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An IoT Photovoltaic Sensing System

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This paper follows the development of an IoT photovoltaic (PV) sensing system built around a pyranometer from Kipp and Zonen. Two Raspberry Pi act as IoT nodes connected to this system with the purpose of collecting time series values, of Global Horizontal Irradiance (GHI) from the pyranometer, and of current from a reference cell. The latter will be then calibrated with the pyranometer based on numerical methods. These time series values are sent to the Influx database cluster for storage. To ensure continuous operations for an extended period and to eliminate single points of failure, a High Availability (HA) architecture was employed. Web based Grafana acts as the monitoring solution for the collected values, stored inside the InfluxDB cluster. After obtaining a somewhat considerable dataset of irradiance-current values from the two nodes, numerical methods are then used to calibrate the reference cell. Linear regression, polynomial regression and interpolation are the methods tested. Based on observations, the numerous iterations of the models and the model performance indicators, interpolation proved to be a sound fit for calibration. The reference cell, after having learnt the values from the pyranometer will be able to swiftly and reliably determine the GHI from the current variation of its solar cell thus acting as a standalone irradiance sensing instrument. An array of such reference cells can then be calibrated to expand the IoT solar sensing network.

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