ABSTRACT

Solar panels as a device for generating renewable energy are often used in remote or hard-to-reach areas. This condition causes problems in monitoring the solar panels performance. Therefore, This necessitates a remote monitoring system solution. The proposed system is developed using an ESP32 microcontroller as the central processing unit, voltage sensors, ACS712 as current sensors, BH1750 as light sensors, and DS18B20 as temperature sensor. The monitoring system records key parameters, including voltage, current, light intensity, and temperature, and transmits real-time data to a web-based platform developed using the Laravel framework. The experimental results indicate that the solar panels generate an average voltage of 27V under optimal sunlight conditions, with current output reaching 2.20A, resulting in a power output of 96.2W. Light intensity levels recorded by the BH1750 sensor range between 0 - 45,000 lux, while temperature fluctuations affect panel efficiency, with an observed efficiency drop of 2.5% per 10°C increase in temperature. The web-based dashboard ensures seamless data visualization, enabling remote monitoring and proactive system maintenance. IoT integration enhances data accuracy, minimizes energy losses, and supports efficient renewable energy management. The findings demonstrate that the proposed system significantly improves solar panel efficiency and reliability by providing real-time insights, allowing users to optimize energy utilization. This study contributes to the advancement of scalable and adaptable renewable energy monitoring solutions, reinforcing the adoption of smart solar energy technologies for sustainable applications.

Keywords: Renewable energy, solar panels, IoT, Monitoring system, remote system.