ABSTRACT

Solar panels are widely used as a source of renewable energy; however, their performance is affected by temperature and light intensity. In tropical regions such as Indonesia, panel temperatures often exceed the optimal limit, resulting in reduced efficiency. Water-based cooling systems have been used to maintain panel temperatures, but most studies only perform temperature or power testing without an integrated monitoring system that compares panels with and without cooling simultaneously.

This study designs a monitoring system that automatically measures panel voltage, current, surface temperature, environmental temperature and humidity, as well as solar radiation intensity. The system is based on an ESP32 microcontroller connected to PZEM-017 and PZEM-016 sensors, a DS18B20 temperature sensor, a DHT22 sensor, and a pyranometer. Data is read on a scheduled basis and sent in real-time to Google Spreadsheet via a Wi-Fi connection, enabling remote monitoring . This approach provides a comprehensive monitoring platform for analyzing the performance of solar panels with and without cooling under the same conditions.

The results of this final project show that the panel with cooling generates an average power of 84.86W, which is higher than the panel without cooling, which only generates 46.06W. Additionally, the panel with cooling exhibits better stability in voltage and current, contributing to the overall efficiency improvement of the system. The use of the cooling system has proven to be effective in enhancing the performance of the photovoltaic panel, and the designed monitoring system facilitates the analysis and maintenance of the off-grid solar power system.

Keywords: Solar Panel, Hydroponics, Energy Efficiency, Real-time Monitoring , Water Cooling System.

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