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IoT-Based SCADA for remote monitoring and controlling PV Water Pumping Systems

Over the past decade, photovoltaic water pumping system (PVWPS) concept failed to perform optimally due to its complexity of multiple systems that run together. Lack of access to real-time data caused poor system's performance and ultimately ceased to supply the solar energy to pump the water. Therefore, a system to integrate and manage the multi-systems nexus of PV solar power output, water pumping, automated irrigation, and water leakage signature is necessary. The aim of the current study is to present the implementation of Supervisory Control and Data Acquisition (SCADA) system for real-time remote monitoring and control of the PVWPS to control the remote terminal units (RTUs) and programmable logic controllers (PLCs) microcomputers that are deployed across the sites. The proposed SCADA system communicates with site equipment such as sensors and actuators for pumps and valves, solar panels and inverters, motors and variable speed drives, sensors and HMI. It involved the reflection of data on a Human Machine Interface (HMI) from different sensors, which are deployed on different locations and data was stored in a cloud system upon which it was able to be visualized and interpreted. The architecture of IoT-based SCADA leveraged on the ThingSpeak IoT platform with built-in MATLAB for advanced analytics. The results show an IoT cloud application, a very user-friendly open source webapp with its built-in intuitive functionalities, for processing, logging and visualising data remotely. It is essentially capable of exploring, visualising: solar PV generation, site-consumption (water and power), water level, meteorological parameters and ON/OFF button to run or stop the pump remotely. The PVWPS dashboard also shows key reports such as the aggregated historic data in daily, weekly, monthly, quarterly and annual totals. This approach of integrating IoT and SCADA technologies to optimize water-energy management in PVWPS offers a reliable and sustainable solution that reduces consumption and enhances productivity.

Keywords: Supervisor Control and Data Acquisition, Photovoltaic water pumping systems, Remote Terminal Unit, Internet of Things, ThingSpeak

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