different solar panel cleaning techniques and systems have been discussed in this paper. The major disadvantages of semi-automatic systems were the use of human intervention and the labor cost associated with it. Whereas the fully automated systems have to be permanently mounted on the solar panels, this can periodically clean the solar panels.

The future technology which can be used in this system are IOT based or GSM based cleaning system which can also provide the current performance of solar panels and efficiency on mobile phones and can be controlled as well. The robots which are developed to clean the systems have high initial investment and is better for industrial areas or solar panels installed at large areas whereas for small areas the basic static cleaning systems which can be fabricated according to the size are used.

## REFERENCES

- [1] Dayal Singh Rajput et.al , “Effect Of Dust On The Performance Of Solar PV Panel”,International Journal of ChemTech Research CODEN( USA): IJCRGG ISSN : 0974-4290Vol.5, No.2, pp 1083-1086, April-June 2013
- [2] S. Mekhilef et.al, “Effect of dust, humidity and air velocity on efficiency of photovoltaic cells”,Elsevier,Renewable &Sustainable Energy Reviews 16 (2012) 2920– 2925.
- [3] M.Catelani, et.al, “Characterization of Photovoltaic panels: the effect of dust” c 2012 IEEE.
- [4] Kelebaoneet.al, “Automated dust detection and cleaning system of PV module, IOSR , Nov-Dec Issue 6
- [5] Shajan K Thomas et.al, “Solar panel automated cleaning system”, IEEE 2018
- [6] Al-Dhaheri S, Lamont L, El Chaar L, Al-Ameri O.” Automated design for boosting photovoltaic (PV) performance offshore”. In: Proceedings of 2010 transmission and distribution conference and exposition; 2010; Abu Dhabi
- [7] Shahzada Pamir Aly, PalanichamyGandhidasan “Novel Dry Cleaning Machine for Photovoltaic and Solar Panels” Qatar Environment and Energy Research Institute (QEERI), Hamad Bin Khalifa University (HBKU), Qatar Foundation PO Box 5825, Doha, Qatar. 2015 IEEE.





10.22214/IJRASET



45.98



IMPACT FACTOR:  
7.129



IMPACT FACTOR:  
7.429



# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089  (24\*7 Support on Whatsapp)