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Solar Photovolatic Panel Cleaning System

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Abstract: *The technical seminar is about the design and development of a solar panel cleaning system. The main object of this design prototype is to clean the solar panel using an electrical mechanism, such that efficiency or quality of solar panel is not compromised. As a matter of fact, gulf region - especially Saudi Arabia- are facing a lot of dust storms and the solar panels need to be cleaned frequently. If task is performed manually, it will be very costly and time consuming. Water sprinklers and a special wiping material shall be used in the conceived mechanism design to insure quality of cleaning.*
Electrostatic cleaning equipment has been developed to remove dust from the surface of soiled solar panels. When a high AC voltage is applied to the parallel screen electrodes placed on a solar panel, the resultant electrostatic force acts on the particles near the electrodes. The reciprocatory motion of the particles between the electrodes arises due to the alternating electrostatic force, where some particles pass through the openings of the upper screen electrode and fall downward along the inclined panel owing to the gravitational force. We demonstrated how dust is removed efficiently from the panel surface.

Keywords: Electrode; solar panel; Electrostaticforce ; power.

I. INTRODUCTION

Accumulation of dust from the outdoor environment on the panels of photovoltaic system is natural.It was found from the study thatthe accumulated dust on the surface of photovoltaic solar panel can reduce the surface of photovoltaic solar panel.The accumulation of dust can reduce the performance of solar panel. Itreduce the system efficiency upto 50%.
So it is important to remove dust from the solar cells .with the help of robot and increase the efficiency of solar cells. There is more than enough solar radiation available around the world to satisfy the demand for solar power systems. The proportion of the sun's rays that reach the earth's surface is enough to provide for global energy consumption 10,000 times over. On average, each square meter of land is exposed to enough sunlight to produce 1,700 kWh of power every year. Solar Panel has a huge effect on our world.
It can helps our environment to be better without using other power generation plants that can harm the environment, but solar power plant needs to be cleaned at least every 3 days. It generally depends on the country for example in the Middle East, it needs to be cleaned every dayso it will cost so much. There are a lot of techniques for cleaning the solar panels; our idea is to design a smart solar panel that cleans itself automatically and remotely

II. METHODOLOGY

Electrostatic solar panel cleaning has been proposed as an exciting alternative that can potentially eliminate the consumption of water and contact scrubbing damage due to the absenceof mechanical components that rub against the panel. Electrodynamic screens (EDS) are the most popular electrostatic dust removal systems.
Some approaches for implementing EDS involvefabricating arrays of interdigitated transparent indium tin oxide (ITO) microelectrodes that are embedded in a dielectric film or installing insulated copper mesh electrodes on top of solar panel surfaces . Upon activating the electrodes, the electric field propels the dust particles via weak, short-range dielectrophoresis and/or weak,passive triboelectric charging

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III. LITERATURE SURVEY

Kawamoto Hiroyuki, Guo Bing,Improvement of an electrostatic cleaning system for removal of dust from solar panels, Journal of Electrostatics.

In their September 2018 article An improved cleaning system has been developed that uses electrostatic forces to remove dust from the surface of solar panels. A two-phase high voltage is applied to the parallel wire electrodes embedded in the glass plate of a solar panel. It was previously demonstrated that the adhering dust can be repelled from the surface of a slightly inclined panel by applying a low-frequency high-voltage.However, the performance is low for extremely small dust particles. The proposed system improves the performance by the application of a high voltage, reduction of adhesion force, utilization of natural wind, and frequent operation before the deposition of dust. In addition to the cleaning performance, the frequency response and actual power consumption of the high voltage source was investigated to provide data for the design and efficiency evaluation of the system. It was demonstrated that the energy consumption is extremely small with a simple and potentially low-cost high voltage source. This technology is expected to increase the efficiency of the mega solar power plants constructed in deserts at low latitudes.

Monto, Pillai Rohit, Impact of dust on solarphotovoltaic (PV) performance

In their 2017 article the peaking of most oil reserves and impending climate change arecritically driving the adoption of solar photovoltaic's (PV) as a sustainable renewable and eco-friendly alternative. Ongoing material research has yet to find a breakthrough in significantly raising the conversion efficiency of commercial PV modules. The installation of PV systems for optimum yield is primarily dictated by its geographic location (latitude and available solar insolation) and installation design (tilt, orientation and altitude) to maximize solar exposure. However, once these parameters have been addressed appropriately, there are other depending factors that arise in determining the system performance (efficiency and output). Dust is the lesser acknowledged factor that significantly influences the performance of the PV installations.

Arabatzis Ioannis, Todorova Nadia, Photocatalytic, self-cleaning, Solar Energy

In the 2018 article A 1-GHz multifrequency, multiwavelength frequency-domain photon migration instrument is used to measure quantitatively the optical absorption (μa) and effective optical scattering (μ′) of normal and malignant tissues in a human subject. Large ellipsoidal (~ 10-cm major axis, ~ 6-cm minor axes) subcutaneous malignant lesions were compared with adjacent normal sites in the abdomen and back. Absorption coefficients recorded at 674, 811, 849, and 956 nm were used to calculate tissue hemoglobin concentration (oxyhemoglobin, deoxyhemoglobin, and total), water concentration, hemoglobin oxygen saturation, and blood volume fraction in vivo. Our results show that the normal and the malignant tissues measured in the patient have clearly resolvable optical and physiological property differences that may be broadly usefulin identifying and characterizing tumors.

IV. WORKING PRINCIPLE

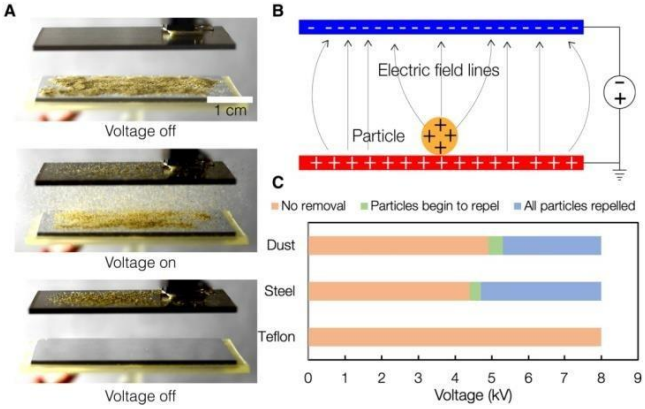

Fig 1: Repulsion of dust by electrostatic charge induction[4].

Dust particles spread on the bottom metallic electrode are observed to repel on application of voltage (~12 kV) between the plates separated by ~1.5 cm. Particles have an average density of 2.6 g/cm^3 and consists of upto 77% silica. (B)

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The electrostatic repulsion results from charging by induction, where charge of same polarity as that of the contacting electrode accumulates on the dust particle. (C) The behavior of dust particles is similar to that of conductive iron particles where particle liftoff happens when the applied voltage reaches a threshold value that enables particles to overcome the force that adhere them on to the surface.

Electrostatic repulsion cause dust particles to detach and virtually leap off the panel surface, without the need for water or brushes. An electrostatic charge is applied on panel surface and the dust particles will slide down.

V. RESULTS AND DISCUSSION

Dust accumulation on PV panels can significantly reduce their power output. While the Geographic region is solar-energy rich, the desert conditions are quite dusty threatening the PV systems power generation potential. The robotic system proposed by me with the help of company is a simple way to tackle this challenge effectively. Although promising results will be obtained. Here we are going to set a new benchmark by using latest technology and replacing the conventional methods of cleaning the solar panels. We are saving water, time and money. In general the technique used by other method explain above total cost of solar panel maintenance goes around 5% of total plant cost annually but cleaning done by robot reduced it by 2%.

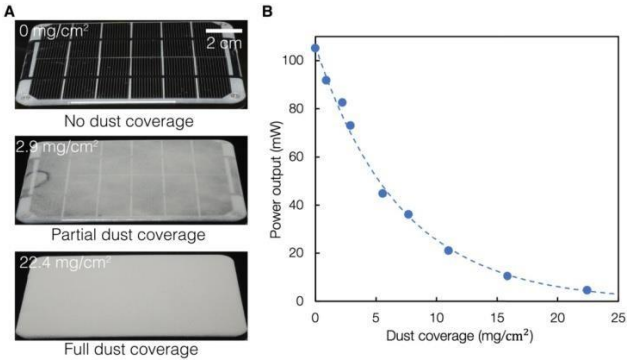

Fig 2: Effect of dust accumulation on solarpanel power output [3].

VI. CONCLUSION

The system uses electrostatic repulsion to remove dust particles from the surface of the solar cells. The researchers had found that although dust itself is not electrically conductive, the particles can be charged by an electrode that runs directly over the surface of the solar panel. A transparent film (similar to that used on smartphones and laptops) is then given an opposite charge and applied to the panel. With the result that the glass surface of the panel repels the annoying dust particles. The system, which works with a small amount of solar energy, could be used in conjunction with a separate cleaning robot or retrofitted to the panels,

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