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Automated photovoltaic module imaging for high throughput data capture and analysis

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Photovoltaic (PV) module imaging has become a critical tool for assessing the performance, reliability, and degradation of PV modules. Automated imaging systems that use advanced hardware and image processing software tools allow for efficient high-throughput data capture across large-scale solar installations. These systems use different imaging techniques such as visible light (RGB) imaging, ultraviolet fluorescence (UV-F) imaging, electroluminescence (EL) imaging, and line sensor scanning. These imaging techniques allow for the detection of faults or anomalies in PV modules. We report on a project focussing on the development of a system for high throughput visual and UV-F imaging of PV modules deployed in utility-scale PV plants. The work follows a two-step approach whereby two systems will be built. The first-step consists of a laboratory-based imaging system to test proof of concept. The system will utilise an Arduino MEGA 328P microcontroller for position control and a Raspberry Pi 5 8 GB as the microprocessor for sensor control, image capturing and storage. The images will later be processed through stitching and basic visual classification.The second-step will use techniques determined to be effective from the initial system to build an onsite imaging and sensing system that allows for rapid large-scale image capture for further image processing and classification. This allows for more data and images to be captured, and thus processed as opposed to manual methods. At the same time, has a much greater resolution as opposed to drone imaging.

This paper will present the design, manufacture, optimisation and preliminary results from the laboratory-based system.

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