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# Employing I.o.T, preserving the effectiveness of a solar panel

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**Abstract:** Due to low efficiency and reliability, solar power plants are now employed as secondary sources. However, because of recent advances in solar panel design technology, the effectiveness of solar panels can reach 50%. This implies that solar power plants will eventually be able to replace other sources of energy as the main source of energy throughout the summer. Solar energy is completely environmentally friendly and provides a pollution-free ecosystem, hence it is also chosen to put on home roofs. The efficiency of solar panels must therefore be preserved. With the help of the Internet of Things (I.O.T), this method is designed to maintain the efficiency of solar panels. Dust accumulation, shadowing, and damaged PV all reduce solar photovoltaic panel efficiency. The reliability of power generated and solar panels' longevity can be significantly increased by cleaning the panels. Real-time monitoring, data collecting, and comparison are explored in this work as ways to identify broken PV panels and solve the shadowing issue utilizing a software-controlled solar tracking system.

Keywords---Solartracking,I.o.T, Realtimemonitoring, Software, Photovoltaic panel.

## Introduction

Photo voltaic module is one which generates electricity from solar radiation. Photo voltaic module consist of semiconductors, with the help of which, solar radiations are converted into direct current. Series of PV modules are connected to form a solar panel. According to our world in data case study report for2021,
12.7% of total energy consumed in world is from renewable energy sources inwhich solar energy ranks third behind hydro and wind energy[1]. But the recentadvancements in the development of solar panel technologies will change thetrend in solar energy production. There is gradual increase in the powerdependent on solar over the years; hence it is necessary to look into the

efficiencyof solar power generation. The main external factors that affect the efficiency ofsolar panel are temperature of solar panels, shading on solar panels, dust andparticles sedimentation on solar panels [2]. The proposed system will eradicatethose above factors and provide the real time remote monitoring and control overthe solar panel setup through the use of internet. Using IoT we can monitor andcontrol the system in real time, this data can be recorded to analyze the patternand to predict the action of the controller [3]. Mega solar power plants are alreadyinstalled in various countries like Australia, the Middle East, USA, Europe, andChina. The on-site issues which usually overlooked are bird droppings, deposition of dusts and water stains, which would reduce the solar panel efficiency significantly. Also there is 10-25% of efficiency reduction due to losses in wiring,module soiling and inverter. It has been analyzed that the dust accumulation is mainly depending on the slope, orientation, type of coating, surface roughness etc. Factors influencing dust settlement. It is reported that energy loses are hugein fixed horizontal panels, which is around 8-22%, than compared to tilted panels(45°),herethelossesaround1-8% only. Also, other external parameters like humidity, temperature, wind speed and regional characteristics like traffic, airpollution and plants play crucial role in dust deposition. Further the biological,electrostatic and chemical properties of dust, also shape, size and weight of thedust particles influence the accumulation of dust on the surface of panels [4].Theperformance was much affected due to local problem of bird droppings, which would result in dropping in efficiency.

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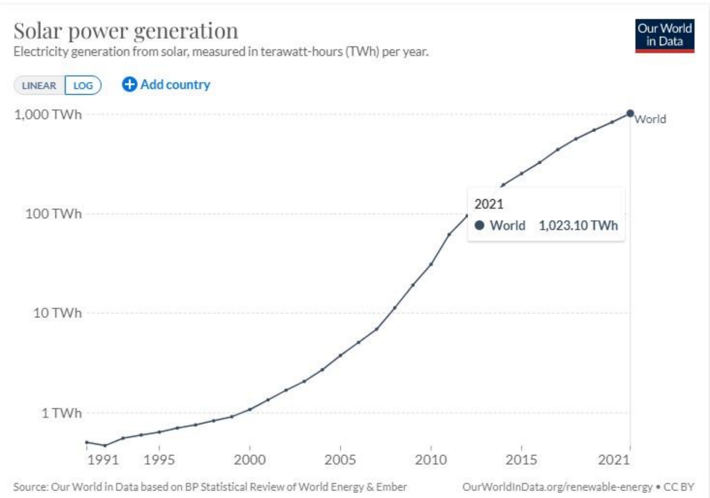
Fig.1.Total solar power generated and consumed by all countries from1991–2021



## Related works

This section discusses a literature review of studies on tracking solar panel efficiency, IoT-enabled real-time system monitoring, solar tracking systems, and solar panel cleaning. The impacts of dust on solar panels and how it affects their efficiency are covered by the authors of*Authors:*J. B. Jawale, V. K. Karra, B. P. Patil, Department of Electronics andTelecommunication Engineering, Army Institute of Technology, Dighi Hills,Pune,India[1].

The use of renewable energy sources, such as solar power, is expanding due to rising electricity prices and concerns about the environmental effects of fossil fuels. With arrays made up of solar panels, solar energy is primarily harnessed. The requirement to keep the panels' surface as clean as possible is highlighted by the fact that even one panel in an array can become significantly less efficient at generating energy. The current labor-based cleaning techniques for solar arrays are inefficient in terms of automation and waste time, water, and energy. A revolutionary design for the is given in this study for the first-ever human-portable robotic cleaning device for solar panels, which can clean and move over a solar panel array's glass surface at the range from horizontal to vertical angles. This is accomplished with the aid of the Arduino Uno R3 microcontroller board, which can easily regulate all the gadgets utilized in this specific model and, as a result, aids in our comprehension of the necessary parameters pertaining to the change in efficiency brought on by the cleaning of the solar panel arrays.

*Authors:* HiroyukiKawamoto,TakuyaShibata,Dept.ofAppl.Mech.&Aerosp.Eng,Waseda Univ.,Tokyo,Japan[2].

To remove sand from solar panels, a novel cleaning system that uses electrostatic force has been created. Parallel wire electrodes installed in a solar panel's cover glass plate are given a single-phase voltage. The output power produced by the solar panel could be recovered up to 80% following the cleaning procedure, and it was shown that more than 80% of the adhering sand was repelled off the surface of the slightly inclined panel. This system practically uses no power at all. This technology is anticipated to boost the effectiveness of large-scale solar energy facilities built in desert regions at low latitudes.

## ProposedSystem

The proposed approach is made up of three separate subsystems that work in concert to produce the desired outcomes. The cleaning mechanism, which is the first subsystem, consists of a frame that encloses the solar panel area. Microfiber brushes with nozzles that can spray water through them are placed on a rotating bar that sweeps over the panel. The biaxial solar tracker mechanism is the second sub-system. The panels are positioned within a bar frame. The third sub-system is the Internet of Things configuration, which enables real-time monitoring and control of the solar panel. A temperature sensor is positioned to measure the solar panel's current temperature. When the temperature exceeds 470 C, cooling of the panels is necessary.

As a result, water cooling is possible utilizing the nozzles that are mounted on the spinning bar. This can be repeated twice, and if the temperature is still excessive, we can tilt the panels using the tracking mechanism to artificially shade the solar panels, which will lower the temperature and keep it within acceptable ranges. The use of a biaxial tracker allows us to regulate the solar panel's movement in all four directions.

Software is used to track things. Using the internet and IoT, the tracker is updated with the necessary value to rotate the solar panel in order to achieve a high efficiency. Real-time remote monitoring and managing can be accomplished via IoT. By sensing the voltage, the output voltage of each panel is updated for IoT.If the specific voltage of the panels drops, this can be utilized to identify the defective panels.

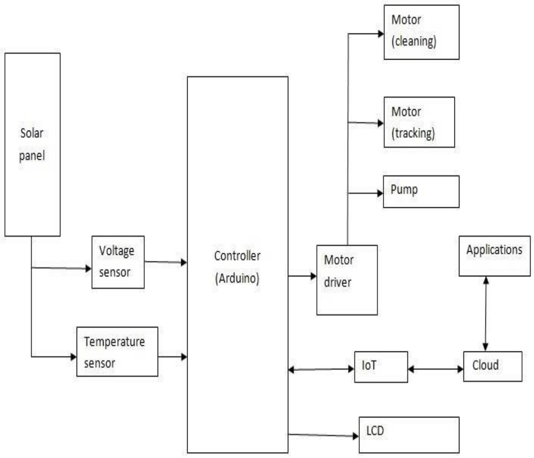
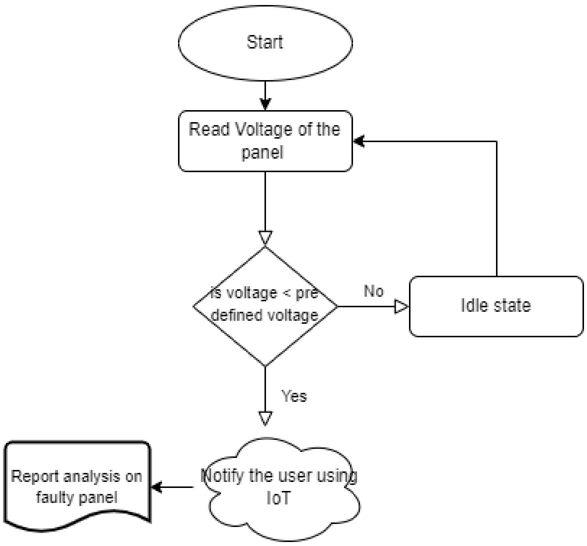


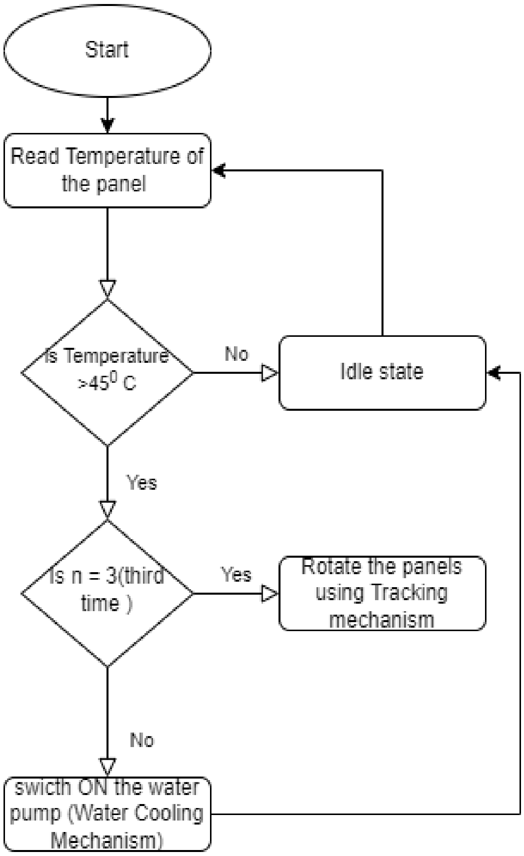

Fig.2.Block Diagram of the proposed system

**Workflow**

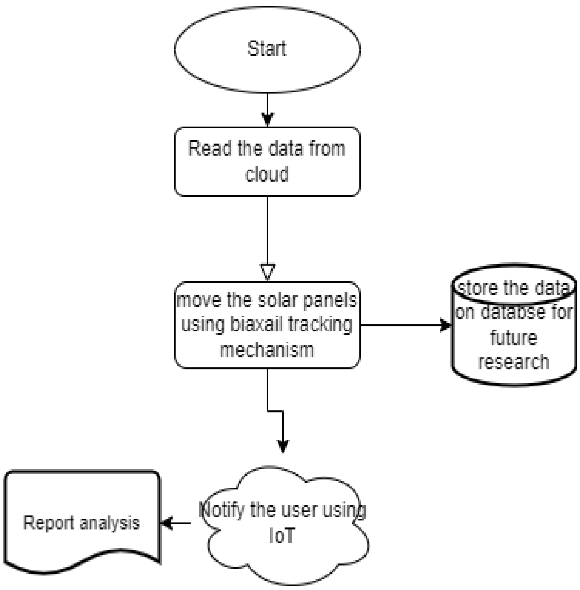
The four subsystems' work processes—cooling system, cleaning system, tracking system, and defect detection system—are as follows. Although all four of these subsystems operate simultaneously, each subsystem's workflow is described separately for clarity.




(a) –Fault detection system

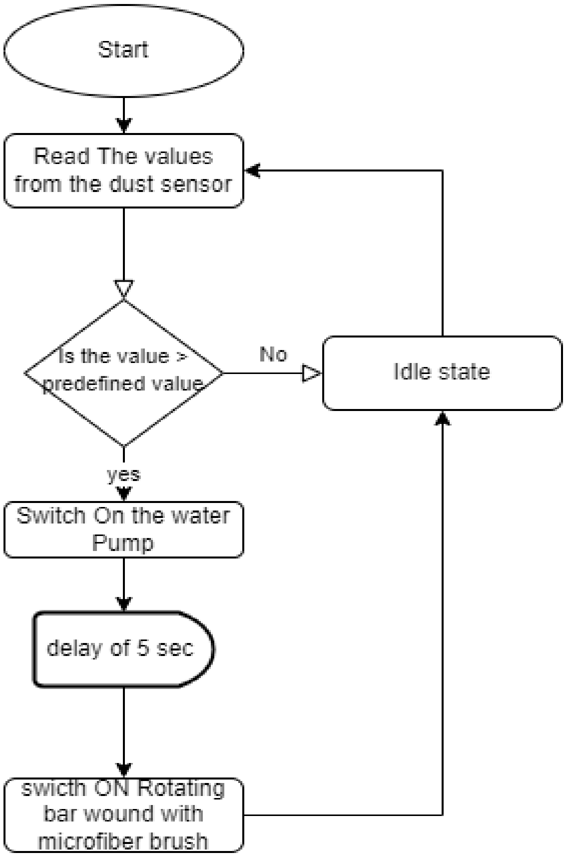



(b) –Water Cooling system




(c) –Software Solar Tracking System

Fig3. Workflow diagram of all four subsystems.




(d) –panel cleaning system

**Simulation**

These simulation results were obtained by simulating the proposed project using Proteus simulation software.

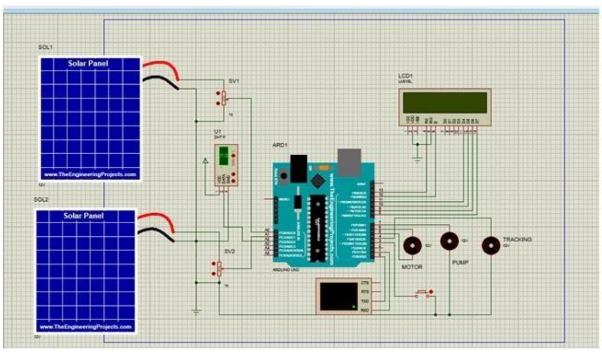


Fig.4.Simulation-idlestate

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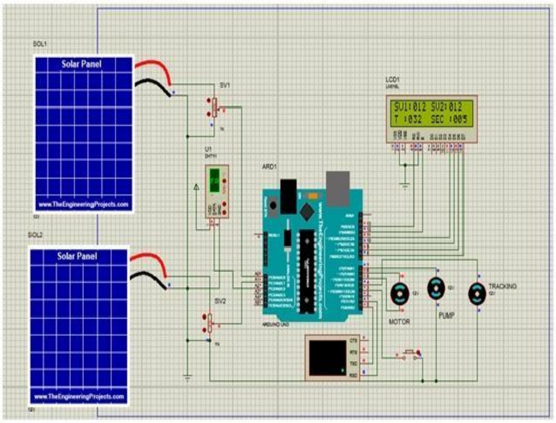


Fig5.Simulation-runningstate

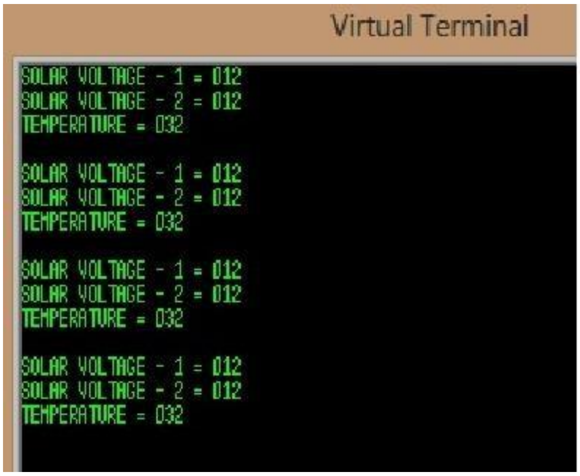


Fig6.Report on Voltage readings(Fault detection subsystem)

## Conclusion

In solar power facilities with a high number of panels available, we may quickly identify the defective panels by applying the proposed method. We can preserve the effectiveness of solar power generation and produce dependable power generation using soar power panels by cleaning the panels on a regular basis. Because it is a component of panel maintenance, cleaning the panels also extends their lifespan. Biaxial trackers are used to track the sun, giving them control over rotation in all four directions. Because they are software-controlled, they are very dependable. The water cooling technique used to lower panel temperatures also helps to remove soft dust particles from the panels' surface. The amount of water and energy wasted during the cleaning process is decreased because it is only done when it is necessary.

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