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Effects of matter deposition on the Power output of Mono- and Poly-crystalline solar panels and assembling of automated GSM-based cleaning system

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Effects of matter deposition on the Power output of Mono- and Poly-crystalline solar panels and assembling of automated GSM-based cleaning system
The overreliance on unsustainable fossil fuels has shifted attention to the adoption of renewable sources such as solar energy, which also faces power efficiency problems due to low solar energy capture. Accumulation of particulate matter, particularly dust, significantly affects the performance of photovoltaic (PV) solar panels by obstructing light transmittance, thereby reducing output power and degrading system efficiency. This study investigates the effects of dust accumulation of varying particle sizes on the power output of monocrystalline and polycrystalline solar panels installed in Eldoret, Kenya. Dust samples collected from a nearby tarmac road were classified into particle size ranges of 0.748 mm to 3.447 mm and applied in controlled amounts to the panel surfaces. The results indicated that dust particle sizes below 1.97 mm on polycrystalline panels retained more efficiency, while monocrystalline panels performed better for dust particles above 1.97 mm. An average 91% power reduction on polycrystalline panels and 96% on monocrystalline panels was observed for a 60 g dust spread of the mixture of unsorted dust particles on the panels. To mitigate power losses due to dust accumulation, an innovative telecommunications-based cleaning system was developed, leveraging GSM feature phone technology to automate panel cleaning. This system achieved a 64% power restoration by removing accumulated dust without requiring internet connectivity, making it an ideal solution for remote or off-grid regions. This study provides crucial insights into panel selection for dusty environments and introduces a cost-effective, accessible maintenance solution for PV systems.
Keywords: Photovoltaic, Dust particles, efficiency, GSM-based cleaning system.

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