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REAL-TIME CURRENT-VOLTAGE CURVE-BASED ON-FIELD VALIDATION OF PHOTOVOLTAIC PERFORMANCE FOR AN ELEPHANT DETERRENT SYSTEM

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Abstract:
On-field monitoring systems for assessing the performance of solar photovoltaic systems in remote or off-grid settings remain limited under tropical outdoor conditions. This work developed and validated a low-cost Arduino-based current-voltage curve tracer to monitor the performance of monocrystalline and polycrystalline solar panels for a dependable unit power supply. The tracer system used an Arduino UNO, an INA219 current sensor, an F301-06 voltage sensor, and a 470 µF capacitive load to capture real-time current, voltage, and power data through Microsoft Excel Data Streamer. The system was validated against a digital multimeter (Fluke 175) and tested in the field for 10 days under irradiance levels of 789-1270 W/m² and ambient temperatures up to 33 °C. Validation showed a mean voltage error of approximately ±0.72% and a mean current error of 8.18%. As a comparison, the monocrystalline panel produced higher output on 8 of 10 days and reached a maximum power output of 10.8 W, while the polycrystalline panel performed better on two lower-irradiance days. The measured

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photovoltaic output was sufficient to meet the estimated average load of the low-power deterrent unit including sensors, controllers and sound-emitting devices, which indicates that the proposed monitoring approach is practical for solar-powered wildlife deterrent applications in off-grid locations.

Keywords:
current-voltage (I-V) curve, Arduino-based tracer, monocrystalline, polycrystalline, capacitive load, Data Streamer, deterrent system

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