ABSTRACT

Solar energy is a potential solution to the global energy crisis, particularly in Indonesia, which has high levels of solar irradiance. However, the efficiency of photovoltaic (PV) systems is affected by fluctuations in light intensity and ambient temperature. This study designs and implements a *fuzzy logic*–based *Maximum Power Point Tracking* (MPPT) system to optimize the output power of solar panels. The system is developed using a buck–boost DC–DC *converter* to improve efficiency and supply stability for a 12 V lamp load. The MPPT system design method includes a literature review, the design of a fuzzy-MPPT prototype that regulates the *converter duty cycle*, and implementation in both hardware and software. Experimental testing was carried out on the *converter* and PV systems between 08:00 and 14:00, comparing the performance of non-MPPT and fuzzy-MPPT modes under varying weather conditions. The results show that the *fuzzy logic*–based MPPT on the buck–boost *converter* can track the maximum power point quickly and stably amid irradiance fluctuations. Average efficiency increased from 66.81% (without MPPT) to 73.90% (with fuzzy MPPT), representing an increase of 7.08%. In addition, the output voltage became more stable, resulting in a more consistent power supply to the load. These findings affirm the effectiveness of the *fuzzy logic* approach in optimizing PV system performance.

Keywords: photovoltaic, *maximum power point tracking*, *fuzzy logic*, *buck–boost converter*, renewable energy.